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MINERALS YEARBOOK OF POLAND 2012

To Content

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PREFACE

The ***Minerals Yearbook of Poland 2012*** is a unique publication, which reviews mineral commodities production and utilisation in Poland. It has been compiled annually since 1996. The current 16th edition is for the first time performed as a task of the Polish Geological Survey according to a plan accepted by the Minister of the Environment. The Polish Geological Institute-National Research Institute (PGI-NRI) fulfils the role of the Polish Geological Survey according to art. 163 of the Geological and Mining Law. Therefore, PGI-NRI took supervised preparation of the publication and approved its final version, while calculations and content were prepared by authors from the Department of Mineral Policy of the Mineral and Energy Economy Research Institute at the Polish Academy of Sciences in Cracow. Similarly to its Polish version, the publication is financed by the National Fund for Environmental Protection and Water Management.

The current edition of the ***Minerals Yearbook of Poland***, like previous publications, contains information on more than 100 mineral commodities. There is a systematic review of statistical data presented for 2008-2012. Data are organized according to European standards – the obligatory Polish Classification of Goods and Services (PKWiU) and Combined Nomenclature (CN). Particular chapters contain information on mineral commodities management such as mineral commodities use, the domestic resources base, perspectives for resources development, current domestic demand and its forecast for coming years. Detailed trade statistics are also presented. The ***Minerals Yearbook of Poland 2012*** constitutes supportive material for Polish mineral policy. Therefore, it is intended for use by Ministries, government agencies as well as public and scientific institutions. On an international basis, it is sent to embassies, chambers of commerce and foreign geological surveys.

The ***Yearbook*** has also been issued in electronic form and placed on the PGI-NRI website http://geoportal.pgi.gov.pl/surowce.

Warsaw, December 2013

Prof. Jerzy Nawrocki

Director
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FOREWORD

The 16th edition of the ***Minerals Yearbook of Poland*** presents data on the economy of over 100 major mineral commodities in Poland in the years 2008–2012. The arrangement of the yearbook has remained basically the same as in the previous editions. The book provides a comprehensive review of the domestic supply and demand for mineral commodities, supported by numerous statistics. The important players in the mineral industries are also profiled and listed at the end of each chapter. As far as possible, the balances for the individual commodity and derivative products in Poland for the years 2008–2012 have continued to be provided. Volumes and values of minerals' foreign trade are supplemented by the trade unit values. Where it is possible, unit values of domestic production are also provided. Relevant issues affecting the mineral industry, as well as future investment and production developments have been also discussed. Introductory chapter, reviewing basic aspects of mineral commodities management in Poland in 2012 and previous four years, was supplemented by summary tables and figures.

The authors would like to thank the Department of Information Services at the Central Statistical Office (GUS), as well as the Department of Mineral Resources and Mining Areas Information at the Polish Geological Institute - National Research Institute, for their assistance in collecting statistical information for this issue of the ***Minerals Yearbook of Poland***. We are also grateful to numerous domestic mineral producers and their associations for their cooperation, which enabled us to improve our work on domestic production statistics.

Authors and Editors

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MINERAL COMMODITIES MANAGEMENT IN POLAND IN 2012

Overall Performance

In 2012, growth of Gross National Product amounted to 1.9% (in 2011: +4.5%). GDP amounted to 1,595 billion PLN (ca. 381 billion EUR). Inflation rate was lower than in 2011: 3.7% (Fig. 1). The rate of official unemployment rose to 13.4%. The Polish currency — zloty (PLN), was slightly depreciated to euro to PLN 4.19/EUR 1.00 and visibly depreciated to US dollar to PLN 3.26/USD 1.00 (annual average rate).

Mineral Commodities Balances

The term **mineral commodity** covers all varieties of commodities, obtained from different mineral sources in specific processes, involving all stages of production, from run of the mine to final products. Such a conception has been incorporated in the hereby **Minerals Yearbook of Poland**. This is also utilized as a tool for analysis of the mineral management in Poland, specifying the varieties and assortment of each commodity, the vertical structure governing how they are obtained, and the relationships between the domestic and international markets.

The balances of mineral commodities constitute a basis for management policy, in terms both of the domestic demand and production, and foreign trade exchange. Considering several annual mineral commodity balances, it is possible to establish the tendencies in production, importation, exportation, and consumption, and the most important factors influencing their fluctuations.

Mineral Commodities Production

The production of mineral commodities in Poland in the period 2008–2012 is presented according to the **Polish Classification of Goods and Services** (**PKWiU**), based on the European classification **Nomenclatures des Activités de Communauté Européane** (**NACE**), which was introduced in 1997. In 2009, new PKWiU classification (called **PKWiU 2008**) was introduced. The production statistics were supplied mainly by the **Department of Information Services** of the **Central Statistical Office** (**GUS**), being supplemented by producers.

Poland is a significant producer of hard coal and lignite, copper, silver, zinc and lead, as well as many industrial minerals, such as rock salt, sulfur, limestone, cement, lime,

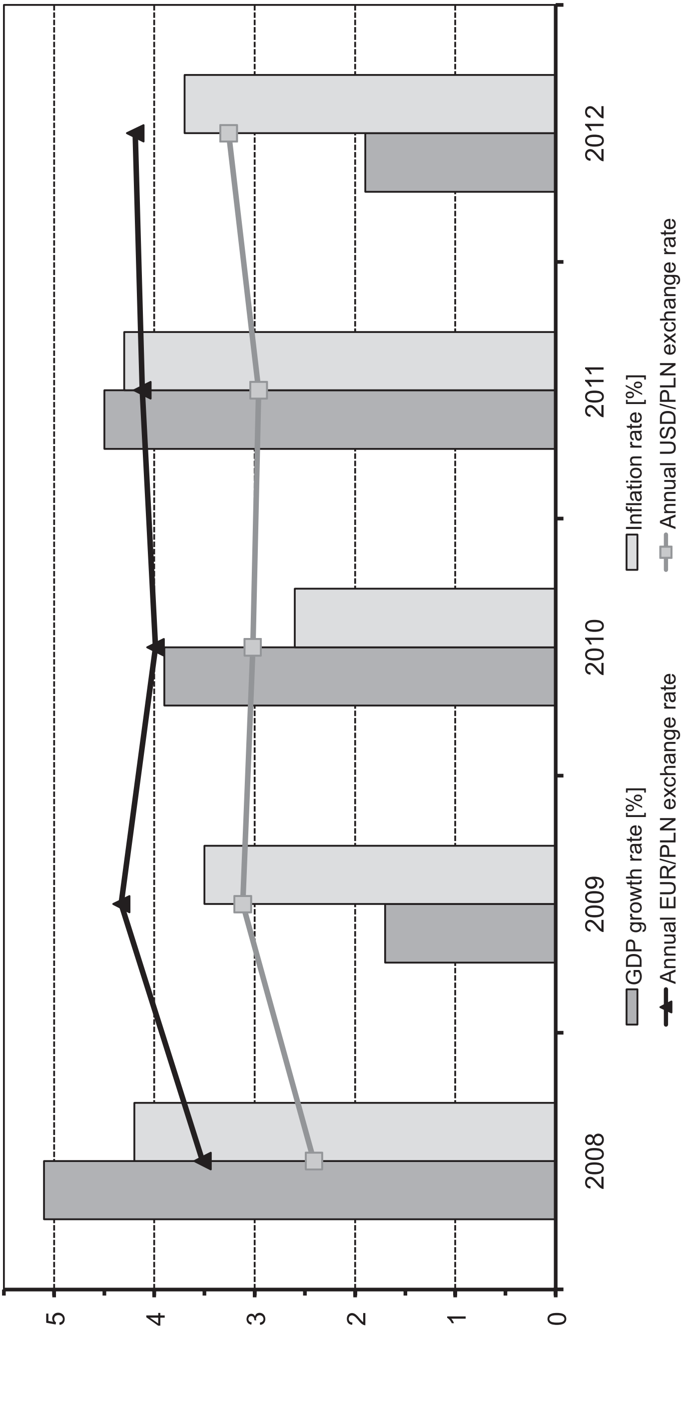

Fig. 1. Evaluation of GDP growth rate and inflation rate in Poland and exchange rates of PLN/EUR and PLN/USD in the years 2008–2012

gypsum, mineral aggregates. In 2012, the total value of domestic mineral production was estimated at 72.3 billion PLN, with 49% share of fuels, 33% share of metallic raw materials, and 18% share of industrial and construction minerals (Fig. 2). Total value of fuels production amounted to ca. 35.8 billion PLN, 75% of which was the value of hard coal production. Total value of metallic raw materials production amounted to ca. 23.8 billion PLN, 59% of which was the value of copper production. Total value of industrial and construction minerals was estimated at ca. 12.7 billion PLN, with 34% share of cement and 29% share of mineral aggregates (Fig. 2). High values were also recorded for lignite, natural gas, crude oil, silver, zinc, lead, limestones and lime (Tab. 1).

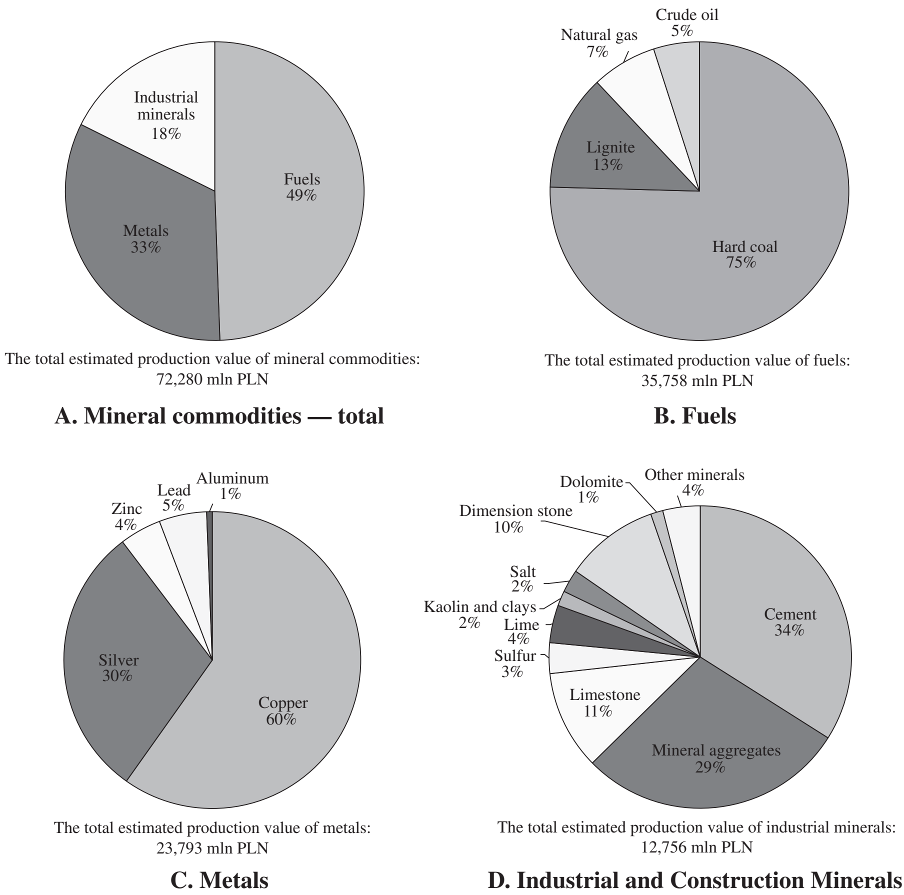

Fig. 2. Estimated production value of mineral commodities in Poland in 2012

Tab. 1. Value of the production of mineral commodities in Poland in 2008-2012

Mineral commodity	2008		2009		2010		2011		2012	
	Value million PLN	Share %	Value million PLN	Share %	Value million PLN	Share %	Value million PLN	Share %	Value million PLN	Share %
Fuels										
Hard coal	21,422	40.8	21,411	40.9	22,336	37.4	25,980	36.3	26,973	37.3
Lignite	3,073	5.9	3,261	6.2	3,476	5.8	4,275	6.0	4,488	6.2
Natural gas	2,061	3.9	2,540	4.8	2,468	4.1	2,542	3.6	2,523	3.5
Crude oil	1,156	2.2	896	1.7	1,162	1.9	1,410	2.0	1,774	2.5
Metals										
Copper	9,443	18.0	8,816	16.8	14,239	23.9	14,080	19.7	14,234	19.7
Silver	1,349	2.6	1,732	3.3	2,447	4.1	6,736	9.4	7,100	9.8
Zinc	909	1.7	811	1.5	943	1.6	1,080	1.5	1,081	1.5
Lead	519	1.0	736	1.4	841	1.4	1,267	1.8	1,233	1.7
Aluminum	248	0.5	107	0.2	149	0.3	125	0.2	145	0.2
Industrial minerals										
Cement	4,918	9.4	4,519	8.6	4,201	7.0	5,148	7.2	4,335	6.0
Mineral aggregates	3,144	6.0	3,488	6.7	2,772	4.6	5,126	7.2	3,565	4.9
Limestone	1,117	2.1	1,073	2.0	1,157	1.9	1,382	1.9	1,352	1.9
Lime	533	1.0	529	1.0	552	0.9	607	0.8	513	0.7
Kaolin and clays	430	0.8	325	0.6	619	1.0	201	0.3	205	0.3
Salt	249	0.5	317	0.6	384	0.6	367	0.5	313	0.4
Stone, dimension	225	0.4	233	0.4	267	0.4	222	0.3	1,288	1.8
Sulfur	577	1.1	746	1.4	155	0.3	258	0.4	418	0.6
Dolomite	154	0.3	150	0.3	142	0.2	152	0.2	167	0.2
Gypsum and anhydrite	67	0.1	58	0.1	58	0.1	62	0.1	64	0.1
Other minerals	897	1.7	660	1.5	1,296	2.2	501	0.9	509	0.7
TOTAL	**52,491**	**100.0**	**52,408**	**100.0**	**59,664**	**100.0**	**71,580**	**100.0**	**72,280**	**100.0**

Tab. 2. Production of selected mineral commodities in Poland

Mineral	Unit	2008	2009	2010	2011	2012	Change 2012/2011 [%]
FUELS							
• Coke	‘000 t	10,075	7,091	9,738	9,377	8,893	-5
• Gas, coke-oven	million m^3	4,207	3,076	4,239	4,055	3,878	-4
• Gas, natural, high-methane	million m^3	2,116	2,047	2,010	2,025	2,016	0
• Gas, natural, nitrified	million m^3	3,335	3,511	3,753	3,896	3,855	-1
• Hard coal	‘000 t	84,345	78,064	76,728	76,448	79,855	+4
• Lignite	‘000 t	59,668	57,108	56,510	62,841	64,280	+2
• Oil, crude	‘000 t	755	687	687	617	680	+10
METALS							
• Aluminum, metal	‘000 t	68	17	16	14	11	-21
• Cadmium, metal	t	603	534	451	526	370	-30
• Copper concentrates	‘000 t Cu	429	439	425	427	427	0
• Copper, metal	‘000 t	527	503	547	571	566	-1
• Ferroalloys	‘000 t	93	16	54	74	81	+9
— ferrochromium and other ferroalloys	‘000 t	3	4	0	-	-	
— ferromanganese	‘000 t	9	2	1	1	1	0
— ferrosilicomanganese	‘000 t	25	0[r]	0	0	0	
— ferrosilicon	‘000 t	56	10	53	73	79	+8
• Gold, metal	kg	902	814	776	704	916	+30
• Lead concentrates	‘000 t Pb	48	37	23	18	17	-6
• Lead, metal	‘000 t	108	100	120[r]	136	141	+4
• Pig iron	‘000 t	4,934	3,095	3,638	3,975	3,944	-1
• Platinum group metals	kg	381	95	156	7,569	265	-65
• Rhenium perrhenate	t	5	4	4	4	4	0

• Selenium	t	82	73	79	85	90	+6
• Silver, content in Cu concentrates	t Ag	1,161	1,207	1,183	1,667	1,149	-31
• Silver, metal	t	1,221	1,221	1,175	1,278	1,292	+1
• Steel, crude	‘000 t	9,727	7,128	7,996	8,777	8,539	-3
• Zinc concentrates	‘000 t Zn	132	116	92	87	77	-11
• Zinc, metal	‘000 t	143	139	135	144	138	-4
INDUSTRIAL MINERALS							
• Aggregates, sand&gravel	‘000 t	143,760	134,515	150,351	236,100	176,600	-25
• Aggregates, crushed	‘000 t	49,442	57,903	62,433	88,697	64,860	-27
• Aggregates, artificial[e]	‘000 t	8,800	7,400	7,100	7,600	5,300	-30
• Aggregates, lightweight[e]	‘000 t	319	210	500	800	300	-62
• Amber	t	NA	NA	NA	NA	NA	X
• Ammonia	‘000 t	2,417	1,958	2,060	2,326	2,526	+9
• Argon	million m^3	20	16	30	187	44	-76
• Asphalts	‘000 t	1,544	1,568	1,567	1,787	1,550	-13
• Barite	‘000 t	0	–	–	–	–	
• Bentonite, raw	‘000 t	3	3	2	1	1	0
• Bentonite, processed	‘000 t	121	81	86	114	102	-11
• Carbon black	‘000 t	36	28	35	45	11	-76
• Cement clinker	‘000 t	12,443	10,659	11,768	13,629	11,807	-13
• Cement	‘000 t	17,207	15,537	15,812	18,993	15,919	-16
• Chalk and related materials	‘000 t	780	677	500	614	742	+21
• Chlorine	‘000 t	354	333	279	283	299	+6
• Clays for building ceramics	‘000 m^3	3,267	2,640	2,157	2,309	1,835	-21
• Clays, refractory (raw)	‘000 t	169	115	82	136	119	-12
• Clays, stoneware	‘000 t	906	646	721	1,291	737	-43
• Clays, white-burning	‘000 t	56	42	70	48	35	-27
• Diatomite and related materials	‘000 t	1	1	1	1	1	0

• Dolomite, raw	‘000 t	2,079	1,750	1,727	1,795	1,763	-2
• Dolomite, dead-burned	‘000 t	127	84	94	85	67	-21
• Feldspar raw materials	‘000 t	644	478	485	539	487	-10
• Gypsum and anhydrite, natural	‘000 t	1,481	1,277	1,179	1,226	1,228	0
• Gypsum, synthetic	‘000 t	1,596	2,076	2,389	2,586	2,790	+8
• Helium	million m^3	2.2	2.6	3.3	3.4	3.3	-3
• Iron oxide pigments	‘000 t	5	4	6	6	6	0
• Kaolin, washed	‘000 t	155	136	125	164	138	-16
• Limestone rock and marl for cement production (mining production)	‘000 t	22,301	20,278	22,431	27,303	24,322	-11
• Limestone rock for lime production (mining production)	‘000 t	16,110	14,881	17,588	21,703	16,728	-23
• Limestone, industrial	‘000 t	32,958	29,821	33,235	40,977	38,211	-7
• Limestone, lake	‘000 t	51	45	17	16	16	0
• Lime	‘000 t	1,952	1,716	1,799	2,036	1,799	-12
• Magnesite, raw	‘000 t	60	47	63	75	84	+12
• Nitric acid	‘000 t	2,267	2,139	2,209	2,168	2,322	+7
• Nitrogen	million m^3	1,256	1,047	985	2,021	1,596	-21
• Nitrogen fertilizers	‘000 t	4,821	4,472	4,709	4,986	5,455	+9
• Oxygen	‘000 t	2,090	1,939	1,979	2,264	2,340	+3
• Peat	‘000 t	632	620	672	746	759	+2
• Phosphoric acid	‘000 t P_2O_5	293	141	293	320	271	-15
• Phosphate fertilizers[1]	‘000 t	120	50	104	115	110	-4
• Potassium salts	‘000 t	6	2	3	0	0	
• Quartz	‘000 t	7	5	5	6	5	-17
• Quartzite, industrial	‘000 t	73	20	34	47	53	+13
• Salt, rock	‘000 t	618	999	1,236	1,254	793	-37
• Salt in brine	‘000 t NaCl	2,783	2,533	2,464	2,633	2,732	+4

• Sand for cellular concrete (mining production)	'000 m^3	340	322	397	414	355	-14
• Sand for lime-sand products (mining production)	'000 m^3	834	560	615	780	731	-6
• Sand, filling	'000 t	6,401	5,928	5,090	4,405	3,762	-15
• Sand, foundry	'000 t	806	720	920	980	950	-3
• Sand, glass	'000 t	2,006	1,800	2,111	2,282	2,212	-3
• Schist, mica	'000 t	19	3	3	5	3	-40
• Schist, phyllite	'000 t	14	24	57	157	190	+21
• Schist, quartz	'000 t	1	1	1	1	1	0
• Soda, calcined	'000 t	1,120	893	1,020	1,071	1,126	+5
• Soda, caustic	'000 t	922	888	610	828	875	+6
• Stone, dimension	'000 t	3,426	3,836	4,598	6,223	4,118	-34
• Sulfur, elemental	'000 t S	985	478	767	916	962	+5
• Sulfuric acid	'000 t	2,102	1,515	1,978	2,184	1,977	-9
• Titanium white	'000 t	40	36	42	39	40	+3

[1] production, sold

Source: ***The Central Statistical Office (GUS), the author's calculation***

In 2012, increasing tendency of production in Poland was observed for only some number of mineral commodities. Notable production growth was recorded especially for the following mineral commodities:

- ***fuels***: crude oil, hard coal, lignite;
- ***metals***: ferroalloys, gold, lead, selenium, silver;
- ***industrial and construction minerals***: ammonia, chalk, synthetic gypsum, magnesite, nitrogen fertilizers, quartzite, salt in brine, caustic soda, casutic soda, sulfur (Tab. 2).

The list of the largest decreases (by over 10%) in the production in 2012 included:

- ***metals***: aluminum, cadmium, platinum group metals;
- ***industrial and construction minerals***: crushed aggregates, sand&gravel aggregates, artificial aggregates, carbon black, cement clinker, cement, ceramic clays, refractory clays, common clays for building ceramics, dead-burned dolomite, kaolin, limestone rock, lime, nitrogen, quartz, rock salt, dimension stone (Tab. 2).

Trade in Mineral Commodities

The trade statistics on mineral commodities in the years 2008–2012 presented in the commodity chapters are listed according to the **Combined Nomenclature** (**CN**), which is based on the European Union's **Combined Nomenclature** (**CN**). The data on trade in mineral commodities given in the **Yearbook** have been provided by the **Department of Information Services** of the **Central Statistical Office** (**GUS**).

There are only ca. 20 mineral commodities exported in larger amounts from Poland (Tab. 3). Poland is traditional exporter of:

- ***fuels***: hard coal, coke;
- ***metals***: refined copper, refined silver, zinc metal, lead concentrates, refined lead, cadmium, selenium, ammonium perrhenate, some ferroalloys;
- ***industrial minerals***: cement, fertilizers (nitrogen, phosphate and multicomponent), refractory clays, glass sand, lime, calcined soda, dimension stone, sulfur, sulfuric acid (Tab. 3).

The highest share of exports in total sales, 30% or more, have been reported for coke, cadmium, refined copper, ferroalloys, lead concentrates, refined lead, ammonium perrhenate, selenium, refined silver, refined zinc, nitrogen fertilizers, phosphate fertilizers, calcined soda, and sulfur (Tab. 3).

The list of mineral commodities, which have to be imported to Poland, is much longer. Around 70 of over 140 mineral commodities consumed in Poland (i.e. almost a half) come exclusively from abroad. In the case of ca. 10 other commodities, imports satisfy minimum 50% of domestic demand (Tab. 4). This indicates how thoroughly the Polish economy is dependent on imported minerals, especially on high-processed ones. The most important of them are as follows:

- ***fuels***: crude oil, high-methane natural gas;
- ***metals***: the majority of metals and/or their concentrates, except for copper, gold, lead, selenium, silver, zinc, pig iron, and raw steel;
- ***industrial*** minerals: the majority or all demand for andalusite and relative minerals, barite, bentonite, borates, bromine, carbon black, white-firing clays, corundum

Tab. 3. Share of exports sales in total sales of selected mineral commodities produced in Poland in 2012

Mineral commodity/ /Derivative product	Exports/ /Domestic production [%]	Mineral commodity/ /Derivative product	Exports/ /Domestic production [%]
FUELS		• Cement clinker	1
• Coke	72	• Cement	2
• Hard coal	9	• Chlorine	4
METALS		• Clays, refractory	8
• Cadmium	99	• Dolomite, raw	2
• Copper, metal	59	• Dimension stone	5
• Ferromanganese	100	• Feldspar	2
• Ferrosilicomanganese	100	• Kaolin, washed	8
• Ferrosilicon	100	• Limestone, industrial	1
• Lead, ores and concentrates	100	• Lime	5
• Lead, metal	34	• Nitrogen fertilizers	34
• Rhenium (ammonium perrhenate)	100	• Peat	5
• Selenium	66	• Phosphate fertilizers	30
• Silver	100	• Phosphoric acid	10
• Zinc, metal	78	• Sand, glass	1
INDUSTRIAL MINERALS		• Soda, calcined	36
• Aggregates, natural crushed	1	• Soda, caustic	7
• Ammonia	6	• Sulfur, elemental	57
• Asphalts, natural and synthetic	32	• Sulfuric acid	14

Source: ***The Central Statistical Office (GUS), the author's calculation***

and emery, diamonds, diatomite, fluorite, graphite, iodine, iron oxide pigments, lithium compounds, magnesite and magnesia, mica, perlite, phosphates, phosphorus, potassium salts, pumice, quartzite, strontium carbonate, talc, vermiculite, wollastonite and zircon.

Consistent with **CN** nomenclature, data on the monetary value of trade in mineral commodities, as well as their balances in the years 2008–2012, were compiled in three groups: ***fuels***, ***metals***, and ***industrial minerals*** (Tab. 5). The ***fuels*** group has been showing deepening trade deficit, down to -56.6 billion PLN in 2008, with improvement to -40.9 billion PLN in 2009 (related to lower crude oil and natural gas prices) and deepening to -82.1 billion PLN in 2012. Permanently positive value of the trade balance in the group of ***metals*** sharply increased to 9.3 billion PLN in 2011, due to growth of international prices of ***refined copper*** (one of the principal Polish export commodities). In 2012 value of the ***metals*** trade balance decreased to ca. 8.3 billion PLN, primarily due to sharp change of ***iron and steel scrap*** trade balance (Tab. 5). The negative financial results of the trade in ***industrial minerals*** (except for ***fertilizers***) approached to almost -2.5 billion PLN in 2011, with some improvement in the last year. The value of usually positive trade balance in ***fertilizers*** varied significantly, being even temporary negative in 2009 (Tab. 5). In 2012, the total revenues from the exportation of ***mineral commodities*** (including ***fertilizers***) were **29,779 million PLN**, i.e. 57% more than in 2008, while the importation value was **105,282 million PLN**, i.e. 41% more than in 2008. That resulted in

Tab. 4. Share of imports to Poland in total domestic consumption of selected mineral commodities in 2012

Mineral commodity/ /Derivative product	Imports/ /Domestic demand [%]
FUELS	
• Coke	5
• Gas, natural, high-methane	74
• Hard coal	12
• Oil, crude	98
METALS	
• Aluminum, ore (bauxites)	100
• Aluminum, oxide (alumina)	100
• Aluminum, metal	92
• Antimony, metal	100
• Antimony, oxide	100
• Arsenic, metal	100
• Arsenic, trioxide	100
• Beryllium, metal	100
• Bismuth, metal	100
• Boron, metal	100
• Calcium, metal	100
• Chromium, ores and concentrates	100
• Chromium, metal	100
• Cobalt, metal	100
• Cobalt, oxide and hydroxide	100
• Copper, ores and concentrates	4
• Copper, refined	8
• Ferrochromium	100
• Ferromanganese	100
• Ferromolybdenum	100
• Ferroniobium	100
• Ferrosilicomanganese	100
• Ferrosilicon	100
• Ferrotitanium	100
• Ferrotungsten	100
• Ferrovanadium	100
• Gallium	100
• Germanium oxide	100
• Indium	100
• Zinc, ores and concentrates	62
• Zinc, metal	62
INDUSTRIAL MINERALS	
• Aggregates, natural crushed	5
• Andalusite, kyanite and sillimanite	100
• Asphalts	27
• Barite	100
• Bentonite, raw	99
• Borates, natural	100
• Bromine	100
• Carbon black	100
• Cement	4
• Chalk and related products	17
• Clays, refractory	22
• Clays, white-burning	91
• Chlorine	5
• Corundum, emery and garnet	100
• Diamonds	100
• Diatomite and related materials	88
• Dolomite, raw	7
• Feldspar	43
• Fluorite	100
• Graphite, natural	100
• Gypsum and anhydrite	3
• Iodine	100
• Kaolin, washed	49
• Lime	3
• Lithium compounds	100
• Magnesite and magnesia, calcined	100
• Magnesite and magnesia, dead-burned and fused	100
• Mica	100
• Mineral wax	100
• Nitric acid	1
• Nitrogen fertilizers	43
• Peat	20

• Iron, ores and concentrates	100	• Perlite	100
• Iron, pig iron	5	• Phosphates	100
• Lead, refined	21	• Phosphorus	100
• Magnesium	100	• Phosphoric acid	12
• Manganese, ores and concentrates	100	• Phosphate fertilizers	4
• Manganese, metal	100	• Potassium salts	100
• Mercury	100	• Pumice	100
• Molybdenum, ores and concentrates	100	• Quartz	39
• Molybdenum, metal	100	• Quartzite, industrial	88
• Nickel	100	• Salt	22
• Niobium	100	• Soda, calcined	2
• Rare earth elements, yttrium and scandium	100	• Stone, dimension	28
• Selenium	29	• Strontium carbonate	100
• Tantalum	100	• Sulfur, elemental	11
• Tellurium	100	• Talc and steatite	100
• Tin	100	• Vermiculite	100
• Titanium, ores and concentrates	100	• Wollastonite	100
• Titanium, metal	100	• Zircon	100
• Tungsten, metal	100		

Source: ***The Central Statistical Office (GUS), the author's calculation***

the trade deficit of **75,503 million PLN**, which was 35% higher than in 2008 (Tab. 5).

Among the ***mineral commodities imported*** to Poland over the last several years, in 2012 the largest influence on the total trade balance had the following: crude oil (trade balance -63,324 million PLN), natural gas (ca. –17,600 million PLN), iron ore and concentrates (–2,030 million PLN), aluminum and aluminum alloys (–1,990 million PLN), potassium fertilizers (-1,132 million PLN), hard coal (-908 million PLN), phosphates (–699 million PLN), anode and blister copper (–608 million PLN), zinc ore and concentrates (–442 million PLN), mineral aggregates (–370 million PLN), copper and copper alloys scrap (-344 million PLN), copper concentrates (–329 million PLN), carbon black (–322 million PLN), silicon (–176 million PLN), alumina (–250 million PLN), iron and steel scrap -217 million PLN), dimension stone (–189 million PLN), pig iron (–199 million PLN), magnesia and magnesite (-178 million PLN), ceramic and refractory clays (–222 million PLN), titanium ore and concentrates (–149 million PLN), nickel (–140 million PLN), phosphorus (–137 million PLN), feldspar (–56 million PLN), kaolin (–56 million PLN), pig iron (-55 million PLN), tin (–54 million PLN), ferroalloys (–50 million PLN), and bauxite (–40 million PLN).

In 2012 the highest positive values of trade balance in ***mineral commodities exported*** from Poland were recorded for the following: refined copper (+8,109 million PLN), silver (+4,234 million PLN), gold (+2,137 million PLN!), nitrogen fertilizers (+1,024

Tab. 5. Value of mineral commodities trade in Poland in 2008–2012

million PLN

Year	2008	2009	2010	2011	2012
Fuels					
Exports	3,500	3,013	3,770	3,940	3,748
Imports	60,132	43,949	63,446	76,888	85,815
Balance	**-56,632**	**-40,936**	**-59,676**	**-72,948**	**-82,067**
Metals					
Exports	11,831	11,486	17,089	21,954	21,152
Imports	9,702	6,947	10,471	12,670	12,898
Balance	**+2,129**	**+4,539**	**+6,618**	**+9,284**	**+8,254**
Industrial minerals[1]					
Exports	1,032	862	1,268	1,668	1,974
Imports	3,006	2,285	2,971	4,172	3,998
Balance	**-1,974**	**-1,423**	**-1,703**	**-2,504**	**-2,024**
Fertilizers					
Exports	2,647	1,207	1,876	2,620	2,905
Imports	1,945	1,578	1,705	2,185	2,571
Balance	**+702**	**-371**	**+171**	**+435**	**+334**
TOTAL					
Exports	19,010	16,568	24,003	30,182	29,779
Imports	74,785	54,759	78,593	95,915	105,282
Balance	**-55,775**	**-38,191**	**-54,590**	**-65,733**	**-75,503**

[1] industrial minerals (without fertilizers)

Source: ***The Central Statistic Office (GUS)***

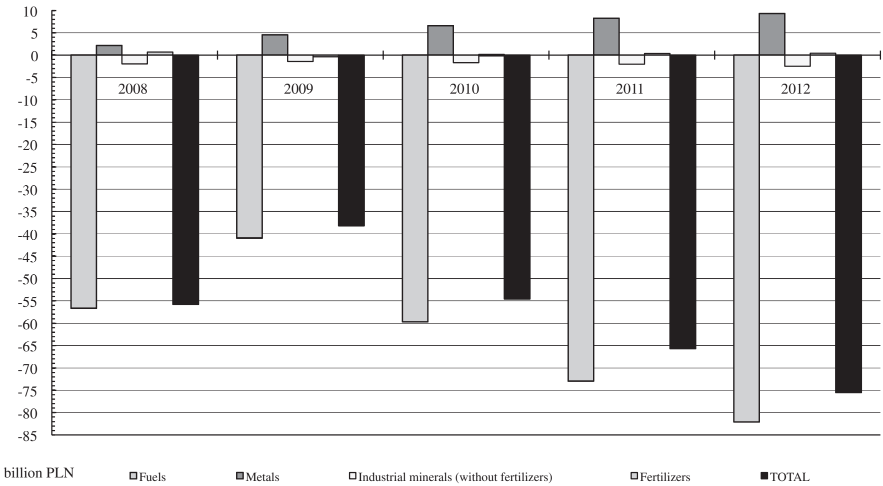

Fig. 3. Trade balance of mineral commodities in Poland in 2008–2012

million PLN), multicomponent fertilizers (+411 million PLN), zinc (+377 million PLN), aluminum and aluminum alloys scrap (+294 million PLN), refined lead (+275 million PLN), sulfur (+239 million PLN), lead concentrates (+109 million PLN), crude steel (+63 million PLN), and salt (+32 million PLN).

Domestic Demand for Mineral Commodities

Determination of quantity and sources of mineral commodities for the domestic economy is one of the most important matters of mineral management analyses. In some cases (e.g. for ***fuels***, but also for ***cement*** and ***elemental sulfur***), it is possible to calculate the level of **real consumption**, according to information from the Central Statistical Office, taking into account also changes of stocks and losses. However, for the majority of mineral commodities, only simplified balances have been drawn up, in which production and imports are listed on the "in" side, and exports on the "out" side. The resulted **'apparent consumption'** indicates the average annual level of demand for these commodities. This is calculated according to the following formula:

Apparent consumption (demand) = Production + Imports – Exports

Actually, for the majority of mineral commodities, the apparent consumption is very close to the real demand. In some cases, however, especially for precious and minor metals, the former value can be underestimated due to possible unofficial smuggling or changes in inventories.

Demand for mineral commodities in Poland in 2012 (real or apparent consumption), is given in Table 6 in comparison to the years 2008-2011. In 2012, the large increases of domestic demand were reported for:

- ***fuels***: crude oil, high-methane gas, lignite;
- ***metals***: alumina, antimony, bauxite, bismuth, cadmium, cobalt, ferroalloys, iron ores and concentrates, manganese ores and concentrates, manganese, molybdenum, zinc ores and concentrates;
- ***industrial minerals***: andalusite and relative minerals, barite, raw bentonite, borates, bromine, chalk, iodine, lithium compounds, raw magnesite, nitrogen ferttilizers, phosphorus, phosphate fertilizers, potassium salts, pumice, industrial quartzite, phyllite schist, calcined soda, caustic soda, talc and steatite, zircon (Tab. 6).

The most significant decreases of domestic demand in 2012, exceeding 20%, were reported for:

- ***metals***: chromium, cobalt oxides, mercury, niobium, rare earth elements compounds, tantalum, tin, titanium, tungsten;
- ***industrial minerals***: carbon black, clays for building ceramics, stoneware clays, diatomite, dead-burned dolomite, graphite, dead-burned magnesite, mica, mica schist, dimension stone, (Tab. 6).

Tab. 6. Demand for selected mineral commodities and their derivative products in Poland in the years 2008–2012

Mineral commodity/ /Derivative product	Unit	Demand					Change 2012/2011 [%]	Notes
		2008	2009	2010	2011	2012		
FUELS								
• Coke	'000 t	3,516	2,693	3,058	2,977	2,783	-7	r
• Gas, coke-oven	million m^3	4,207	3,076	4,239	4,055	3,878	-4	p
• Gas, natural, high-methane	million m^3	13,269	12,770	14,010	13,970	14,819	+6	r
• Gas, natural, nitrified	million m^3	3,408	3,569	3,770	3,852	3,870	0	r
• Hard coal	'000 t	82,667	75,730	84,788	83,527	82,951	-1	r
• Lignite	'000 t	59,631	57,084	56,569	62,633	64,008	+2	r
• Oil, crude	'000 t	21,036	20,425	22,239	24,169	25,151	+4	r
METALS								
• Aluminum, ore (bauxites)	'000 t	69	48	35	36	55	+53	p
• Aluminum, oxide (alumina)	'000 t	152	51	62	61	62	+2	p
• Aluminum, metal	'000 t	138	88	133	135	122	-10	p
• Antimony, metal	t	30	25	20	20	23	+15	p
• Antimony, oxide	t	1,022	948	1,022	968	903	-7	p
• Arsenic, metal	t	38	19	42	39	38	-3	p
• Arsenic, trioxide	t As_2O_3	22	11	0	0	0	X	p
• Bismuth, metal	t	21	17	30	20	22	+10	p
• Boron, metal	t	0	0	0	0	16	X	p
• Cadmium	t	51	38[r]	3	2	4	+100	p
• Calcium	t	0	0	15	58	0	-100	n
• Chromium, ores and concentrates	'000 t	38	11	27	31	27	-13	p
• Chromium, metal	t	108	0	29	68	46	-32	p
• Cobalt	t	34	38	30	30	32	+7	p

•	Cobalt, oxide and hydroxide	t	29	8	10	107	14	-87	p
•	Copper, ores and concentrates	'000 t Cu	448	462	437	441	445	+1	p
•	Copper, refined	'000 t	237	203	261	256	253	-1	p
•	Ferrochromium	'000 t	12	5	7	7	9	+29	p
•	Ferromangananese	'000 t	36	30	30	43	30	-30	p
•	Ferrosilicomanganese	'000 t	47	55[r]	50	64	57	-11	p
•	Ferrosilicon	'000 t	22	9	11	15	22	+47	p
•	Ferromolybdenum	t	1,375	539	0	0	0	X	p
•	Ferroniobium	t	198	196	267	240	368	+53	p
•	Ferrotitanium	t	103	98	174	190	270	+42	p
•	Ferrovanadium	t	349	142	0	79	180	+128	p
•	Ferrotungsten	t	0	9	9	11	7	-36	n
•	Gallium	kg	53	17	31	27	61	+126	p
•	Germanium oxide	kg	28	3	15	77	57	-26	p
•	Gold	kg	1,555	1,063	919	0	0	X	p
•	Indium	kg	77	48	20,031	66	9	-86	p
•	Iron, ores and concentrates	'000 t gross	7,773	3,777	6,473	5,973	6,574	+10	p
•	Iron, pig iron	'000 t	5,165	3,241	3,749	4,202	4,064	-3	p
•	Lead, ores and concentrates	'000 t Pb	0	0	4	3	0	-100	n
•	Lead, refined	'000 t	91	75	109[r]	119	117	-2	p
•	Magnesium	t	4,473	3,323	4,649	5,517	4,985	-10	p
•	Manganese, ores and concentrates	'000 t	54	2	4	3	4	+33	p
•	Manganese, metal	t	638	352	1,483	369	639	+73	p
•	Mercury	t	0	0	0	33	13	-61	n
•	Molybdenum, ores and concentrates	t	38	0	0	34	0	-100	p
•	Molybdenum, metal	t	55	1	3	0	0	0	p

•	Molybdenum, oxides	t	56	81	197	189	241	+28	p
•	Nickel	t	2,863	1,080	1,319	2,343	1,995	-15	p
•	Niobium	kg	12	38	34	5	0	-100	p
•	Platinum group metals	kg	489	128	0	0	187	X	p,e
•	Rare Earth Elements, Ytrium, and Scandium - metals	t	1	2	8	0	2	X	p
•	Rare Earth Elements, Ytrium, and Scandium - compounds	t	205	57	183	107	77	-28	p
•	Selenium	t	49	30	45	44	44	0	p
•	Silicon	t	10,851	10,854	16,290	16,189	16,128	0	p
•	Silver	t	148	97	NA	97	NA	X	p
•	Steel, raw	'000 t	9,743	7,129	7,976	8,752	8,516	-3	p
•	Tantalum	kg	5,437	1,049	2,090	1,646	223	-86	p
•	Tellurium	kg	1,055	907	2,260	1,646	1,514	-8	p
•	Thallium	kg	1	0	1	1	1	0	p
•	Tin	t	1,555	1,340	877	988	717	-27	p
•	Titanium, ores and concentrates	'000 t	91	84	105	99	84	-15	p
•	Titanium, metal	t	41	2	288	1,768	54	-97	p
•	Tungsten	t	15	10	36	28	4	-86	p
•	Zinc, ores and concentrates	'000 t Zn	187	166	157	143	200	+40	p
•	Zinc, metal	'000 t	91	77	96	80	82	+3	p
•	Zircon, metal	t	1	3	2	0	0	X	p
INDUSTRIAL MINERALS									
•	Aggregates, sand and gravel	'000 t	125,035	120,802	137,917	237,703	177,373	-25	p
•	Aggregates, natural crushed	'000 t	52,022	60,184	65,114	93,645	67,694	-28	p
•	Aggregates, artificial[e]	'000 t	8,800	7,400	7,100	7,600	5,300	-30	p
•	Aggregates, lightweight	'000 t	300	210	500	800	300	-62	p
•	Amber	t	NA	NA	NA	NA	NA	NA	n

•	Ammonia	'000 t	2,223	2,003	2,086	2,250	2,382	+6	p
•	Andalusite, kyanite, and sillimanite	'000 t	18	8	18	14	17	+21	p
•	Asphalts	'000 t	1,330	1,620	1,616	1,799	1,448	-20	p
•	Barite	'000 t	14	8	11	14	20	+43	p
•	Bentonite, raw	'000 t	178	126	158	210	230	+10	p
•	Bentonite, processed	'000 t	101	58	65	89	79	-11	p
•	Borates, natural	t	1,348	1,435	1,869	1,535	1,572	+2	p
•	Bromine	t	6	1	7	4	62	+15 times	p
•	Carbon black	'000 t	110	102	173	184	136	-26	p
•	Cement, clinker	'000 t	12,542	10,568	11,785	13,605	11,715	-14	p
•	Cement	'000 t	17,504	15,462	15,918	19,653	16,279	-17	r
•	Chalk and related materials	'000 t	845	720	587	709	892	+26	p
•	Chlorine	'000 t	343	324	297	287	302	+5	p
•	Clays for building ceramics	'000 m^3	3,267	2,640	2,157	2,309	1,835	-21	p
•	Clays, refractory	'000 t	183	133	98	153	139	-9	p
•	Clays, stoneware	'000 t	906	646	721	1,291	737	-43	p
•	Clays, white-burning	'000 t	454	293	363	465	413	-11	p
•	Corundum and emery	t	549	67	293	428	0	-100	p
•	Corundum, synthetic (Electrocorundum)	'000 t	37	17	29	28	31	+11	p
•	Diamonds	kg	1,844	52,594	557	42,533	656	-98	p
•	Diatomite and related materials	'000 t	10	10	7	8	5	-37	p
•	Dolomite, raw	'000 t	2,220	1,858	1,824	1,858	1,862	0	p
•	Dolomite, dead-burned	'000 t	128	85	95	89	68	-24	p
•	Feldspar	'000 t	962	746	801	941	842	-11	p
•	Fluorite	'000 t	9	10	9	11	11	0	p
•	Gypsum and anhydrite	'000 t	3,247	3,511	3,697	3,894	4,096	+5	p

• Graphite, natural	t	4,122	2,809	6,976	9,770	6,706	-31	p
• Iodine	t	14	5	9	8	9	+13	p
• Kaolin, washed	'000 t	272	214	224	270	247	-9	p
• Limestone, commercial product	'000 t	32,612	29,649	33,125	40,667	37,965	-7	p
• Limestone, lake	'000 t	51	45	17	16	16	0	p
• Lime	'000 t	2,046	1,734	1,769	2,039	1,766	-13	p
• Lithium compounds	t	194	208	229	255	265	+4	p
• Magnesite, raw	'000 t	65	51	66	77	85	+10	p
• Magnesite, calcined	'000 t	3	6	10	7	7	0	p
• Magnesite, dead-burned and fused	'000 t	122	75	106	133	106	-20	p
• Mica	t	892	1,177	1,105	1,887	1,443	-24	p
• Mineral wax	t	33	3	3	0	6	X	p
• Nitric acid	'000 t	2,278	2,149	2,210	2,170	2,322	+7	p
• Nitrogen fertilizers	'000 t	3,579	3,970	3,583	4,032	4,414	+9	p
• Oxygen	'000 t	2,140	1,956	1,965	2,219	2,273	+2	p
• Peat	'000 t	759	733	839	916	901	-2	p
• Perlite	t	19,901	21,512	24,464	25,275	24,726	-2	p
• Phosphates	'000 t	1,449	459	1,302	1,438	1,238	-14	p
• Phosphorus	'000 t	9	7	11	14	15	+7	p
• Phosphoric acid	'000 t	295	131	292	308	276	-10	p
• Phosphate fertilizers	'000 t	80	43	71	70	80	+14	p
• Potassium salts	'000 t	841	191	818	790	812	+3	p
• Pumice	t	5,505	4,275	3,749	2,768	3,895	+41	p
• Quartz	'000 t	16	13	14	10	8	-20	p
• Quartzite, industrial	'000 t	163	35	122	150	163	+9	p
• Salt (with brine)	'000 t	3,390	3,505	4,022	4,409	3,584	-19	p
• Sand for cellular concrete	'000 m^3	340	322	397	414	355	-14	p

• Sand for lime-sand products	‘000 m^3	834	560	615	780	731	-6	p
• Sand, filling	‘000 m^3	6,401	5,928	5,090	4,405	3,762	-15	p
• Sand, foundry	‘000 t	806	720	920	980	950	-3	p
• Sand, glass	‘000 t	1,751	1,652	1,912	2,063	2,021	-2	p
• Schist, mica	‘000 t	19	3	3	5	3	-40	p
• Schist, phyllite	‘000 t	14	24	57	157	190	+21	p
• Schist, quartz	‘000 t	7	1	1	1	1	0	p
• Soda, calcined	‘000 t	611	574	677	697	733	+5	p
• Soda, caustic	‘000 t	860	828	575	789	820	+4	p
• Stone, dimension	‘000 t	3,851	3,929	4,926	7,478	5,460	-27	p
• Strontium carbonate	t	486	80	144	196	169	-14	p
• Sulfur, elemental	‘000 t	543	295	483	545	450	-17	r
• Sulfuric acid	‘000 t	1,693	1,208	1,712	1,772	1,591	-10	p
• Talc and steatite	‘000 t	28	18	26	25	27	+8	p
• Titanium white	‘000 t	42	37	43	40	41	+3	p
• Vermiculite	t	205	139	NA	NA	NA	X	p
• Wollastonite[e]	t	5	5	NA	NA	NA	X	p
• Zeolites, synthetic	t	6	6	7	NA	NA	X	p
• Zircon	t	841	363	523	475	653	+37	p

Notes: **e** — estimated, **n** — assumption impossible, **p** — apparent consumption, **r** — real consumption

Source: ***The Central Statistical Office (GUS), the author's calculation***

AGGREGATES

Overview

A few main groups of **mineral aggregates** are different from each other regarding quality and graining. However, in some applications they are used interchangeably in building, road, and railway construction. Mineral aggregates are divided into a few main groups:

- **natural aggregates** obtained from deposits, not being processed besides mechanical processing (crushing, classification, washing); they are divided into two subgroups:
  - — **natural sand** and **gravel aggregates** obtained from loose sedimentary rocks (sand and gravel),
  - — **natural crushed aggregates**, obtained from compact rocks by their extraction and processing;
- **artificial aggregates**, recovered from mining and metallurgical wastes, as well as by thermal processing of various primary and secondary raw materials;
- **recycled aggregates** derived from reprocessing materials previously used in construction.

The definition of natural aggregates does not include: ***sand for the production of cellular concrete and silicate brick*** (see: **SAND FOR CELLULAR CONCRETE AND SAND-LIME PRODUCTS**), ***filling sand*** for stowing in underground mines (see: **SAND, FILLING**), ***industrial sand*** for foundries, construction chemistry, water filtering, construction sandblasting, cement durability testing, hydraulic fracturing in oil and gas industry (see: **SAND, INDUSTRIAL**), as well as the most valuable ***glass sand*** (see: **SAND, GLASS**). Therefore, this chapter refers exclusively to ***construction sand*** and ***gravel***.

Natural sand and **gravel aggregates** are a loose mixture of ***pebbles***, ***gravel***, and ***sand***. Among them, two main groups can be distinguished, depending on the degree of processing and grain size:

- **natural non-crushed sand** and **gravel aggregates**: ***common sand*** 0–2 mm, ***gravel*** (fractions 2–4, 4–8, 8–16, 16–31.5, 31.5–63 mm, and mixed fractions e.g. 2–8, 2–16, 8–16 mm etc.), ***classified*** and ***non-classified sand*** and ***gravel mixes*** (fractions 0–4, 0–8, 0–16, 0–31.5, 0–63 mm), and ***pebbles*** (63–250 mm);
- **natural crushed sand** and **gravel aggregates**: ***crushed sand*** 0–2 mm, ***pebble grits*** (fractions the same as gravel), and ***pebble mixes*** (fractions the same as sand and gravel mixes).

The group of compact rocks, suitable for **natural crushed** aggregates production, consists of magmatic, metamorphic, and sedimentary rocks, characterized by suitable resistance to climatic factors, compression, and wear. In order to determine whether they can be applied in buildings, roads, or railways, the rocks should be thoroughly examined: the mineral composition should be determined, to detect any constituents which may decompose under prevailing climatic conditions, and the physical and mechanical properties: density, water absorption, compression strength, grindability, freeze-resistance, emulgation index. Rocks for the production of **natural crushed aggregates** (**crushed stone**) are extracted from deposits with the use of explosives. The output is crushed and classified as required. The shape of aggregates may be modified by granulation. Thus, natural crushed aggregates are divided into:

- **common natural crushed aggregates**: ***crushed stone*** (63–250 mm), ***breakstone*** (31.5–63 mm), ***key aggregate*** (4–31.5 mm), and ***rock dust*** (0–4 mm);
- **granulated natural crushed aggregates**: ***grits*** in a few grain size classes (between 2 and 63 mm), ***crushed sand*** (0–2 mm), and ***classified mixes of crushed aggregates*** (various fractions between 0–63 mm).

Artificial aggregates are produced from ***clay minerals*** or ***industrial waste materials***. The most important of them are:

- **artificial aggregates manufactured from clays by thermal processing**, such as ***gravelite*** (***haydite***);
- **artificial aggregates obtained through the thermal processing of industrial waste materials**, e.g. ***gralite shale***, ***shale gravelite*** (***"łupkoporyt"***), ***ash gravelite*** (***"popiołoporyt"***), ***pumice-stone slag***, ***granulated slag***, etc.;
- **artificial aggregates made of industrial waste materials without any thermal processing**, e.g. ***"elporyt"*** (comminuted slag from power plants fired with coal dust), ***shale gravelite*** (self-burnt carbonaceous shale obtained by comminution and classification of old coal waste dumps), ***fly ash***, ***blast-furnace slag***, etc.;
- **organic aggregates**, produced from artificial organic materials.

Sources

Natural sand and ***gravel aggregates*** are of common occurrence in Poland, forming large deposits. The most important of these are deposits of glacial natural aggregates, mainly from the **North Polish Glaciation**. Approximately 40% of the resources occur in the river valleys of the **Carpathian** and **Sudetes** mountains (the latter being of the highest quality among domestic aggregates). Underwater deposits of aggregates are also known and exploited in the southern part of the **Baltic Sea** (the **Słupsk Bank**). There are 9,076 deposits of ***natural sand*** and ***gravel aggregates*** in Poland, containing ca. 17,735 Mt (as of 31 December 2012). The largest deposits occur in Lower Silesia and the Carpathians, as well as in NE Poland. In 2012, over 2,600 deposits were exploited, while over 1,900 were abandoned.

Rocks for the production of ***natural crushed aggregates*** (***crushed stone***) — recognized in the group of crushed and dimension stone deposits — occur mainly in Lower Silesia (54% of domestic resources), in the Świętokrzyskie Mountains (22%), in the Carpathian Mountains (12%), and in the Silesia-Cracow region (9%). The remaining 3% occur in other regions of Poland. The total resources of crushed and dimension stone deposits amount to 10,509 Mt, in 742 deposits (as of 31 December 2012). This figure does not include any reserves from deposits of ***limestone for lime*** and ***cement production***,

dolomites for metallurgy and ***ceramics***, ***phyllite-schist***, ***mica-schist***, or ***quartz-schist***. In Lower Silesia there are deposits of high quality ***granite***, ***basalt***, and ***melaphyre***, as well as ***gabbro/diabase***, ***syenite***, ***porphyry***, ***gneiss***, ***amphibolite***, ***serpentinite***, ***migmatite***, ***hornfels***, ***sandstone***, and ***greywacke***. In the Świętokrzyskie Mountains among the recognised deposits are primarily ***limestone***, ***dolomite***, ***sandstone***, and ***chalcedonite***. The Silesia-Cracow region is rich in ***dolomite*** and ***limestone*** deposits and a few extrusive rock deposits (***porphyry***, ***diabase***, ***melaphyre***), whereas the Carpathian Mountains contain almost exclusively ***sandstone*** deposits. The largest reserves of: ***limestone*** (1,716 Mt), ***granite*** (1,722 Mt), ***sandstone*** (1,639 Mt), ***dolomite*** (1,070 Mt), ***porphyry*** (777 Mt), ***basalt*** (574 Mt), ***gabbro-diabase*** (512 Mt), and ***melaphyre*** (487 Mt) are recognised.

The production of ***artificial aggregates*** from natural raw materials in Poland is based mainly on common ***clays*** of suitable expansion properties or bulk density. Their deposits are widespread in Poland, but the largest ones occur in the Pomorskie and Lubelskie voivodeships. The total resources of 41 recognised deposits are 169 Mm^3, i.e. ca. 338 Mt (as of 31 December 2012).

Another important sources for the production of ***artificial aggregates*** include waste materials, such as ***hearth slag*** and ***fly ashes*** from power stations, ***blast furnace slag***, ***converter slag***, ***shaft furnace slag*** from smelters, and ***coal shale***.

Debris materials (consisting mainly of concrete) is also important, but in Poland — up till now — rather still only potential source suitable for production of ***recycling aggregates***.

Production

Mineral aggregates are produced from primary and secondary sources, but primary sources predominate. In recent years, production from secondary sources considerably increased, mainly on the basis of mining, metallurgical and power industry wastes. Increasing use of secondary materials is limited to the main industrial regions of the country. So, mineral aggregates produced on the basis of primary sources (deposits) will remain the main group of aggregates manufactured in Poland.

Natural sand and ***gravel aggregates*** mining output, after 25% reduction in the years 2001–2002, due to rapid recovery of domestic demand, in the years 2003-2008 rose by 120% to 149 Mt in 2008. In 2009, it was temporary reduced by 5% to 141 Mt, but in 2010-2011 it sharply rose again by 76% to record volume of over 248 in 2011 Mt (Tab. 1). In 2012, reduction by 26% to ca. 185 Mt was reported.

Tab. 1. Mining output of natural aggregates in Poland

'000 t

Year	2008	2009	2010	2011	2012
Total output	**149,312**	**141,114**	**157,236**	**248,690**	**184,745**
Dolnośląskie	14,064	14,599	14,062	21,674	13,903
Kujawsko-Pomorskie	4,471	9,362	6,188	14,748	4,837
Lubelskie	3,959	3,439	5,220	8,262	7,208
Lubuskie	4,188	4,094	4,946	9,090	6,305
Łódzkie	8,350	7,994	8,148	21,905	21,764

Małopolskie	11,713	12,025	14,467	20,975	15,234
Mazowieckie	18,153	14,306	20,585	28,756	15,487
Opolskie	6,493	6,848	6,385	8,151	6,593
Podkarpackie	5,907	5,928	9,568	24,192	22,833
Podlaskie	10,972	9,010	13,142	20,485	14,464
Pomorskie	11,072	12,094	11,370	12,403	11,843
Śląskie	7,963	6,679	4,939	8,218	6,204
Świętokrzyskie	2,035	2,276	2,632	3,268	2,643
Warmińsko-Mazurskie	12,487	11,099	13,675	19,690	13,475
Wielkopolskie	9,658	8,754	11,910	14,065	11,834
Zachodniopomorskie	17,734	12,607	9,999	12,240	9,838
Baltic Sea	93	–	–	569	279

Source: ***Mineral Resources Datafile****-verified*

The largest mining output of ***natural sand*** and ***gravel aggregates*** comes currently from voivodeships with large reserve base, but also from voivodeships displaying high demand for such aggregates. The first group consists of such voivodeships as: Dolnośląskie, Małopolskie, Opolskie, Podkarpackie, Podlaskie, Warmińsko-Mazurskie, Zachodniopomorskie; the second group includes such voivodeships as: Mazowieckie, Pomorskie, Kujawsko-Pomorskie (especially in 2009 and 2011), Wielkopolskie (2011), Łódzkie (2011), and Śląskie. Significance of various regions depends also on intensity of construction works in such region. Recently, a good example is the high mining output in Mazowieckie, Łódzkie, Wielkopolskie, Lubuskie and Zachodniopomorskie voivodeships due to construction of A-2 motorway, while in 2007–2011 — in Pomorskie and Kujawsko-Pomorskie voivodeships due to construction of A-1 motorway, in Mazowieckie and Warmińsko-Mazurskie voivodeships as a result of construction (partly reconstruction) of S-7 and S-8 expressways, and since 2010 - in Małopolskie and Podkarpackie voivodeships (construction of A-4 motorway). Commonly, the smallest amounts of natural sand and gravel aggregates (mainly sand) are produced in Świętokrzyskie and Lubelskie voivodeships. Offshore extraction was reopened in 2011 (Tab. 1).

From among the large number of ***natural sand*** and ***gravel aggregate*** mines (over 2,600), only in 36 exceeded the output of 1 Mt in 2012, in 82 the output was between 0.5 and 1 Mtpy, whereas 0.1–0.5 Mtpy have been produced in ca. 380 plants. 3/4 of the total number of aggregates mines produce less than 50,000 tpy, most often only a few thousand tons per year (Tab. 2).

Due to the fact that data on mining sector production are compiled only for companies with a minimum of 10 employees, natural sand and gravel aggregates production from a large number of small manufacturers is not included in official production data published by the **Central Statistical Office** (Tab. 3). This is well visible when we compare the mining output level reported by **Mineral Resources Datafile** (over 184 Mt in 2012) with official production data (76.8 Mt). So, production of each assortment was estimated on the basis of mining output, share of fraction <2 mm and technical equipment in each mine. Such estimated total production of natural sand and gravel aggregates has shown dynamic growth since 2002 and in 2011 it amounted to ca. 236 Mt (Tab. 3). Processing

Tab. 2. Structure of natural sand and gravel aggregates mining output in Poland in 2012

Voivodeship	Mines and mining output level [‘000 tpy]						
	<50	50–100	100–200	200–500	500–1,000	>1,000	Total
Total number of mines	1 968	187	188	193	82	36	2 654
Dolnośląskie	53	15	10	23	9	3	113
Kujawsko-Pomorskie	130	14	19	12	7	-	182
Lubelskie	196	17	9	7	-	1	230
Lubuskie	35	6	11	10	4	1	67
Łódzkie	195	14	16	14	8	4	251
Małopolskie	57	5	14	19	7	5	107
Mazowieckie	331	25	11	25	3	7	402
Opolskie	32	2	4	2	7	1	48
Podkarpackie	192	10	17	22	6	2	249
Podlaskie	151	9	13	8	5	5	191
Pomorskie	93	16	15	7	2	2	135
Śląskie	29	6	11	7	2	1	56
Świętokrzyskie	41	4	5	2	1	-	53
Warmińsko-Mazurskie	133	16	10	12	11	3	185
Wielkopolskie	268	22	19	13	2	-	324
Zachodniopomorskie	32	6	4	10	8	1	61

Source: ***Mineral Resources Datafile****-verified*

wastes make the balance between total mining output and total estimated production. From among eleven in 2011 and nine voivodeships in 2012 with production exceeding 10 Mtpy, production of ***gravel*** and ***other classified products*** dominate in Dolnośląskie, Małopolskie, Podkarpackie, Warmińsko-Mazurskie and Podlaskie voivodeships, while production of ***raw sand*** and ***non-classified mix*** — in Mazowieckie, Łódzkie, Wielkopolskie, Zachodniopomorskie, Pomorskie and Kujawsko-Pomorskie voivodeships.

Classified sand had the largest share in ***natural sand*** and ***gravel aggregates*** production up to 2010, but from 2011 it is replaced by ***raw sand***, ***raw sand with gravel admixture*** (Tab. 3). Low demand for it, especially in N and W Poland, results in discarding of a part of sand back into mine. So, its consumption is much lower than production (Tab. 3). Recently, dynamic growth of ***raw sand***, ***raw sand with gravel admixture*** and ***non-classified mix*** is observed. They are used primarily (over 90%) for the base of new motorways and other roads, especially in Wielkopolskie, Łódzkie and Mazowieckie voivodeships, and recently — in Pomorskie, Kujawsko-Pomorskie and Podkarpackie voivodeships.

Gravel is the second, but at two last years third, most important aggregate of this group. Their production rose sharply to ca. 49 Mt in 2011 (Tab. 3), especially in Dolnośląskie and Małopolskie voivodeships (over 4 Mtpy), as well as Mazowieckie, Podlaskie, Warmińsko-Mazurskie and Opolskie, Podkarpackie voivodeships (over

Tab. 3. Natural sand and gravel aggregates statistics in Poland — CN 2505 90, 2517 10 10

'000 t

Year	2008	2009	2010	2011	2012
Mining output[1]	**149,312**	**141,114**	**157,236**	**248,690**	**184,745**
Production[2]	**77,529**	**78,487**	**85,586**	**109,969**	**76,773**
• Construction sand	41,040[e]	39,590[e]	44,960[e]	56,520[e]	40,280[e]
• Gravel and mixes, aggregates from pebbles	36,489	38,897	40,623	53,449	36,493
Production[3,r]	**141,715**	**134,568**	**150,268**	**239,398**	**177,733**
• Sand, raw	32,230	29,944	34,798	65,158	50,858
• Sand, raw with gravel admixture	14,533	19,143	26,539	52,772	41,028
• Mix, non-classified	4,684	5,360	5,500	10,423	7,852
• Gravel	36,140	31,933	33,739	44,906	31,454
• Mix, classified	6,953	5,702	5,790	7,706	5,524
• Sand, classified	47,175	42,486	43,902	58,433	41,017
— *including: sand, sold*	*30,506*	*28,873*	*30,731*	*48,400*	*30,100*
Imports[2]	**1,424**	**1,188**	**853**	**1,721**	**902**
• Construction sand	204	174	5	143	25
• Gravel and mixes	1,220	1,014	848	1,578	877
Exports[2]	**88**	**128**	**116**	**118**	**129**
• Construction sand	55	101	98	83	44
• Gravel and mixes	33	27	18	35	85
Consumption[2]	**78,865**	**79,547**	**86,323**	**111,572**	**77,546**
Consumption[3,r]	**125,576**	**122,157**	**137,917**	**241,001**	**178,506**

Source: (1) ***Mineral Resources Datafile****-verified, (2)* ***The Central Statistical Office (GUS)****, (3)****authors' estimation***

3 Mtpy each). There is a lack of gravel production in Świętokrzyskie voivodeship, and very small amounts in Lubelskie voivodeship.

Assortment structure of ***natural sand*** and ***gravel aggregates*** production is variable in various regions, depending on local quaternary geology, possibilities of production of gravel and grits of pebbles, as well as on demand for particular assortment. For example, larger share of gravel is reported in western voivodeships (Dolnośląskie, Opolskie, Lubuskie), in SE Poland (Małopolskie, Podkarpackie voivodeships) and in NE Poland (Podlaskie and Warmińsko-Mazurskie voivodeships), which are sold to other regional markets (Warsaw, Łódź, Poznań). Regions around large metropolises (Warsaw, Cracow, Wrocław, Gdańsk) show balanced structure of production, with higher share of mixes and sand.

Ca. 42% of the total supply comes from 17 largest companies or producing groups, extracting 1 Mtpy or more each (Tab. 2, 5). Former state-owned, multi-plant Mineral Mines constitute significant part of them. Currently, almost all of them are privatised. The largest companies producing natural aggregates are: **Górażdże Kruszywa** producing group (consisting of Zielonogórskie Mineral Mines, Opolskie Mineral Mines and

Białostockie Mineral Mines), **Lafarge Kruszywa** producing group, **Olsztyńskie Mineral Mines**, owned by **CRH plc** (Ireland), **Cemex** producing group, **Eurovia Kruszywa** producing group (Wrocławskie Mineral Mines and "Kosmin" Mineral Mines of Łódź), three workers' companies: **Szczecińskie Mineral Mines**, **"Kruszgeo" Rzeszów**, and **"Kruszgeo" Wielkopolskie Mines Poznań**, as well as **Suwalskie Mineral Mines** (sold in 2004 to **"Eko-Invest" Ltd. j.v.** of **Białystok**). The number of large private companies, established in the last decade, is also significant, especially in northern Poland. It is e.g. **ZPK Krupińscy** in NE Poland and informal group of 7 mines in Zachodniopomorskie voivodeship owned by three persons: **Szczepański-Durał-Danilewicz**. Significance of some producers, especially delivering sand and non-classified mix, is temporary, being related to large engineering works in some areas (Tab. 4). There is a lack of larger sand and gravel producers in Lubelskie and Świętokrzyskie voivodeships, due to lack of deposits of good enough quality and quantity.

Tab. 4. The largest domestic producers of natural sand and gravel aggregates in Poland in 2012

Producer	Voivodeship	Market share [%]
• **Górażdże Kruszywa**	Opolskie, Dolnośląskie, Lubuskie, Podlaskie	**4.6**
• **Kruszgeo Rzeszów S.A.**	Małopolskie, Podkarpackie	**4.1**
• **Lafarge Kruszywa i Beton Ltd.**	Zachodniopomorskie, Pomorskie, Mazowieckie, Małopolskie, Lubuskie	**3.6**
• **Olsztyńskie KSM Ltd.**	Warmińsko-Mazurskie, Mazowieckie, Pomorskie, Podlaskie, Zachodniopomorskie	**3.6**
• **Cemex Polska Ltd.**	Opolskie, Mazowieckie, Małopolskie, Warmińsko-Mazurskie, Łódzkie	**3.4**
• **Kruszgeo Wielkopolskie Kopalnie Ltd.**	Wielkopolskie	**3.4**
• **ZPK Rupińscy**	Podlaskie, Warmińsko-Mazurskie, Mazowieckie, Dolnośląskie	**3.0**
• **Eurovia Kruszywa Ltd.**	Łódzkie, Dolnośląskie, Lubuskie	**2.4**
• **Budokrusz Ltd.**	Mazowieckie, Warmińsko-Mazurskie	**2.1**
• **Szczecińskie KSM S.A.**	Zachodniopomorskie, Lubuskie	**1.9**
• **Szczepański-Durał-Danilewicz**	Zachodniopomorskie	**1.6**
• **Suwalskie KSM Ltd.**	Podlaskie, Warmińsko-Mazurskie	**1.3**
• **Krakowskie ZEK S.A.**	Małopolskie, Śląskie	**1.1**
• **PPDM Kruszbet Suwałki S.A.**	Podlaskie, Warminsko-Mazurskie	**1.0**
• **PPKMiL Katowice Ltd.**	Śląskie	**0.8**
• **Lubelskie KSM Ltd.**	Lubelskie	**0.6**
• **JD Trade Ltd.**	Opolskie	**0.6**

Source: ***authors' estimation***

The mining output of ***crushed*** and ***dimension stone*** in Poland, which are used about 90% for ***natural crushed aggregates*** production since 2003 was increasing continuously up to record level of ca. 83.7 Mt in 2011, out of them over 85% have been obtained to crushed aggregates production (Tab. 5). In 2012 output was reduced by 25% due to lower demand for crushed aggregates. Location of deposits results in concentration of mining output in the southern part of Poland. Dolnośląskie voivodeship dominates (47–53% of total output), while Świętokrzyskie voivodeship has 27–31% share, Małopolskie voivodeship 10–13%, Śląskie voivodeship 5–8%, and Opolskie voivodeship 2–4%.

Tab. 5. Mining output of compact rocks in Poland

'000 t

Year	2008	2009	2010	2011	2012
TOTAL MINING OUTPUT	**49,066**	**53,639**	**61,438**	**82,382**	**61,992**
Magmatic Rocks	**24,411**	**23,600**	**25,124**	**33,461**	**25,080**
• Basalt	9,500	8,414	8,556	11,555	8,626
• Melaphyre	3,173	3,255	3,950	4,993	3,774
• Gabbro	1,920	1,646	1,379	1,750	1,254
• Diabase	1,402	1,601	1,654	2,136	1,629
• Porphyry	1,410	1,099	1,237	1,554	1,342
• Granite	6,135	6,737	7,457	10,391	7,857
• Granodiorite	83	65	12	280	281
• Syenite	788	780	879	802	318
Metamorphic Rocks	**2,441**	**5,271**	**6,275**	**6,639**	**3,883**
• Amphibolite	582	790	1,023	1,031	632
• Gneiss	328	1,125	1,205	1,856	923
• Migmatite	989	2,689	2,875	2,693	1,652
• Serpentinite	542	667	1,172	1,059	676
Sedimentary Rocks	**22,214**	**24,768**	**30,039**	**42,282**	**33,029**
• Dolomite	9,710	10,465	10,392	15,278	12,270
• Greywacke	341	542	363	481	461
• Limestone	6,676	7,368	11,514	17,292	13,299
• Quartzitic sandstone	1,553	1,763	2,254	2,749	2,042
• Sandstone	3,777	4,472	5,297	6,339	4,766
• Chalcedonite	157	158	219	143	191

Source: ***Mineral Resources Datafile****-verified,* ***authors' estimation***

The production of crushed aggregates based on output of compact rocks still growing and in 2011 has been reached record level over 70 Mt, mainly due to the apogeum of the road construction works. In the last year annual production of these aggregates has been dropped by 17,4 Mt to a similar level like at 2010 (Tab. 6). The main rocks used for crushed aggregates continue to be ***basalt***, ***granite***, ***melaphyre***, and ***gabbro/diabase*** among magmatic rocks; ***amphibolite*** and ***migmatite*** among metamorphic rocks; and ***dolomite***, ***limestone***, and ***sandstone*** among sedimentary rocks. Magmatic rocks traditionally dominate in the structure of production up to 2010 when are replaced by sedimentary rocks (Tab. 6). Production of crushed aggregates came from magmatic rocks has been reached record level more then 30 Mt in 2011, but in the last year dropped by 7 Mt to a level noted in 2010. Share of magmatic rocks decreased from 50–51% in the years 2006–2008 to 44% in 2012 (Tab. 6). In this group, the most intensively exploited and processed are: ***basalt*** (8-11 Mtpy) in over 25 mines/plant of various size, ***granite*** (5-9 Mtpy) in over 25 quarries, ***melaphyre*** (3-4 Mtpy) in five large mines, ***gabbro/diabase*** (2,5-3,5 Mtpy) in three quarries. Single quarries of ***porphyry***, ***granodiorite*** and ***syenite*** are of minor importance. All quarries and plants of magmatic rocks are located in Lower Silesia, except of 3 mines of ***basalt*** and 2 of ***granite*** at Opole voivodeship and single mines of ***porphyry*** and ***diabase*** in Kraków vicinity. The assortment of production is variable: in some plants ***grits*** production dominate, while in others — ***key aggregate***, ***breakstone***, or even ***crushed stone*** or ***large engineering stone***.

There are only single mines/plants of metamorphic rocks used for crushed aggregates production: ***amphibolite***, ***serpentinite***, ***gneiss***, and — since 2007 — ***migmatite*** (total production rose to 6.2 Mt in 2011). All quarries of metamorphic rocks are located in Lower Silesia, except of 2 mines in Opole region.

Share of sedimentary rocks in crushed aggregates production is significant: 42–47% in recent years, with rise to near 50% in 2012 (Tab. 6). The predominant types of sedimentary rocks in production of crushed aggregates are ***dolomite*** (over 12 Mt in 2011), and ***limestone*** (12 Mt in 2011), with minor — but increasing importance of ***sandstone*** (4-6 Mtpy) and ***quartzitic sandstone*** (ca. 2 Mtpy). ***Limestone*** crushed aggregates production is concentrated in the Świętokrzyskie Mountains region (over 20 mines), while in the Carpathians, Kraków region and a few other regions single limestone mines are active. Moreover, significant quantities of limestone crushed aggregates are produced by lime plants. ***Dolomite*** crushed aggregates production is concentrated in Upper Silesia-Kraków and the Świętokrzyskie Mountains regions (8 mines in each region). Moreover, they are delivered also from waste dolomite rock in zinc-lead ore mines, and dolomite rock from deposits recognised for smelters and refractories (Upper Silesia-Cracow region). The mining output and production of ***sandstone*** aggregates is concentrated in the Carpathian Mountains, where 8 large mines and few smaller quarries/plants are in operation. Another sedimentary rocks used for crushed aggregates production is ***greywacke***, mined in three quarries (two in Opole region, one near Kłodzko).

Tab. 6. Production of crushed aggregate from compact rock deposits in Poland

'000 t

Year	2008	2009	2010	2011	2012
TOTAL PRODUCTION	**42,505**	**46,567**	**52,871**	**70,285**	**52,870**
Magmatic Rocks	**22,453**	**21,740**	**23,146**	**30,717**	**22,989**
• Basalt	8,920	7,858	8,018	10,838	8,132
• Diabase	1,288	1,465	1,514	1,953	1,481
• Gabbro	1,690	1,509	1,262	1,610	1,151
• Melaphyre	3,001	3,086	3,711	4,677	3,523
• Porphyry	1,410	1,099	1,237	1,554	1,342
• Granite	5,360	5,977	6,604	9,122	6,832
• Granodiorite	76	47	10	238	239

• Syenite	708	699	790	725	286
Metamorphic Rocks	**2,310**	**4,959**	**5,863**	**6,199**	**3,618**
• Amphibolite	551	745	964	969	594
• Gneiss	299	1,018	1,089	1,698	833
• Migmatite	940	2,556	2,732	2,558	1,569
• Serpentinite	520	640	1,078	974	622
Sedimentary Rocks	**17,742**	**19,868**	**23,862**	**33,369**	**26,263**
• Chalcedonite	74	74	109	71	95
• Dolomite	7,667	8,285	8,330	12,281	10,023
• Greywacke	320	512	337	449	422
• Limestone	4,744	5,238	8,133	12,217	9,506
• Quartzitic sandstone	1,426	1,621	2,061	2,510	1,864
• Sandstone	3,511	4,138	4,892	5,841	4,353

Source: ***authors' estimation*** and ***producers data***

Production of ***natural crushed aggregates*** in Poland since 2003 — due to intensive development of road construction, rose almost four-fold up to record 88.7 Mt in 2011 (Tab. 7). The most significant growth in recent years was reported on crushed aggregates made of dolomite and limestone, as well as of metamorphic rocks.

Tab. 7. Crushed aggregates statistics in Poland — CN 2517 10 20–80

'000 t

Year	2008	2009	2010	2011	2012
Mining output[1]	50,243	53,064	62,433	83,720	63,188
Production[2]	49,442	57,903	62,809	88,697	64,860
• including production from compact rocks deposits[3,e]	*42,431*	*46,122*	*52,246*	*73,778*	*53,950*
Imports[2]	3,555	3,074	3,217	5,881	3,659
Exports[2]	975	793	912	933	825
Consumption[a]	52,022	60,184	65,114	93,645	67,694

Source: *(1)**Mineral Resources Datafile**, (2)**The Central Statistical Office (GUS)**, (3)**author's estimation***

Rocks from other groups of deposits are also partly used for the production of crushed aggregates, for example: ***limestone rock*** from deposits recognised for the lime and cement industry (5–7 Mtpy), ***waste dolomite rock*** in zinc-lead mines (up to 1 Mtpy), and ***dolomite rock*** from deposits recognised for smelters and refractories (ca. 2 Mtpy).

In the structure of ***natural crushed aggregates*** production in the last year has been recorded increase of share of ***granulated natural crushed aggregates*** (***grits***), up to 60–65%. The rest constitute ***common natural crushed aggregates*** (***breakstone***, ***key aggregate***). The crushed aggregates are manufactured primarily in Dolnośląskie Voivodeship (30–35%), Świętokrzyskie voivodeship (21–23%), and Małopolskie voivodeship (15–17%), with minor importance of Śląskie voivodeship (10–14%) and Opolskie voivodeship (2–4%). Type and quality of natural crushed aggregates is diversified. Natural crushed aggregates of magmatic rocks, manufactured mainly in Dolnośląskie and Opolskie voivodeships, are of the highest quality. In Małopolskie voivodeship, high quality porphyry and diabase aggregates, and lower quality dolomite and sandstone aggregates are produced. In Świętokrzyskie voivodeship, medium quality limestone aggregates, as well as higher quality dolomite aggregates are manufactured. The share of granulated natural crushed aggregates is the largest in Dolnośląskie, Małopolskie and Opolskie voivodeships.

Natural crushed aggregates in Poland are delivered by ca. 110 companies. Over 20 of them are small, with annual production of under 0.1 Mtpy. Currently, ca. 120 mines extracts deposits at the level of over 0.1 Mtpy, using output for crushed aggregates production (Tab. 8). The majority of them occur in Lower Silesia and in SE Poland. In 2012, ca. 65% of the total supply came from the 20 large companies, extracting over 1 Mtpy each (Tab. 9). The majority of these companies possess one or two plants, while multi-plant companies (3–5 mines) are rather rare.

Tab. 8. Structure of mines extracting compact rocks deposits in Poland in 2012[1]

Voivodeship	Mines and mining output level [‘000 tpy]					
	<100	100–200	200–500	500–1,000	>1,000	Total
Total number of mines	137	30	30	34	28	259
Dolnośląskie	50	13	12	18	13	106
Lubelskie	4	-	-	-	-	4
Łódzkie	25	2	1	1	-	29
Małopolskie	19	3	7	4	2	35
Mazowieckie	13	-	-	-	-	13
Opolskie	5	3	2	1	-	11
Podkarpackie	8	1	-	-	1	10
Śląskie	2	2	3	2	1	10
Świętokrzyskie	11	6	5	8	11	41

[1] primarily for natural crushed aggregates production [2] mainly small mines delivering dimension stone

Source: ***Mineral Resources Datafile****-verified*

Artificial aggregates from metallurgical and ***mining wastes*** are produced in the same way like natural aggregates, i.e. by crushing and sieving (sometimes also washing). Their quality is sometimes even better than quality of some crushed aggregates (e.g. some limestone aggregates). They compete with natural crushed aggregates, regarding quality and price. **“Harsco Metals Polska” Ltd.** (previously: **“Alexander Mill Services” Ltd.**) with plants in Warszawa, Ostrowiec, Zawiercie, and Bytom is currently the most important supplier. Its max. production achieved level of ca. 2.5 Mtpy, but currently it amounts to under 1.5 Mtpy. **“Slag Recycling” Ltd.** of **Kraków**, utilising the slag dumps of the **Sendzimir Steelworks**, was another very important producer of this type of aggregates, with production up to 2.5 Mtpy. However, since 2009 this company is not carried on such production any longer. Older dump of the **Sendzimir Steelworks** slag is extracted by **“Madrohut” Ltd.** In the Upper Silesia, ca. 10 smaller producers of such

Tab. 9. The largest domestic producers of natural crushed aggregates in Poland in 2012

Producer	Voivodeship	Estimated market share [%]
I. Production from crushed and dimension stone deposits		
• **Kopalnie Dolomitu S.A.**, Sandomierz	Świętokrzyskie, Podkarpackie	8.0
• **Lafarge Kruszywa i Beton Ltd.**, Warszawa[1]	Świętokrzyskie, Dolnośląskie, Małopolskie, Kujawsko-Pomorskie	7.6
• **Dolnośląskie Surowce Skalne S.A.,** Warszawa	Dolnośląskie	5.9
• **Basalt AG** (Kopalnie Surowców Skalnych w Bartnicy Ltd., Bartnica)	Dolnośląskie	5.2
• **Strabag Ltd.**, Warszawa (Kopalnie Melafiru w Czarnym Borze Ltd., Czarny Bór; Mineral Polska Ltd., Czarny Bór)	Dolnośląskie	4.6
• **Eurovia Kruszywa Ltd.**, Wrocław	Dolnośląskie, Świętokrzyskie	4.5
• **Kieleckie Kopalnie Surowców Mineralnych S.A.**, Kielce	Świętokrzyskie	3.1
• **Colas Kruszywa Ltd.**, Palędzie	Dolnośląskie	3.0
• **Kopalnie Porfiru i Diabazu Ltd.**, Krzeszowice	Małopolskie	2.5
• **PGP "Bazalt" S.A.,** Wilków	Dolnośląskie	2.1
• **Olsztyńskie Kopalnie Surowców Mineralnych Ltd.**, Olsztyn	Dolnośląskie, Małopolskie	2.0
• **Kopalnia Wapienia "Morawica" S.A.**, Morawica	Świętokrzyskie	1.9
• **Kopalnie Odkrywkowe Surowców Drogowych Sp. z o.o.,** Nasławice	Dolnośląskie	1.7
• **Kopalnia Granitu "Kamienna Góra" Sp. z o.o.,** Micigózd	Świętokrzyskie, Opolskie	1.7
• **"Chemia Polska",** Warszawa („PRI-Bazalt" S.A., „Sjenit" S.A.)	Dolnośląskie	1.7
• **"Berger Surowce" Ltd.**, Wrocław	Dolnośląskie	1.6
• **Wojciech Duda,** Toruń	Świętokrzyskie	1.6
II. Production from other deposits		
• **"Nordkalk Miedzianka" S.A.**, Piekoszów	Świętokrzyskie	2.9
• **ZPW "Trzuskawica" S.A.**, Trzuskawica	Świętokrzyskie	2.6
• **Górnicze Zakłady Dolomitowe S.A.**, Siewierz	Śląskie	2.0
• **"Boloil" S.A.**, Bukowno	Małopolskie	1.6

[1] also on the basis of industrial limestone from Barcin-Piechcin-Pakość deposit and granodiorite stone imported from Ukraine

Source: ***authors' estimation***

aggregates operate, with **"HK Eko-Grys" Ltd.** in **Dąbrowa Górnicza**, **"Eko-Bryza" Ltd.** in **Chorzów**, **"Ehazet" Ltd.** in **Katowice**, and **"Ekosar" Ltd.** in **Bytom** as the most important. Outside of Silesia-Cracow region, steelmaking slag is also utilized in Warsaw, Ostrowiec Świętokrzyski and Stalowa Wola. Similar aggregates are also manufactured from ***shaft furnace slag from copper smelters*** in Głogów (new unit of **KGHM Ecoren S.A.**, up to 1.0 Mtpy) and Legnica. ***Aggregates from shaft furnace slag from zinc smelter*** are also delivered by **"Miasteczko Śląskie" Zinc Smelter**. Total production of ***aggregates from metallurgical slag*** is estimated to amount ca. 4.9 Mt in 2011, with drop to only 2.3 Mt in 2012 (Tab. 10). Level of this production decreased distinctly in the last four years due to exhaustion of some old dumps of slag.

Tab. 10. Structure of domestic market of aggregates

Mt

Year	2008	2009	2010	2011	2012
Aggregates, total					
Production[1]	**183.9**	**185.5**	**208.0**	**336.2**	**244.9**
Demand[1]	**187.9**	**186.9**	**211.0**	**343.0**	**242.4**
• **Natural sand and gravel aggregates**					
Production (sold)	125.2	121.1	137.2	239.4	175.1
Consumption	126.6	122.2	137.9	241.0	169.2
• **Natural crushed aggregates**					
Production	49.4	57.9	62.8	88.7	64.9
Consumption	52.0	60.2	65.1	93.6	67.7
• **Artificial aggregates from metallurgical slag**					
Production^e = Consumption^e	6.6	5.0	4.6	4.9	2.3
• **Artificial aggregates from mining wastes[2]**					
Production^e = Consumption^e	2.2	2.4	2.5	2.7	3.0
• **Artificial aggregates from materials thermally processed[3]**					
Production^e = Consumption	0.5	0.5	0.9	0.8	0.3
• **Aggregates from recycling**					
Production = Consumption	NA	NA	NA	NA	NA

[1] without aggregates from recycling
[2] mostly from self-burned coal shale
[3] from clays and industrial wastes thermal processing

Source: ***authors' estimation***

Artificial aggregates from coal processing wastes are of lower quality comparing to ***aggregates from metallurgical slag***. They are currently manufactured on the basis of old dumps of such wastes by several companies in Upper Silesia. Their total estimated production rose to ca. 3.0 Mt in 2012 (Tab. 10), primarily due to development of low quality aggregates production on the basis of sandstone and mudstone-sandstone wastes by **“Haldex” S.A.** Minor producers of aggregates from auto-burnt coal shale are: **“Tercharpol” S.A. Siemianowice Śląskie, “Barosz Gwimet” Ltd. Marklowice,** and **“Haller” S.A. Katowice.**

Artificial aggregates manufactured from clays by thermal processing, i.e. ***gravelite*** from clays, are currently produced by two companies: **“Saint-Gobain Construction Products Polska” Ltd. Weber Leca Unit** in **Gniew** near Gdańsk, and **“Keramzyt” Ltd.** in **Mszczonów** near Warsaw. Their combined production amounted to ca. 0.3 Mt in 2012.

Artificial aggregates obtained through the thermal processing of industrial waste materials are of marginal importance in Poland. Currently, this is entirely ***ash gravelite***, manufactured primarily under the name ***pollytag*** by **“Pollytag” S.A.** of **Gdańsk** at ca. 0.1 Mtpy, and by **PGE Turów** power plant at ca. 0.1 Mtpy.

Recycled aggregates are produced in Poland in very limited amounts yet. There is a lack of exact data on production of such aggregates, because a lot of them are commonly used directly for construction purposes on site by their producers. Their production is not yet reported by the Central Statistical Office. However, this production can be estimated currently at 0.5–1.0 Mtpy.

Trade

A characteristic feature of the ***aggregates*** market is local production and use within a distance convenient for road transportation (seldom railway). However, in case of the particularly favourable location of plants, they can be traded internationally. Recently, exports of gravel from Lower Silesia to Germany and the Czech Republic, were not exceeding 0.2 Mtpy, with visible minor importance in the last years (Tab. 11). On the other hand, imports of ***natural sand*** and ***gravel aggregates*** were commonly 100,000–200,000 tpy, with strong increase to 0.9-1.7 Mtpy since 2008, primarily due to development of imports from Germany, but also from Ukraine (Tab. 12).

Tab. 11. Natural sand and gravel aggregates exports from Poland, by country — CN 2517 10 10, 2505 90

‘000 t

Year	2008	2009	2010	2011	2012
Exports	**88.3**	**127.5**	**115.6**	**118.4**	**128.2**
Czech Republic	46.3	116.3	106.5	96.8	57.9
Germany	26.0	0.2	0.1	0.0	19.7
Lithuania	12.5	8.0	6.0	17.7	46.8
Others	3.5	3.0	3.0	3.9	3.8

Source: ***The Central Statistical Office (GUS)***

The similar trends were observed in ***natural crushed aggregates*** trade. Proximity of market of eastern lands of Germany, resulted in continuous exports of such aggregates at 0.8-1.0 Mtpy (Tab. 13).

Lack of sources for ***natural crushed aggregates*** production in northern and eastern Poland, and high costs of transportation of aggregates from other regions of Poland, resulted in growing imports of crushed aggregates, up to over 5.8 Mt in 2011, with visible

Tab. 12. Natural sand and gravel aggregates imports to Poland, by country — CN 2505 90, 2517 10 10

000' t

Year	2008	2009	2010	2011	2012
Imports	**1,423.8**	**1,187.2**	**853.1**	**1,721.4**	**902.5**
Czech Republic	1.3	14.3	20.6	9.1	12.9
Germany	1,199.5	947.4	481.3	907.6	504.0
Slovakia	138.3	49.8	57.7	155.3	81.4
Sweden	-	-	-	-	85.0
Ukraine	79.4	171.3	289.5	635.4	208.5
Others	5.3	4.4	4.0	14.0	10.7

Source: ***The Central Statistical Office (GUS)***

Tab. 13. Natural crushed aggregates exports from Poland — CN 2517 10 20–80

'000 t

Year	2008	2009	2010	2011	2012
Exports	**975.0**	**793.3**	**911.5**	**932.9**	**825.0**
Czech Republic	24.9	21.9	18.3	7.2	0.7
Germany	936.3	763.7	883.7	902.0	763.9
Lithuania	-	-	-	13.0	52.1
Others	13.8	7.7	9.5	10.7	8.3

Source: ***The Central Statistical Office (GUS)***

reduction in 2012 (Tab. 14). These come from Norway and Sweden (northern Poland market), Ukraine (eastern Poland market), the Czech Republic and Slovakia (southern Poland market), but recently also from Germany.

Tab. 14. Natural crushed aggregates imports to Poland — CN 2517 10 20–80

'000 t

Year	2008	2009	2010	2011	2012
Imports	**3,554.6**	**3,073.7**	**3,217.4**	**5,881.2**	**3,658.9**
Belarus	18.3	–	0.1	–	–
Czech Republic	105.6	34.1	290.9	212.4	48.3
Finland	37.5	38.5	30.6	22.7	–
Germany	1,269.1	1,273.4	867.5	1,825.9	991.7
Norway	862.4	735.2	946.7	2,567.3	2,001.5
Slovakia	517.8	415.9	225.8	101.1	100.4
Sweden	404.0	388.6	353.3	311.2	203.6
Ukraine	333.9	182.7	487.6	826.5	303.1
Others	6.0	5.3	14.9	14.1	10.3

Source: ***The Central Statistical Office (GUS)***

The volume of ***artificial aggregates*** trade is difficult to determine, because they are classified under various items of the official trade nomenclature. Probably producers include it together with ***crushed aggregate***, in the common item **CN 2517 10 80**.

Nevertheless, it is known that **“Saint-Gobain Construction Products Polska” Ltd. Weber Leca Unit** in **Gniew** exports a part of its production of ***gravelite***, while **Pollytag S.A.** of **Gdańsk** exports over 50,000 tpy of ***ash gravelite*** called ***pollytag***.

The trade balance in ***natural sand*** and ***gravel aggregates***, due to the significant decrease of exports, and large increase of imports, since 2007 is highly negative, varying between 33-63 million PLN/y (Tab. 15). The negative trade balance in ***natural crushed aggregates*** due to declining exports and rapidly increasing imports, was continuously going down, to over 257million PLN in 2011, but in 2012 it improved to 168 million PLN due to lower imports in this year (Tab. 15).

Tab. 15. Value of mineral aggregates trade in Poland

‘000 PLN

Year	2008	2009	2010	2011	2012
Natural sand and gravel aggregates					
Exports	2,435	4,498	4,119	4,351	5,443
Imports	52,068	50,665	37,654	67,820	42,781
Balance	**-49,633**	**-46,167**	**-33,535**	**-63,469**	**-37,338**
Natural crushed aggregates					
Exports	20,037	21,281	20,461	23,201	20,787
Imports	162,177	173,036	134,491	280,607	189,462
Balance	**-142,140**	**-151,755**	**-114,030**	**-257,406**	**-168,675**

Source: ***The Central Statistical Office (GUS)***

Consumption

The consumption of ***natural sand*** and ***gravel aggregates*** is closely related to the level of civil engineering work in residential construction, industrial construction, transport infrastructure, etc. Domestic demand for such aggregates in concrete production since 2003 revived. Moreover, quickly increasing use of sand and non-classified mix in engineering works was also reported. This is why total domestic consumption of ***sand and gravel aggregates*** rose to as high as ca. 241 Mt in 2011, with 25% reduction in 2012 (Tab. 3).

The construction industry remains the main consumer of aggregates. Currently over 70 Mtpy, i.e. almost all production of ***classified sand and gravel aggregates*** (gravel, classified sand, classified mix) is consumed by the construction industry for the production of ready-mix concrete, concrete products and dry mixes, or used on site in the construction of individual houses. Ready-mix concrete, produced by concrete-mixing plants, is consumed by the residential construction, industrial construction, and road building industries (see: **CONCRETE AND CONCRETE PRODUCTS**). These sectors traditionally use classified mixes, though gravel and classified sand started to dominate in this sector. Classified sand is also used for the production of building mortar and construction chemistry products. On the other hand, the majority of produced ***non-classified mix*** and ***raw sand*** (70-110 Mtpy, in 2011 even over 128 Mt) is currently used for engineering works (enbankments of roads).

Value of domestic ***natural sand*** and ***gravel aggregates*** market is estimated to be 2,000–2,500 million PLN/y in recent years. It is not precisely illustrated by the data from the Central

Statistical Office, because it collects data on sold production only from large producers, employing over 50 workers. Reported value of natural sand and gravel aggregates sales by large producers rose from 411 million PLN in 2001 to ca. 2,094 million PLN in 2011, with visible reduction to ca. 1,508 million PLN in 2012. Sales of natural sand and gravel aggregates by smaller companies makes probably the next ca. 500–1,000 million PLN/y.

Situation on the domestic natural aggregates market can also be illustrated by the average unit values of main ***natural sand*** and ***gravel aggregates*** assortments. In the years 2004–2008 these prices strongly rose, especially in case of gravel and mixes, but in the next two years they declined by over 20% (Tab. 16). It is worth mentioning, that range of price for the same assortment in different regions is quite wide, depending on local demand for such aggregates, availability of local sources and transportation costs. For example, price of ***building sand*** varies between ca. 3–8 PLN/t in Warmińsko-Mazurskie, Podlaskie and Zachodniopomorskie to 18–20 PLN/t in Małopolskie, Podkarpackie and Świętokrzyskie voivodeships. Average price of ***gravel*** fluctuated from 24–28 PLN/t in Dolnośląskie, Lubelskie, and Wielkopolskie voivodeships to over 35 PLN/t in Warmińsko-Mazurskie and Podlaskie voivodeships.

Tab. 16. Average unit values of sales of the main types of aggregates in Poland

PLN/t

Year	2008	2009	2010	2011	2012
Sand	11.3	10.9	10.0	11.2	11.5
Gravel and mixes	34.4	27.6	26.7	27.3	27.8
Natural crushed aggregates	29.5	27.9	27.3	28.3	26.2

Source: ***The Central Statistical Office (GUS)***

The main areas of ***classified sand*** and ***gravel aggregates*** consumption in Poland are connected with a few large cities. On the basis of the value of construction production and level of ready-mix concrete production, the most important markets for ***classified sand*** and ***gravel aggregates*** in Poland are assumed to be the following voivodeships: Mazowieckie — 16-18% of the domestic market, Śląskie and Wielkopolskie — 9–10% each, Dolnośląskie, Małopolskie, and Pomorskie — 7–8% each, Łódzkie — 6-7%. These markets comprise 65-70% of domestic ***classified sand*** and ***gravel aggregates*** consumption. Some of these markets are self-sufficient, but not Warsaw, Poznań, and Łódź market, where a large part of aggregates comes from SW, SE, and NE Poland. ***Non-classified mix*** and ***raw sand*** are used in the largest amounts in areas of intensified road engineering works. In 2010, they were located especially in Łódzkie, Mazowieckie, Podkarpackie, Pomorskie and Wielkopolskie voivodeships. Share of foreign suppliers of natural sand and gravel aggregates is still marginal (up to 1%).

Natural crushed aggregates find use mainly in the road and railway construction. The most important rock materials for these purposes are ***crushed aggregates*** (crushed stone, breakstone, key aggregate, grits) made of ***basalt***, ***melaphyre***, ***diabase***, ***porphyry***, ***granite***, ***gabbro***, ***amphibolite***, ***gneiss***, ***migmatite***, ***serpentinite***, ***dolomite***, ***limestone***, ***sandstone***, and ***greywacke***. ***Basalt*** and ***melaphyre*** aggregates are also used for road pavements. In the civil construction, most of the aggregates made of magmatic rocks are used for high grade and special concrete. Sedimentary rock aggregates are used for lower grade concrete. A special application of crushed stone aggregates is the production of ***terrazzo***, which is manufactured using primarily ***grits*** from ***marble***, ***dolomitic marble***, and ***decorative limestone***. It is estimated, that currently ca. 70% on natural crushed aggregates id used in road construction, 10-15% in railway construction, 15-20% in industrial and housing construction (for production of high-class concrete).

Some of these stones have specific applications, e.g. ***basalt*** for the production of ***rock wool*** and ***basalt casting products*** (see: **ROCK SMELTING COMMODITIES**), ***diabase*** also for ***rock wool***, ***melaphyre*** for ***asphalt pavements***, ***granite*** for ***feldspar*** and ***feldspar-quartz flours*** (see: **FELDSPAR**), ***limestone*** and ***dolomite*** for ***fertilisers***, ***pure limestone*** and ***dolomitic marble*** for ***flour for the glass-making*** and ***ceramics industries*** (see: **LIMESTONE AND LIME**; **DOLOMITE**), etc.

The consumption of ***natural crushed aggregates*** is closely related to the level of civil engineering work in transport infrastructure (roads, railways) and to the demand for high-class concrete. Domestic demand for such aggregates since 2003 reported spectacular growth in Poland, due to intensification of construction works, especially road construction, being a result of high level of EU funds for infrastructure development in Poland. This is why total domestic consumption of ***natural crushed aggregates*** rose to ca. 93.6 Mt in 2011, i.e. by ca. 220% comparing to 2002 (Tab. 6).

Value of domestic ***natural crushed aggregates*** market was strongly increasing up to almost 2,300 million PLN in 2011, with redcution to under 1,600 million PLN in 2012. It is not precisely illustrated by the data from the Central Statistical Office, because it collects data on sold production only from large producers, employing over 50 workers, where value of crushed natural aggregates was increasing continuously in the years 2002–2011, up to 2,321 million PLN in 2011. The next 50–70 million PLN of natural crushed aggregates sales falls probably to smaller companies. The average unit values of natural crushed aggregates show increasing tendency since 2002, with rapid growth reported in the years 2007-2008, and some fluctuations in the following years (Tab. 16).

Crushed aggregates regional markets have different sources of supply, as a result of crushed aggregates producers' location almost entirely in the southern Poland. Regional markets in southern Poland are dominated by local producers. Warsaw and Łódź markets are supplied by both Lower Silesian producers of highest quality crushed aggregates from magmatic rocks, as well as by closer located limestone and dolomite crushed aggregates suppliers from Kielce region. Some imported crushed aggregates also entered recently this market (e.g. from Ukraine). In the northern and eastern Poland, market shares of imported crushed aggregates rose even to over 40%. The average share of imported crushed aggregates in Poland recently amounted to 5-6%.

Artificial aggregates from metallurgical and ***mining wastes*** find use as cheaper substitute of ***crushed aggregates*** in the road, railway and civil construction. Their market was developed since mid-1990s, up to ca. 11 Mtpy in 2006–2007, with distinct reduction to only ca. 5 Mt in 2012 (Tab. 10). They are very competitive to natural crushed aggregates, but their market is limited primarily to Upper Silesia-Cracow region. ***Recycled aggregates*** are also raw materials competitive to natural aggregates, but mainly in large cities.

Ca. 75% of domestic ***gravelite*** is consumed by the construction and road building industries for insulation, drainage, and structural purposes. Much smaller quantities are utilised by horticulture (as a subsoil in new cultivable areas and for potted plants) and geotechnics (as a filling material for the construction of light embankments). The principal recipients of ***gravelite*** are ***lightweight concrete*** manufacturers. Uses of ***ash gravelite*** are similar to those of ***gravelite***.

Major companies involved in mineral aggregates production in Poland as of December 2012

- Lafarge Kruszywa i Beton Sp. z o.o. (Lafarge Kruszywa i Beton Ltd.), ul. Iłżecka 24, 02–135 Warszawa, tel. +48 22 3246000, fax +48 22 3246005, www.lafarge.pl — *natural sand and gravel aggregates, basalt, melaphyre, granite, limestone, dolomite and sandstone crushed aggregates.*
- Górażdże Kruszywa Sp. z o.o. (Górażdże Kruszywa Ltd.), ul. Cementowa 1, Chorula, 47–316 Górażdże, tel. +48 77 4468600, fax +48 77 4468602, www.heidelbergcement.com/pl — *natural sand and gravel aggregates.*
- Cemex Polska Sp. z o.o. (Cemex Polska Ltd.), Al. Jerozolimskie 212A, 02-486 Warszawa, te. +48 22 5714100, fax +48 22 5714101, www.cemex.pl — *natural sand and gravel aggregates, granite and dolomite crushed aggregates.*
- Olsztyńskie Kopalnie Surowców Mineralnych Sp. z o.o. w Olsztynie (Olsztyńskie Mineral Mines Ltd.), ul. Budowlana 3, 10–424 Olsztyn, tel. +48 89 5211000, fax +48 89 5122637, www.oksm.pl — *natural sand and gravel aggregates, basalt, granite and sandstone crushed aggregates.*
- Eurovia Kruszywa Sp. z o.o. we Wrocławiu (Eurovia Kruszywa Ltd. of Wrocław), ul. Szwedzka 5, 55–040 Kobierzyce, tel. +48 71 3800300, fax +48 71 3800330, www.eurovia-kruszywa.pl — *natural sand and gravel aggregates, basalt, granite and quartzite crushed aggregates.*
- “Kruszgeo” S.A. Przedsiębiorstwo Produkcji Kruszywa i Usług Geologicznych w Rzeszowie (“Kruszgeo” Aggregates Production and Geological Services Enterprise Joint Stock Co. — Rzeszów), ul. Reja 16, 35–959 Rzeszów, tel. +48 17 8536051, fax +48 17 8636278, www.kruszgeo.com.pl — *natural sand and gravel aggregates.*
- Zakłady Produkcji Kruszyw “Rupińscy” Sp. j. w Szumowie (“Rupińscy” Aggregates Production Plants Co. of Szumowo), ul. Przemysłowa 28, 18-305 Szumowo, tel. +48 86 4768122, fax +48 86 4768131, www.zpkszumowo.pl — *natural sand and gravel aggregates.*
- Szczecińskie Kopalnie Surowców Mineralnych S.A. w Szczecinie (Szczecin Mineral Mines Joint Stock Co.), ul. Tartaczna 9, 70–893 Szczecin, tel. +48 91 4621242, fax +48 91 4621096, www.sksm.com.pl — *natural sand and gravel aggregates.*
- “Kruszgeo” Wielkopolskie Kopalnie Sp. z o.o. w Poznaniu (“Kruszgeo” Wielkopolskie Mines — Poznań Ltd.), ul. Grunwaldzka 21, 60–783 Poznań, tel. +48 61 8662249, fax +48 61 8659811, www.kruszgeo.poznan.pl — *natural sand and gravel aggregates.*
- Kopalnie Surowców Skalnych w Bartnicy Sp. z o.o. (Rock Mineral Quarries Ltd. of Bartnica), Bartnica 70, 57–451 Świerki, tel. +48 74 8720070, fax +48 74 8720078, www.bartnica.com.pl — *melaphyre, gabbro and diabase crushed aggregates.*
- “Dolnośląskie Surowce Skalne” S.A. w Warszawie “Dolnośląskie Surowce Skalne” Joint Stock Co. of Warsaw), Rondo ONZ 1, 00–124 Warszawa, tel. +48 22 3549320,

fax +48 22 3549330, www.dss.pl — *amphibolite and migmatite crushed aggregates.*

- Kopalnie Melafiru w Czarnym Borze Sp. z o.o. (Melaphyre Mines Ltd. of Czarny Bór), ul. Wesoła 12, 58–379 Czarny Bór, tel. +48 74 8866830, fax +48 74 8866833, www.mineral-polska.com — *melaphyre crushed aggregates.*
- “Colas Kruszywa” Sp. z o.o. w Palędziu (“Colas Kruszywa” Ltd. of Palędzie), ul. Nowa 49, 62–070 Palędzie, tel. +48 61 8945460, fax +48 61 8945465, www.colas.pl — *basalt and granite crushed aggregates.*
- Przedsiębiorstwo Górniczo-Produkcyjne “Bazalt” S.A. w Wilkowie (“Bazalt” Mining and Producing Plant Joint Stock Co. of Wilków), 59–500 Złotoryja, P.O. Box 34, tel. +48 76 8783872, fax +48 76 8783421, www.pgpbazalt.pl — *basalt crushed aggregates.*
- Kopalnie Porfiru i Diabazu Sp. z o.o. w Krzeszowicach (Porphyry and Diabase Quarries Ltd. of Krzeszowice), ul. Kościuszki 10, 32–065 Krzeszowice, tel. +48 12 2820619, fax +48 12 2822600, www.kruszywa.com — *porphyry and diabase crushed aggregates.*

For producers of limestone and dolomite crushed aggregates, see: **LIMESTONE AND LIME**; **DOLOMITE**.

- Harsco Metals Polska Sp. z o.o. (Harsco Metals Polska Ltd.), al. Komisji Edukacji Narodowej 36, 02–722 Warszawa, tel. +48 22 5461050 fax +48 22 5461060, www.harscometals.com — *aggregate from metallurgical slag*.
- “KGHM Ecoren” S.A. w Lubinie (“KGHM Ecoren” Joint Stock Co. of Lubin), ul. Marii Skłodowskiej-Curie 45A, 59–301 Lubin, tel. +48 76 7468970, fax +48 76 7468971, www.ecoren.pl — *aggregate from metallurgical slag*.
- “HK Eko-Grys” Sp. z o.o. w Dąbrowie Górniczej (“HK Eko-Grys” Ltd. of Dąbrowa Górnicza), ul. Koksownicza 8, 42–523 Dąbrowa Górnicza, tel./fax +48 32 7955218, www.ekogrys. pl — *aggregate from metallurgical slag*.
- “Haldex” S.A. w Katowicach (“Haldex” Joint Stock Co. of Katowice), Pl. Grunwaldzki 8/10, 40–127 Katowice, tel. +48 32 7869552, fax +48 32 7869559, www.haldex.com.pl — *shale gravelite from dumps*.
- “Saint-Gobain Construction Products Polska” Sp. z o.o. Oddział Weber Leca w Gniewie (“Saint-Gobain Construction Products Polska” Ltd. Weber Leca Unit of Gniew), ul. Krasickiego 9, 83–140 Gniew, tel. +48 58 5352595, fax +48 58 5352596, www.netweber.pl — *gravelite*.
- Przedsiębiorstwo Kruszyw Lekkich “Keramzyt” Sp. z o.o. w Mszczonowie (“Keramzyt” Lightweight Aggregate Enterprise Ltd. of Mszczonów), ul. Warszawska 43, 96–320 Mszczonów, tel./fax +48 46 8571710, www.keramzyt.pl — *gravelite*.
- Pollytag S.A. (Pollytag Joint Stock Co.), ul. Wielopole 6, 80–556 Gdańsk, tel./fax +48 58 3431129, www.pollytag.com.pl — *ash gravelite*.

ALUMINUM

Overview

Aluminum (**Al**) ranks after iron as the second most commonly used metal in the world. It has maintained its standing in the world economy, despite the fact that in practice it is of importance only in the form of drawn, rolled, or extruded products, or as a component of alloys. The main areas of application are the manufacture of transportation means (automobiles, aircraft, railway cars), the building, engineering, and electrical industries, the production of packing materials, and others. Approximately 80% of world aluminum production is obtained from ***alumina*** processing, as so-called **primary aluminum**, whereas the rest is recovered from ***scrap***, as **secondary aluminum**.

Sources

There is no domestic production of ***alumina***, which was imported for ***primary aluminum*** production (see: **BAUXITE AND ALUMINA**). The secondary sources of aluminum consist of ***Al scraps*** and ***wastes***.

Production

The only Polish producer of ***primary aluminum*** - the **"Konin" Aluminum Smelter** of Konin (owned by **Impexmetal S.A.** belonging to **GK Boryszew S.A.**), in 2009 terminated this production, carried on since 1966. Smelter had capacity of electrolysis unit ca. 55,000 tpy (Tab. 1). The smelter produced three grades of ***primary aluminum*** — 99.8%, 99.7% and 99.5% Al — on the basis of imported ***alumina***. This plant remains the largest producer of ***rolled products*** in Poland. Since 2009 plant consumed majority of imported aluminum, as well as aluminum and aluminum alloys scraps. Now, smelter can produce max. 80,000 tpy of rolled products.

Tab. 1. Aluminum statistics in Poland — CN 7601 10

'000 t

Year	2008	2009	2010	2011	2012
Production[e]	68.0	16.9	16.0	13.9	11.1
— *primary*	*50.0[e]*	–	–	–	–
— *secondary*	*18.0*	*16.9*	*16.0*	*13.9*	*11.1*
Imports	71.4	72.4	126.0	125.9	112.5
Exports	1.4	1.4	8.8	5.3	1.9
Consumption[a]	138.0	87.9	133.2	134.5	121.7

Source: ***The Central Statistical Office (GUS), Huta Aluminium "Konin" S.A.***

The recovery of ***non-alloyed aluminum*** from ***scrap*** and ***wastes*** is not well developed in Poland (Tab. 1). In 2006, reliable data on production of ***alloyed primary and secondary aluminum*** were reported for the first time (Tab. 2). Primary alloys are produced from non-alloyed aluminum, while secondary alloys from ***aluminum scrap*** and ***wastes***. Total production of secondary aluminum can be estimated at ca. 205,000 t Al in 2011, and 214,000 t Al in 2012.

Tab. 2. Aluminum alloys statistics in Poland — CN 7601 20

'000 t

Year	2008	2009	2010	2011	2012
Production	342.1	236.3	265.7	302.6	312.0
— *primary*	*109.3*	*91.6*	*92.6*	*111.9*	*109.0*
— *secondary*	*232.8*	*144.7*	*173.1*	*190.6*	*203.0*
Imports	192.5	151.1	199.5	249.0	252.8
— *primary*	*131.4*	*104.9*	*135.2*	*164.3*	*176.5*
— *secondary*	*61.1*	*46.2*	*64.3*	*84.7*	*76.3*
Exports	79.6	63.9	98.4	110.4	115.5
— *primary*	*7.0*	*6.1*	*11.0*	*11.7*	*9.7*
— *secondary*	*72.6*	*57.8*	*87.4*	*98.7*	*105.8*
Consumption[a]	455.0	329.6	366.8	441.2	449.3
— *primary*	*233.7*	*196.5*	*216.8*	*264.5*	*275.8*
— *secondary*	*221.3*	*133.1*	*150.0*	*176.6*	*173.5*

Source: ***The Central Statistical Office (GUS)***

Trade

In the years 2006–2007 increased imports of ***aluminum*** were observed, up to 105,900 t in 2007. In period 2008–2009, purchases were reduced to ca. 72,400 tpy, in 2010–2011 they rose again up to 126,000 tpy, while in 2012 they decreased by 11% to ca. 112,500 t (Tab. 3). Majority of imports originated from European countries, mostly from Russia — ca. 58%, Iceland — ca. 12%, Germany — ca. 5%, and Belgium — ca. 4%, while ca. 12% of imports from non-European countries, e.g. USA, South Africa, Mozambique, Brazil, Canada, and others (Tab. 3). Exports (re-exports) of ***aluminum*** were recently negligible, though in 2008–2012 ca. 1,400–1,800 tpy were sold to Germany, while in 2010–2011 7,400 t and 3,600 t (respectively) were sold to the Czech Republic (Tab. 1). Growth of ***aluminium*** imports volume and unit price in 2010–2011 (Tab. 6) resulted in strong increase of negative trade balance by over 140% to 947 million PLN, but in 2012 due to lower purchases and lower unit values decrease of negative trade balance by over 14% to 813 million PLN was reported (Tab. 5).

With exception of 2009, increasing tendency of ***aluminum scrap*** and ***waste materials*** trade was reported. Their exports volume was higher than imports volume (Tab. 4), but due to difference in unit values of imports and exports (Tab. 6), positive trade balance decreased to 149 million PLN. In 2012 situation reversed and positive balance rose to 244 million PLN (Tab. 5). In the years 2010–2012 net imports of ***aluminum alloys*** rose by 57% (Tab. 2), and imports unit values wer higher than exports ones (Tab. 6), so trade deficit deepened to ca. 1200 million PLN (Tab. 5).

Tab. 3. Polish imports of aluminum, by country — CN 7601 10 00

'000 t

Year	2008	2009	2010	2011	2012
Imports	**71.4**	**72.4**	**126.0**	**125.9**	**112.5**
Belgium	11.2	11.4	16.8	14.8	4.8
Brazil	2.2	–	4.3	1.3	0.7
Canada	3.5	0.2	3.7	0.1	0.9
Czech Republic	0.1	0.0	2.0	1.2	0.1
France	0.8	0.0	0.1	1.2	–
Germany	0.8	16.3	10.1	5.3	5.7
Ghana	–	–	–	0.7	0.7
Iceland	10.9	2.9	9.7	10.7	13.5
Ireland	–	0.3	–	–	–
Italy	–	1.6	3.6	3.5	2.1
Japan	–	–	–	1.6	0.8
Netherlands	2.6	0.6	3.3	1.0	3.8
Norway	2.3	4.1	0.0	0.1	0.0
Mozambique	3.9	3.9	4.4	1.7	2.1
Romania	–	0.7	–	–	–
Russia	31.8	15.1	65.5	80.0	65.4
Slovakia	0.0	14.6	1.2	–	–
Slovenia	–	0.1	–	–	0.7
South Africa, Republic of	–	–	0.2	0.2	2.5
Sweden	–	–	0.5	0.9	0.1
Tajikistan	0.6	0.1	–	–	–
Ukraine	0.4	–	0.4	–	–
United Kingdom	–	0.3	0.1	1.0	2.5
USA	–	0.0	0.0	–	5.8
Others	0.3[r]	0.2	0.1	0.6	0.3

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Aluminum scrap and waste materials trade in Poland — CN 7602

'000 t

Year	2008	2009	2010	2011	2012
Imports	67.0	66.8	84.9	106.4	111.8
Exports	122.7	99.5	124.0	150.6	156.1

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Value of aluminum commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Aluminum CN 7601 10					
Exports	11,447	11,710	63,287	43,511	17,204
Imports	481,224	405,957	895,167	990,205	830,360
Balance	**-469,777**	**-394,247**	**-831,880**	**-946,694**	**-813,156**
Aluminum alloys CN 7601 20					
Exports	520,581	349,834	733,876	925,261	889,982
Imports	1,402,796	1,022,458	1,533,432	2,127,547	2,066,332
Balance	**-882,215**	**-672,624**	**-799,556**	**-1,202,286**	**-1,176,350**
Aluminum scrap and waste materials CN 7602					
Exports	604,352	394,838	600,692	746,604	822,505
Imports	280,490	225,931	422,795	597,609	578,801
Balance	**+323,862**	**+168,907**	**+177,897**	**+148,995**	**+243,704**

Source: ***The Central Statistical Office (GUS)***

Tab. 6. Average unit values of aluminum commodities trade in Poland

Year	2008	2009	2010	2011	2012
Aluminum CN 7601 10					
Exports unit values					
— PLN/t	8,026.3	8,224.8	7,166.0	8,140.9	8,829.4
— USD/t	3,356.1	2,638.0	2,351.9	2,832.2	2,699,3
Imports unit values					
— PLN/t	6,740.0	5,603.6	7,103.5	7,866.3	7,382.9
— USD/t	2,917.7	1,834.6	2,347.2	2,694.8	2,263.9
Aluminum alloys CN 7601 20					
Exports unit values					
— PLN/t	6,537.9	5,478.6	7,461.1	8,380.7	7,705,2
— USD/t	2,823.4	1,773.6	2,473.7	2,861.5	2,358.4
Imports unit values					
— PLN/t	7,285.5	6,768.9	7,685.3	8,543.8	8,173.8
— USD/t	3,120.9	2,191.1	2,549.4	2,924.3	2,498.4
Aluminum scrap and waste materials CN 7602					

Exports unit values					
— PLN/t	4,926.2	3,967.4	4,845.1	4,958.2	5,270.6
— USD/t	2,115.0	1,278.9	1,604.6	1,698.7	1,609.7
Imports unit values					
— PLN/t	4,188.4	3,382.6	4,982.8	5,614.6	5,175.5
— USD/t	1,815.3	1,112.5	1,657.1	1,914.7	1,586.6

Source: ***The Central Statistical Office (GUS)***

Consumption

Consumption of ***aluminum metal*** in Poland was quickly increasing until 2007, but in the years 2008–2009, dropped to only 87,900 t in 2009. In 2010–2011 it recovered to 134,500 t, and in 2012 decreased again to 121,700 t (Tab. 1). It gives 3.2 kg Al per capita (3.5 kg per capita in 2010–2011) and is still one of the lowest consumption factors in Europe. If we account also consumption of ***alloyed aluminum*** (estimated at ca. 329,000 t in 2011, and ca. 340,000 t in 2012), total ***aluminum*** consumption amounted to ca. 464,000 t in 2011, and ca. 462,000 t in 2012.

The exact aluminum consumption pattern in Poland is not known. It is estimated that ca. 90% of this metal is consumed by a few large plants delivering ***aluminum*** and ***aluminum alloy products***. These are the **Impexmetal S.A., Konin Aluminum Smelter** (casting alloys, sheets and bands made of aluminum and aluminum alloys, aluminum foil), the **Kęty S.A.** (casting alloys, tubes, bars, wires made of aluminum and aluminum alloys), the **NPA Skawina Ltd.** (wire rods, wires, casting alloys, powders, oxides), the **PPZ Nicromet** (casting alloys, non-alloyed aluminum, aluminum for steel deoxydation), the **Alumetal S.A.** (casting alloys, aluminum for steel deoxydation), the **Poland Smelting Technologies POLST Ltd.** (casting alloys), the **Dziedzice Metals Mill S.A.** (rods and rolled sections made of aluminum alloys), and the **Będzin Smelter S.A.** (bands, disks, cast profiles made of aluminum; declared bankruptcy). Since the mid-1990s, Polish aluminum industry undergoes process of consolidation. Two capital group were formed. In 1995, **Impexmetal** foreign trade company bought shares of **"Konin" Aluminum Smelter**. Later on, it started to control **Skawina Metallurgical Plant** (currently: **NPA Skawina Ltd.**). It bought also majority of **Dziedzice Metals Mill S.A.** shares. In 2005, **Boryszew S.A. Capital Group** took control of **Impexmetal S.A.** As a result, **Boryszew Capital Group** has a 100% share in domestic manufacture of ***Al and Al alloys rolled products***.

The second capital group was formed by **Kęty Light Metals Works**. Since 1996, the **Kęty** plant started to be modernized. Later on, Group started to control **Metalplast Co.** of Bielsko-Biała (aluminum windows and doors), as well as constructed in 1998 a new aluminum containers plant in Tychy, managed by **Alupol Ltd.** At present, **Kęty Capital Group** has ca. 35% share in domestic ***extruded and drawn aluminum products*** manufacture, ca. 22% share in ***aluminum containers*** production, and ca. 40% in ***aluminum windows and doors*** manufacture.

Companies involved in aluminum production in Poland as of December 2012

- Impexmetal S.A., Huta Aluminium Konin w Koninie (Impexmetal Joint Stock Co., Konin Aluminum Smelter of Konin); ul. Hutnicza 1, 62–510 Konin; tel. +48 63

2474488, 2474422; fax +48 63 2474788, 2474787, www.aluminium-konin.com.pl — *secondary aluminum.*

- Kęty S.A. (Kęty Joint Stock Co. of Kęty); ul. Kościuszki 111, 32–650 Kęty; tel. +48 33 8446000; fax +48 33 8453093, 8453094, www.gk-kety.com.pl — *secondary aluminum*.
- NPA Skawina Sp. z o.o. (NPA Skawina Ltd. of Skawina); ul. Piłsudskiego 23, 32–050 Skawina; tel. +48 12 2760808; fax +48 12 2760888, www.npa.pl — *secondary aluminum*.
- Przedsiębiorstwo Przerobu Złomu "Nicromet" ("Nicromet" Scrap Processing Enterprise of Bestwinka); ul. Witosa 28, 43–512 Bestwina; tel. +48 32 3242100; fax. +48 32 3242130, www.nicromet.pl — *secondary aluminum*.
- Alumetal S.A. (Alumetal Joint Stock Co. of Kęty); ul. Kościuszki 111, 32–650 Kęty; tel. +48 33 8446815; fax +48 33 8450261, www.alumetal.pl — *secondary aluminum*.
- POLST Sp. z o.o. (Poland Smelting Technologies Ltd. of Wałbrzych); ul. M. Jachimowicza 2, 58–306 Wałbrzych; tel. +48 74 8869800; fax. +48 74 8869801, www.polst.com.pl — *secondary aluminum*.

ANDALUSITE — KYANITE — SILLIMANITE

Overview

Andalusite, **kyanite**, and **sillimanite** occur in metamorphic rocks (***schists***, ***gneiss***, ***quartzites***, ***corundum-sillimanite rocks***) and in clastic rocks, e.g. in ***beach sands***, as heavy minerals. When these minerals are roasted, beginning at 1,315°C (**kyanite**) up to 1,549°C (**sillimanite**), they form a mixture of ***mullite*** and ***quartz glaze***, and at 1,810°C ***corundum*** and ***quartz glaze***. This feature is very useful in the production of ***high-alumina refractories***.

Sources

Poland has no reserves of ***andalusite***, ***kyanite***, or ***sillimanite***, and the discovery of such deposits is unlikely.

Production

There is no production of ***andalusite***, ***kyanite***, or ***sillimanite*** in Poland.

Trade

The demand for ***andalusite*** and ***related minerals*** is covered entirely by imports. The amount of imports depends on domestic steel industry, being the main consumer of ***andalusite refractories***, as well as on level of world prices. Due to these factors, in recent years it varied in a wide range between 7,700 and 18,000 tpy (Tab. 1). Imports of ***andalusite concentrates*** are dominated by the Republic of South Africa (partly through European brokers) and France, but since 2010 also ***andalusite concentrates*** from the new Peruvian mine have been imported. Small amounts of ***cyanite concentrates*** were also imported from the US, India, China and others (Tab. 2). Re-exports are negligible and irregular (Tab. 1).

Tab. 1. Andalusite and related minerals statistics in Poland — CN 2508 50

t

Year	2008	2009	2010	2011	2012
Imports	17,683	7,764	17,979	13,579	17,384
Exports	35	1	-	-	0
Consumption[p]	17,648	7,763	17,979	13,579	17,384

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of andalusite and related minerals, by country — CN 2508 50

t

Year	2008	2009	2010	2011	2012
Imports	**17,683**	**7,764**	**17,979**	**13,579**	**17,384**
Canada	-	-	-	-	300
China	-	20	100	-	-
France	10,132	2,810	7,289	3,386	3,495
Germany	211	39	597	345	527
India	50	225	450	-	-
Netherlands	24	-	170	-	-
Peru	-	20	1,582	2,800	3,850
South Africa, Republic of	7,195	4,444	7,746	6,621	8,693
USA	15	124	20	329	324
Others	56	82	25	98	195

Source: ***The Central Statistical Office (GUS)***

The balance in ***andalusite*** and ***related minerals*** trade is consistently negative. Depending on imports volume and variable world prices, it varied recently between 10 and 25 million PLN (Tab. 1, 3). Average unit values of imported ***andalusite*** and ***related minerals*** concentrates — in USD/t — recently oscillated between 440-503 USD/t (Tab. 4).

Tab. 3. Value of andalusite and related minerals trade in Poland — CN 2508 50

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	86	2	-	-	0
Imports	17,144	10,358	23,711	20,029	25,222
Balance	**-17,058**	**-10,356**	**-23,711**	**-20,029**	**-25,222**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of imported andalusite and related minerals to Poland — CN 2508 50

Year	2008	2009	2010	2011	2012
PLN/t	969.5	1,334.0	1,318.8	1,475.1	1,450.8
USD/t	395.0	450.6	440.7	503.1	441.1

Source: ***The Central Statistical Office (GUS)***

Consumption

Andalusite, as well as marginal amounts of ***kyanite***, is used in Poland mainly for the production of ***high-alumina refractory materials*** in several domestic plants, e.g. especially in **Vesuvius Skawina**, with minor importance of **ArcellorMittal Refractories**

Kraków and **PCO Żarów**. The production of high alumina refractory materials highly depends on variable domestic steel industry demand, which results in unstable level of the consumption of these raw materials in Poland, between 7,700–18,000 tpy in recent years.

Applications of ***andalusite*** in the foundry industry (as components of molding sands) are of minor importance.

ANTIMONY

Overview

Antimony (**Sb**) and its compounds are obtained from individual deposits of ***antimony ores***, and as a ***co-product*** from the processing of ***Zn***, ***Pb***, ***Cu***, and ***Ag ores***, or from secondary sources, mainly from ***scrap*** of the ***lead-acid batteries***.

Antimony is a typical alloying metal. Its consumption increased rapidly until the mid-1970s, due to its application in ***lead alloys*** for the production of ammunition. Currently, antimony compounds used as flame retardants in plastics, started to be the main direction of antimony use.

Sources

Some polymetallic veins with ***antimony minerals*** are known in Lower Silesia, but they have only historical importance.

Production

There is no production of ***antimony ores*** or ***commodities*** in Poland.

Trade

Domestic demand is covered by the importation of various amounts of ***antimony oxides*** and ***antimony metal***. Imports of ***antimony metal*** in the years of 2008–2012 varied between 48–70 tpy (Tab. 1). Recently, the main suppliers of antimony metal were China, often through Western European brokers, e.g. from Belgium, Germany, Nethetrlands, United Kingdom or Italy, and in 2011 also Kazakhstan (Tab. 1). ***Antimony oxides*** are traded too, and main imports came from China, Western European countries, Japan, and in 2012 also from Bolivia and Slovakia. In the years of 2008–2012 imports of ***antimony oxides*** was at the stable level of ca. 1,000 tpy with slight decrease in 2012 (Tab. 1). Re-exports of ***antimony metal***, as well as of ***antimony oxides*** were recorded in recent years, being directed mainly to the Central and East European countries (Tab. 1).

The balance of ***antimony commodities*** trade has been consistently negative (Tab. 2). The increase of their prices on international markets caused rapid growth of negative trade balance value, which in the years of 2010–2012 was close to 24, 38 and 34 million PLN/y, respectively, but in previous two years was twice lower and amounted to under 14 million PLN/y (Tab. 2).

Tab. 1. Antimony commodities statistics in Poland

t

Year	2008	2009	2010	2011	2012
Antimony metal CN 8110 10					
Imports	**55**	**70**	**48**	**67**	**62**
Belgium	–	–	–	2	–
China	35	19	–	–	27
Italy	–	1	8	–	–
Japan	0	0	–	0	–
Kazakhstan	–	–	–	10	–
Luxembourg	–	–	–	–	14
Netherlands	5	33	7	11	8
Spain	–	5	–	9	–
United Kingdom	11	7	30	32	11
Vietnam	–	3	–	–	–
Others	4	2	3	3	2
Exports	**25**	**45**	**28**	**47**	**39**
Consumption[a]	**30**	**25**	**20**	**20**	**23**
Antimony oxides CN 2825 80					
Imports	**1,068**	**1,030**	**1,069**	**1,021**	**948**
Belgium	42	161	334	324	258
Bolivia	–	–	–	–	181
China	975	800	674	642	324
France	12	18	0	3	1
Germany	35	15	31	31	50
Italy	0	0	3	9	10
Korea, Rerpublic of	–	–	–	0	14
Mexico	1	0	–	–	–
Netherlands	–	10	–	–	4
Slovakia	2	–	1	–	102
Spain	0	25	25	11	3
Sweden	1	–	–	–	–
United Kingdom	–	–	–	0	1
Exports	**46**	**82**	**47**	**53**	**45**
Consumption[a]	**1,022**	**948**	**1,022**	**968**	**903**

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of antimony commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Antimony metal CN 8110 10					
Exports	394	895	734	2,252	1,753
Imports	882	1,334	1,228	3,043	2,700
Balance	**-422**	**-439**	**-494**	**-791**	**-947**
Antimony oxides CN 2825 80					
Exports	672	1,341	1,273	2,057	1,675
Imports	13,824	14,865	24,674	39,200	35,013
Balance	**-13,152**	**-13,524**	**-23,401**	**-37,143**	**-33,338**

Source: ***The Central Statistical Office (GUS)***

The unit values of imported ***antimony commoditeis*** rose rapidly in the years of 2010-2012, by more than 100%, reflecting their quotations on international market (Tab. 3). In the years 2008–2012 the unit values of imported antimony commodities expressed in PLN/t were continously increasing, despite the decreased price expressed in USD/t in 2009 and in 2012 (Tab. 3).

Tab. 3. Unit value of antimony commodities imports to Poland

Year	2008	2009	2010	2011	2012
Antimony metal CN 8110 10					
PLN/t	16,019.6	19,051.3	25,768.4	42,424.6	43,675.8
USD/t	7,008.9	6,290.6	8,616.6	15,504.7	13,285.4
Antimony oxides CN 2825 80					
PLN/t	12,943.8	14,432.3	23,085.2	38,407.3	36,940.7
USD/t	5,551.2	4,693.5	7,644.4	13,091.5	11,310.7

Source: ***The Central Statistical Office (GUS)***

Consumption

The majority of ***metallic antimony*** is used for producing ***printer's metal*** and ***bearing alloys*** containing tin and lead (so-called ***hard lead***), copper alloys, fuses, thermometers, and the solders used in electronics. More than 30% of ***antimony*** is used in the form of compounds (mainly ***oxides***) in the rubber, paint and varnish, textile, and glass-making industries, and others. Imported ***antimony sulfides*** were in temporary use for the production of safety matches, among other things.

ARSENIC

Overview

Arsenic trioxide (As_2O_3), obtained from sulfides and used for hundreds of years as a poison, is the basic raw material for the production of arsenic (As). It is primarily recovered during the initial roasting of ***copper***, ***lead***, ***gold***, and other ***ores*** for ecological reasons. Small amounts of **arsenic metal** are obtained by the reduction of ***arsenic trioxide***. **Arsenic** and its sulfides were used for making poisons, and for depilation and leather dressing.

Sources

The remaining reserves of the abandoned **Złoty Stok** ***As-Au ore*** deposit (Lower Silesia) contain 19,600 t As. Moreover, there is ca. 2,150 t As in the abandoned **Czarnów** polymetallic ores mine (as of 31 December 2012).

Production

There has not been production of ***arsenic-bearing ores*** or ***arsenic trioxide*** in Poland since 1961.

Trade

Polish demand for ***arsenic trioxide*** is satisfied entirely by imports, which in the years of 2008–2009 had decreasing tendency down to 11 t in 2009, while in the period of 2010–2012 it was lesser than 1 tpy, and amounted to only 16 kg in 2010, 386 kg in 2011 and 392 kg in 2012 (Tab. 1). Imports came mainly from Belgium and Germany (manufacturers), and from Switzerland (re-exporter). In the years 2008–2012 there was no exports of ***arsenic trioxide*** from Poland (Tab. 1). Since 2008, stable amounts - ca. 42–49 tpy of ***arsenic metal*** - are imported, except for 2009 when such imports decreased to 20 t (Tab. 2). They come basically from Belgium and China (manufacturers), and – in recent years – also from Germany, France and the Netherlands (re-exporters). In the years

Tab. 1. Polish imports of arsenic trioxide, by country — CN 2811 29 10

t

Year	2008	2009	2010	2011	2012
Imports= Consumption[a]	**22**	**11**	**0**	**0**	**0**
Belgium	22	10	–	–	0
Germany	0	1	–	0	0
Switzerland	0	0	0	0	0

Source: ***The Central Statistical Office (GUS)***

2008–2012 small re-exports of ***arsenic metal*** from Poland were recorded. The imports of ***arsenic commodities*** has resulted in a negative trade balance (Tab. 3). The unit values of their imports to Poland depends mainly on the quantity of traded material (Tab. 4).

Tab. 2. Polish imports of arsenic metal by country — CN 2804 80

t

Year	2008	2009	2010	2011	2012
Imports	**42**	**20**	**49**	**45**	**44**
Belgium	37	8	49	44	43
China	5	5	–	1	1
Germany	0	2	0	0	0
Netherlands	–	5	–	–	–
Exports	**4**	**1**	**7**	**6**	**6**
Consumption	**38**	**19**	**42**	**39**	**38**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of arsenic commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Arsenic trioxide CN 2811 29 10					
Exports	–	–	–	–	–
Imports	245	139	4	7	12
Balance	**-245**	**-139**	**-4**	**-7**	**-12**
Arsenic metal CN 2804 80					
Exports	24	9	58	39	49
Imports	300	240	389	260	276
Balance	**-276**	**-231**	**-331**	**-221**	**-227**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Unit values of arsenic commodities imports to Poland

Year	2008	2009	2010	2011	2012
Arsenic trioxide CN 2811 29 10					
PLN/t	11,136	12,613	228,438	18,912	31,191
USD/t	3,913	4,533	76,500	6,733	9,319
Arsenic metal CN 2804 80					
PLN/t	7,143	11,725	7,926	5,834	7,407
USD/t	2,992	3,886	2,616	1,986	2,294

Source: ***The Central Statistical Office (GUS)***

Consumption

Arsenic trioxide is used mainly in agriculture (insecticides), the ceramics, glass-making, and chemical industries, pharmaceuticals, etc., whereas ***arsenic metal*** is utilized as a component of tin and lead alloys (bearing alloys, etc.).

ASBESTOS

Overview

Asbestos is a fibrous, flexible, easily-felting mineral belonging to the ***serpentine*** group (***chrysotile asbestos***) or ***amphibole*** group (***actinolite***, ***amianthus***, ***antophyllite***, ***crocidolite***, etc.). These have been widely used in many industries, due to their tensile strength and flexibility, as well as heat resistance (***chrysotile asbestos***) and chemical resistance (***amphibole asbestos***).

Over the last 20 years **asbestos** has been eliminated from use in many countries, due to the carcinogenic effect of its very small microscopic fibers. The health hazard is confirmed in some applications, but in others its use is permissible, provided that the required conditions for production and use are maintained. Nevertheless, the problems have considerably reduced the asbestos use. Since the early 1990s, total or partial ban of their use was introduced in several countries, also in Poland (since 1998).

Sources

Poland has no deposits of ***asbestos***, nor any prospects for their discovery.

Production

There is no domestic production of ***asbestos***.

Trade

Since the new law on "prohibited use of products containing asbestos" (28th September 1997) was put into force, the imports of them was almost completely ceased, with the exception of small amounts which were imported in 2006 from Zimbabwe, in 2009 from Canada, and in 2010 from Great Britain (Tab. 1). They were consumed in the manufacturing of the asbestos diaphragms, which are utilised in the chlorine production. In 2009, the only working installation of this type was in Zachem SA Chemical Plant in Bydgoszcz[1]. In this case, like in many European countries, asbestos can be applied due to lack of other substitutes, because use of substitutes could increase the risk of explosion. The law allows to import some materials containing asbestos, but their type should be defined in special decree. At the end of 2012, Zachem plant ceased production of organic and inorganic chemicals reducing its activities only to the sale of energy, sewage treatment and disposal of land or real estate site.

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[1] Besides of **Zachem plant** in **Bydgoszcz**, there are only two chemical plants producing chlorine with use of asbestos diaphragms in Europe: **Rheinsberg** and **Stade** (both in Germany)

Tab. 1. Asbestos statistics in Poland — CN 2524

t

Year	2008	2009	2010	2011	2012
Imports = Consumption[a]	–	35	0	–	–

Source: ***The Central Statistical Office (GUS)***

Trade balance of ***asbestos*** was negative in these years, when imports occurred (Tab. 2).

Tab. 2. Value of asbestos trade in Poland — CN 2524

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	–	–	–	–	–
Imports	–	554	3	–	–
Balance	**–**	**-554**	**-3**	–	–

Source: ***The Central Statistical Office (GUS)***

Consumption

Asbestos on an industrial scale were recently used only in the **Zachem** plant in **Bydgoszcz** for manufacturing of diaphragms being applied in chlorine production. The technology requires changing diaphragms each year so about 5 tpy of asbestos wastes were generated. The company possessed the required consent of the Minister of Economy for imports and utilization of asbestos, valid up to 31st December 2008. Since 2009, Zachem has used asbestos diaphragms on the basis of Integrated Licenses granted by Voivode of Kujawsko-Pomorskie Voivodeship valid until 2016. Since December 2009, the company have made efforts to build a new asbestos-free chlorine production plant. The investment plans were depented by the economic situation of company, which resulted in chemicals prodcution cease (including chlorine) in the end of 2012.

ASPHALTS, NATURAL AND SYNTHETIC

Overview

Natural asphalts belong to the group of **liquid caustobiolites** (**bitumens**), the products of ***crude oil*** weathering in the vicinity of natural leaks on the earth surface. **Asphaltites**, related to asphalts, are products of the oxidation and polymerization of some of its constituent elements. Differences in climatic conditions result in corresponding differences in the black, dense, or fragile substances thus produced, which are often known by specific local names.

Natural asphalts have in most cases been replaced by **synthetic asphalts**, which are obtained in the course of ***crude oil*** refining (distillation). The following types of asphalts are distinguished: ***road asphalt***, ***brittle industrial asphalt*** for paper, rubber, paints and varnishes, etc., ***insulating asphalts***, ***compounds***, and ***solutions of asphalt***, etc.

Sources

Poland has no deposits of ***natural asphalt***, nor any prospects for discovery.

Production

There is no domestic production of ***natural asphalt***. In the years 2008–2012 the production of ***synthetic asphalt*** in Poland stabilized at 1.5-1.6 Mtpy, except of climb to almost 1.8 Mt in 2011 (Tab. 1). The main producers are: **Lotos Asfalt Ltd.** (over 50% of domestic production) with three production centres in Gdańsk, Jasło and Czechowice, and **Orlen Asfalt Ltd.**, which has two production centres in Płock and Trzebinia refineries. There are also smaller ***synthetic asphalt*** producers, e.g. **BP Bitumen Polska**, delivering mainly ***modified road asphalts*** on the basis of imported components.

Tab. 1. Asphalt statistics in Poland — CN 2713 20, 2714 90

'000 t

Year	2008	2009	2010	2011	2012
Production[1]	1,543.8	1,567.5	1,566.6	1,787.8	1,549.9
Imports	225.9	305.7	422.7	490.6	403.7
Exports	439.9	253.3	373.0	479.4	505.2
Consumption[a]	1,329.8	1,619.9	1,616.3	1,799.0	1,448.4

[1] asphalt recovery in oil refineries

Source: ***The Central Statistical Office (GUS)***

Trade

Because of their similarity, ***natural*** and ***synthetic asphalts*** are often confused in trade documents. Currently, probably almost entirely ***synthetic asphalt*** is imported and exported. Together with production increase, also asphalt trade with neighbouring countries was intensified, e.g. the Czech Republic, Germany, Slovakia, Sweden and Lithuania, but also Romania, Austria, Hungary, and recently also Finland and Bulgaria (Tab. 2, 3). Asphalt exports were dynamically increasing until 2008, when positive trade balance amounted to 350 million PLN. In 2009 and 2010 exports were lower, while imports increased, so trade deficit amounted to -69 million PLN in 2010 (Tab. 4). In the last two years, exports were increasing again, while imports slightly decreased, being 20% lower than exports, with similar unit values (Tab. 5). Thanks to that trade balance started to be strongly positive again, reaching ca. 200 million PLN (Tab. 4).

Tab. 2. Polish exports of asphalt, by country — CN 2713 20, 2714 90

'000 t

Year	2008	2009	2010	2011	2012
Exports	**439.9**	**253.3**	**373.0**	**479.4**	**505.2**
Austria	38.8	20.8	21.2	13.0	20.0
Belgium	3.0	–	–	–	–
Bulgaria	0.2	0.3	0.1	0.1	10.8
Czech Republic	79.6	47.0	44.0	62.0	92.3
Equatorial Guinea	–	–	5.4	–	–
Finland	–	–	–	28.7	51.8
France	–	–	2.5	6.5	0.2
Gabon	–	–	0.5	4.3	–
Ghana	–	–	0.2	0.6	1.1
Germany	45.4	36.2	60.5	71.1	55.6
Hungary	13.2	6.7	10.8	9.8	9.5
Ireland	–	–	12.3	–	–
Ivory Coast	–	0.2	3.8	–	–
Kenya	–	–	1.9	6.4	3.6
Latvia	9.8	0.5	1.2	10.2	16.0
Lithuania	55.0	10.6	17.8	41.5	31.9
Netherlands	6.1	8.8	7.1	20.3	–
New Caledonia	–	–	1.6	5.7	2.6
Norway	0.0	–	11.6	2.7	–
Moldova	–	–	–	1.4	4.6
Philippines	–	–	1.7	0.1	–
Romania	138.1	85.1	75.9	97.4	126.2
Russia	3.5	1.6	1.5	0.1	0.3
Senegal	–	7.1	7.9	14.5	7.8
Slovakia	26.6	19.5	17.3	16.6	20.9

Switzerland	2.0	6.8	7.6	1.5	1.6
Sweden	8.1	0.3	13.4	43.3	31.9
Tanzania	–	–	0.1	1.1	9.7
Uganda	–	–	0.0	0.6	5.3
Ukraine	9.5	0.0	0.2	0.4	0.8
United Kingdom	–	–	41.4	13.8	–
Others	1.0[r]	1.8[r]	3.5[r]	5.7	0.7

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Polish imports of asphalt, by country — CN 2713 20, 2714 90

'000 t

Year	2008	2009	2010	2011	2012
Imports	**225.9**	**305.7**	**422.7**	**490.6**	**403.7**
Austria	0.0	0.0	1.0	1.5	14.5
Belarus	0.1	0.9	–	0.2	–
Belgium	0.0	0.0	–	0.0	0.0
Bulgaria	–	–	–	1.7	19.5
Czech Republic	17.6	23.6	67.1	70.9	66.8
Denmark	0.0	0.0	0.1	0.1	–
France	0.0	0.1	10.1	18.4	5.9
Germany	133.2	156.9	197.1	228.8	193.6
Hungary	19.8	38.6	50.9	64.5	28.4
Italy	–	4.4	–	–	–
Lithuania	1.5	4.8	14.8	9.2	6.3
Netherlands	0.3	0.1	0.0	0.0	–
Slovakia	0.6	1.1	9.5	23.4	20.2
Sweden	52.8	71.4	67.1	71.2	48.0
Ukraine	–	2.7	5.0	–	–
Others	0.0[r]	1.1[r]	0.0[r]	0.7	0.5

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Value of asphalt trade in Poland — CN 2713 20, 2714 90

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	555,907	325,454	498,112	843,615	1,026,676
Imports	206,676	360,594	567,061	859,981	826,557
Balance	**+349,231**	**-35,140**	**-68,949**	**-16,366**	**+200,119**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Average unit values of asphalt trade in Poland — CN 2713 20, 2714 90

Year	2008	2009	2010	2011	2012
Exports unit values					
PLN/t	1,263.8	1,285.1	1,335.5	1,759.7	2,032.1
USD/t	562.7	418.4	436.0	607.0	622.7
Imports unit values					
PLN/t	914.9	1,179.6	1,341.4	1,753.0	2,047.3
USD/t	397.8	388.8	439.3	602.9	627.1

Source: ***The Central Statistical Office (GUS)***

Consumption

There is no precise information about the structure of ***asphalts*** consumption in Poland. ***Natural asphalts*** are utilized for road pavements (road asphalts constitute over 94% of total asphalts production), for the production of moisture-proofing materials and acid/base resistant coatings, and in the paint and varnish industry. They are regarded as equivalent to their substitutes, the ***synthetic asphalts*** obtained in petroleum refining, produced in the following grades: ***road asphalt***, ***brittle commercial asphalt***, ***insulating commercial grades***, ***asphalt for lacquers***, and other special products such as ***pitches***, ***cements***, ***masses***, ***filling compounds***, ***solutions***, ***emulsions***, and ***pastes***. They compete with similar products from the coke industry, i.e. ***pitches*** and ***pitch products*** (see: **COKE**).

Companies involved in synthetic asphalts production in Poland as of December 2012

- ORLEN Asfalt Sp. z o.o. w Płocku (ORLEN Asphalt Ltd. of Płock), ul. Chemików 7, 09–411 Płock, tel. +48 24 3653827, fax +48 24 3655596, www.orlen-asfalt.pl — *road asphalt, commercial asphalt, modified asphalt*.
- ORLEN Asfalt Sp. z o.o. w Trzebini (ORLEN Asphalt Ltd. of Trzebinia), ul. Fabryczna 22, 32–540 Trzebinia, tel. +48 32 6180123, 6180132, fax +48 32 6180133, www.orlen-asfalt.pl — *road asphalt, commercial asphalt.*
- LOTOS Asfalt Sp. z o.o. w Gdańsku (LOTOS Asphalt Ltd. of Gdańsk), ul. Elbląska 135, 80–718 Gdańsk, tel. +48 58 3264300, fax +48 58 3264380, www.lotosasfalt.pl — *road asphalt, commercial asphalt, modified asphalt*.
- LOTOS Asfalt Sp. z o.o. w Jaśle (LOTOS Asfalt Ltd. of Jasło), ul. 3 Maja 101, 38–200 Jasło, tel. +48 13 4466544, fax +48 13 4466549, www.lotosasfalt.pl — *commercial asphalt, road asphalt.*
- LOTOS Asfalt Sp. z o.o. w Czechowicach-Dziedzicach (LOTOS Asfalt Ltd. of Czechowice-Dziedzice), ul. Łukasiewicza 2, 43–502 Czechowice-Dziedzice, tel. +48 32 3237811, fax +48 32 3237813, www.lotosasfalt.pl — *modified asphalt*.
- BP Polska Sp. z o.o., Terminal Asfaltów Drogowych w Ścinawie (BP Polska Ltd., Road Asphalts Terminal of Ścinawa), ul. Leśna 8, 59–330 Ścinawa, tel. +48 76 8436436, fax +48 76 8436006, www.bp.pl/bitumen — *road asphalt*.

BARITE

Overview

The main source of **barium** (**Ba**) is ***barite*** (***$BaSO_4$***), which forms individual deposits of different types or occurs as a component in other deposits, whereas ***witherite*** (***$BaCO_3$***) is of minor importance. Generally, barium is used in the form of barite, and only small amounts are utilized for the production of other barium compounds, including ***synthetic barite*** and ***synthetic witherite***.

Barite is a mineral of declining economic importance. In many applications it has been replaced by substitutes, except for drilling, which utilizes 85–90% of the barite supplied in the market.

Sources

The resources of the four known ***barite*** deposits in **Stanisławów**, **Jedlinka**, **Jeżów Sudecki** (Lower Silesia), and **Strawczynek** amount to 5.7 Mt (as of 31 December 2012). Most of them are in the **Stanisławów** deposit (5.2 Mt), where an important mineral accompanying barite is ***fluorite***, which could be obtained in the course of ore dressing.

Production

Until 1997, Polish mining production of ***barite*** was based on the **Boguszów** and **Stanisławów** deposits, extracted by the **"Boguszów" Barite Mine Ltd.** In the years 1999–2006, and in 2008 again, **R&S Co.** of **Boguszów** was producing barite commodities, mainly ***flotation barite powders***, in the remaining processing plant, however — not on the basis of mining output, but on the basis of old flotation tailings, being deposited for many years nearby processing plant. This production varied between 2,000–3,000 tpy in the years 1999–2006 (Tab. 1), while in 2008 — only 324 t.

Tab. 1. Barite statistics in Poland — CN 2511 10

'000 t

Year	2008	2009	2010	2011	2012
Production	0.3	–	–	–	–
Imports	13.9	7.5	11.1	13.6	20.1
Exports	–	–	0.0	0.0	0.0
Consumption[a]	14.2	7.5	11.1	13.6	20.1

Source: ***The Central Statistical Office (GUS), producer's data***

Trade

The demand for ***barite*** in Poland has traditionally been supplemented by imports. After recent domestic production cease, imports are the only barite source. Until 2011, the main supplier was Slovakia (**Zelba a.s.**), but since 2012 Turkey and Morocco are the main suppliers, though recently larger quantities were imported also from China, Italy, Germany, as well as and from Dutch traders (Tab. 2). The main imported grades are ***flotation barite powders*** (i.e. 90% of total imports) for drilling mud, supplemented by high quality ***flotation barite powders*** for glass, paints, rubber and chemical industry.

Tab. 2. Polish imports of barite, by country — CN 2511 10

'000 t

Year	2008	2009	2010	2011	2012
Imports	**13.9**	**7.5**	**11.1**	**13.6**	**20.1**
China	1.3	1.5	1.2	1.2	0.5
Germany	0.4	0.2	0.3	0.8	0.2
Italy	3.3	0.1	0.3	0.5	0.5
Morocco	–	–	2.1	1.8	5.4
Netherlands	2.6	1.6	1.3	1.7	2.9
Slovakia	5.6	4.0	5.3	5.2	3.7
Slovenia	–	–	–	0.8	–
Turkey	–	–	0.2	1.0	6.2
Others	0.7^{r}	0.1^{r}	0.4^{r}	0.6	0.7

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***barite*** is consistently negative (Tab. 3), depending on imports level and average unit values of imported grades (Tab. 4).

Tab. 3. Value of barite trade in Poland — CN 2511 10

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	0	0	10	25	59
Imports	9,129	6,368	8,810	11,798	16,230
Balance	**-9,129**	**-6,368**	**-8,800**	**-11,773**	**-16,171**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of barite imported to Poland — CN 2511 10

Year	2008	2009	2010	2011	2012
PLN/t	655.8	846.8	793.0	867.1	806.0
USD/t	274.3	273.2	263.6	300.5	245.3

Source: ***The Central Statistical Office (GUS)***

Consumption

Currently ca. 90% of ***barite*** is consumed by the domestic drilling sector. The rest is used by the glass-making industry, paints and varnishes, rubber industry, and others. Demand for barite is strictly correlated with the drilling activity in Poland. Development of prospection of shale gas and increase of deep drillings due to this fact resulted in large increase of domestic ***barite*** consumption.

BAUXITE AND ALUMINA

Overview

Aluminum (*lat*. aluminium, **Al**) is one of the most common elements of the lithosphere, constituting 8.05% of its mass. Aluminum is present in many minerals, but only some of them, mainly hydroxides (***gibbsite***, ***diaspore***, or ***boehmite***) and hydroxide-bearing rocks (***gibbsite***, ***diaspore***, and ***boehmite bauxites***), form huge individual deposits of latheritic type in the equatorial band. These are the main source for the production of **alumina** (***aluminum oxide*** or ***hydroxide***, Al_2O_3). It is the main commodity for the production of **primary aluminum**, **alundum** (***fused aluminum oxide***), **high-alumina refractories**, **chemical compounds of aluminum**, etc. Other aluminum — bearing rocks, such as ***nephelinite*** and ***leucite***, as well as ***alunites***, are of local significance for alumina production.

The three main commodities — **bauxite**, **alumina**, **primary aluminum** — predominate in the broad and complex structure of aluminum commodities. More than 95% of bauxite is processed into alumina, and almost 90% of alumina is consumed by manufacturers of primary aluminum.

Bauxite

Sources

There are no ***bauxite*** deposits in Poland, and no prospects for their discovery.

Production

There is no domestic production of ***bauxites***.

Trade

All domestic demand for bauxites is met by imports. These are mainly ***calcined bauxites***, with minor quantities of ***raw bauxite***. In 2008, 71,500 t of bauxites were imported, in the years 2009-2011 imports dropped to 44,800 t, and 2012 rose again to 55,400 t (Tab. 1). When decreasing, the largest reduction of imports was reported in case of ***raw bauxite*** from Greece and ***calcined bauxites*** from China. In 2012, imports of raw bauxite from Greece rose by 70%, while imports from other direction were slightly reduced (Tab. 2). Commonly, small quantities of bauxite were re-exported (Tab. 1), but in 2010-2011 these re-exports rose significantly, being directed to the Czech Republic. In 2012 re-exports were not reported.

Tab. 1. Bauxite statistics in Poland — CN 2606

'000 t

Year	2008	2009	2010	2011	2012
Imports	71.5	48.9	48.2	44.8	55.4
Exports	2.8	0.6	12.9	8.5	–
Consumption[a]	68.7	48.3	35.3	36.3	55.4

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of bauxite, by country — CN 2606

'000 t

Year	2008	2009	2010	2011	2012
Imports	**71.5**	**48.9**	**48.2**	**44.8**	**55.4**
China	19.1	4.8	10.0	8.8	9.5
Czech Republic	2.4	0.3	0.2	0.6	1.2
Germany	3.5	2.1	1.3	1.3	1.4
Greece	43.2	36.7	25.9	20.3	34.5
Guyana	0.5	0.9	2.1	10.0	5.4
Hungary	0.3	–	0.3	–	0.4
India	–	–	0.1	0.3	0.1
Luxembourg	–	–	0.3	0.5	0.0
Netherlands	2.3	2.3	2.3	2.4	2.6
Turkey	–	1.3	5.5	–	–
United Kingdom	–	–	–	0.5	0.0
Others	0.2[r]	0.5[r]	0.2[r]	0.1	0.3

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***bauxite*** is consistently negative (Tab. 3), while deficit is correlated with imports volume and imports unit values (Tab. 4).

Tab. 3. Value of bauxite trade in Poland — CN 2606

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	2,404	1,175	3,470	1,741	–
Imports	43,915	32,968	35,925	35,947	40,348
Balance	**-41,511**	**-31,793**	**-32,455**	**-34,206**	**-40,348**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of bauxite imports to Poland — CN 2606

Year	2008	2009	2010	2011	2012
PLN/t	614.5	673.8	746.0	801.9	728.4
USD/t	269.0	219.3	249.0	278.4	221.7

Source: ***The Central Statistical Office (GUS)***

Consumption

There is a lack of detailed information on bauxite consumption structure in Poland. Lower grades of ***crude bauxite*** are used in the steel industry, while higher grades for the production of aluminous cement and in chemical industry. ***Calcined bauxite*** is used mainly by refractory industry. Reduction of high-alumina refractories production on the basis of calcined bauxite resulted in much lower consumption of this raw materials in 2009 (Tab. 5). Since 2010, high-alumina refractories and aluminous cement production slightly recovered, so reduction of apparent consumption of bauxite in 2010 and minimal growth in 2011 is probably related to the change of consumers' bauxite stocks. In 2012, apparent consumption significantly rose, so probably some stocks were supplemented due to low prices (tab. 4), but data on stock changes are not available.

Tab. 5. Structure of bauxites consumption in Poland

'000 t

Year	2008	2009	2010	2011	2012
Consumption[a]	**68.7**	**48.3**	**35.3**	**36.3**	**55.4**
• aluminous cement[e]	40.0	36.0	22.0	20.0	34.0
• refractories and others[e]	28.7	12.3	13.3	16.3	21.4

Source: ***The author's estimation***

Alumina

Sources

The only potential domestic source of ***alumina*** is ***fly ash*** from the **"Turów" Power Plant**, containing over 30% Al_2O_3. Until 1993, this was used in the production of ***calcined alumina*** at the **"Groszowice" Cement Plant** in a pilot operation based on an original production method developed by Polish scientist Jerzy Grzymek.

Production

Alumina is not currently produced in Poland.

Trade

Domestic demand for ***alumina*** is met entirely by imports, which in 2008 amounted to 152,200 t (Tab. 6). Closure of ***electrolytic aluminum*** production in Konin smelter in the beginning of 2009 (see: **ALUMINUM**) resulted in sharp decrease of ***calcined alumina*** (aluminum oxide) imports, which until 2009 constituted over 80% of total imports, while ***hydrated alumina*** (aluminum hydroxide) — the rest. In 2009, these shares changed to 55% and 45%, respectively, while in 2010 imports of ***hydrated alumina*** were higher than of ***calcined alumina***. Since 2010 ***calcined alumina*** imports are increasing again (Tab. 7). Since 2009 on the domestic market of calcined alumina the dominating position was held by products from Germany, Hungary, and Bosnia & Herzegovina. Hydrated alumina was imported mainly from Germany, Spain, Hungary, and Sweden (Tab. 7). Marginal amounts of alumina have recently been re-exported (Tab. 6).

Tab. 6. Alumina statistics in Poland — CN 2818 20, 30

'000 t

Year	2008	2009	2010	2011	2012
Imports	152.2	50.8	62.2	61.1	62.8
Exports	0.1	0.1	0.1	0.2	0.7
Consumption[a]	152.1	50.7	62.1	60.9	62.1

Source: ***The Central Statistical Office (GUS)***

Tab. 7. Polish imports of alumina, by country — CN 2818 20, 30

'000 t

Year	2008	2009	2010	2011	2012
Imports	**152.2**	**50.8**	**62.2**	**61.1**	**62.8**
• ***calcined alumina***	***126.9***	***27.7***	***30.4***	***34.3***	***37.0***
• ***hydrated alumina***	***25.3***	***23.1***	***31.8***	***26.8***	***25.8***
Austria	0.1	0.0	0.0	0.0	2.0
Bosnia and Herzegovina	4.5	3.7	6.3	8.7	8.6
China	0.8	0.5	1.1	0.1	0.2
France	2.3	1.3	1.6	2.1	2.4
Germany	39.3	18.3	27.9	24.9	25.8
Greece	0.0	0.0	0.0	0.3	0.0
Hungary	13.2	9.9	12.6	13.3	10.7
Ireland	28.1	0.0	–	0.0	–
Italy	0.2	0.2	0.2	0.3	0.4
Romania	–	–	–	–	3.0
Slovenia	1.5	0.5	1.7	1.5	0.9
Spain	59.4	11.2	9.7	4.6	2.7
Sweden	1.7	4.2	0.4	4.1	5.1
United Kingdom	0.0	0.4	0.1	0.1	0.1
USA	0.3	0.4	0.2	0.2	0.3
Others	0.9[r]	0.2[r]	0.4[r]	0.9	0.6

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***alumina*** is consistently negative (Tab. 8). After reduction in 2009, it deepened again to ca. 133 million PLN in 2012 (tab. 8). The main reason was increase of expensive ***calcined alumina*** imports (tab. 9), while deficit of ***hydrated alumina*** trade was reduced since 2011.

Tab. 8. Value of alumina trade in Poland — CN 2818 20, 30

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	336	432	368	1,418	1,922
Imports	171,202	102,678	115,490	116,155	134,983
Balance	**-170,866**	**-102,246**	**-115,122**	**-114,737**	**-133,061**

Source: ***The Central Statistical Office (GUS)***

Tab. 9. Average unit values of alumina imports to Poland

Year	2008	2009	2010	2011	2012
Calcined alumina CN 2818 20					
PLN/t	1,146.0	2,719.3	2,725.0	2,500.2	2,827.9
USD/t	482.7	877.8	903.3	853.6	866.5
Hydrated alumina CN 2818 30					
PLN/t	1,021.2	1,182.6	1,030.0	1,138.2	1,178.1
USD/t	432.5	387.7	342.5	389.2	360.8

Source: ***The Central Statistical Office (GUS)***

Consumption

Until 2009, the consumption structure of ***calcined alumina*** has been dominated by the smelting of aluminum at **Aluminum Smelter** in Konin (ca. 64% of total domestic consumption, Tab. 10). After closure of ***aluminum electrolysis*** in Konin smelter, all imported ***hydrated and calcined alumina*** are used in non-metallurgical industries, for ***high-alumina refractory materials*** and ***aluminous cement*** manufacture, in the chemical industries, glass industries, electroceramic industries and others.

Tab. 10. Structure of alumina consumption in Poland

'000 t

Year	2008	2009	2010	2011	2012
Consumption[a]	**152.1**	**50.8**	**62.1**	**60.9**	**62.1**
• Aluminum production[e]	98.0	–	–	–	–
• refractories, aluminous cement, and others[e]	54.1	50.8	62.1	60.9	62.1

Source: ***Consumers' data, the author's estimation***

BENTONITES AND BLEACHING CLAYS

Overview

Bentonites and **montmorillonite clays** are sedimentary rocks rich in ***montmorillonites***. A common feature of these rocks is their ability to swell, their susceptibility to the dispersion of water, and their easy absorption of cations and organic substances from water solutions. Accordingly, these rocks are utilized in the foundry, drilling, and ceramic industries.

Montmorillonites, particularly ***sodium montmorillonite***, have an outstanding capacity for decoloring solutions and removing impurities from oil. That is why they are used as **bleaching clays**. However, the most effective agents in decoloring and clearing solutions and suspensions, are ***palygorskite*** and its variety ***attapulgite***, considered a separate group of clay minerals. In the US they are called **Fuller's earth**, whereas in the United Kingdom this term is used for some ***calcium montmorillonites***.

Sources

In Poland typical ***bentonites***, i.e. containing more than 75% montmorillonite, occur very seldom. More common are ***bentonite clays*** and ***montmorillonite clays*** with 50–75% content of montmorillonite. The total resources of 7 deposits amounted to 2.7 Mt, including 0.5 Mt in **Krzeniów**, the only deposit developed (as of 31 December 2012).

In the northern part of the Carpathian Foredeep, near **Chmielnik**, there are several-meters-thick deposits of ***bentonite clays*** containing thin insertions of ***pale bentonites***. They consist mainly of ***calcium montmorillonite***. These clays were extracted until 1987. Currently, there are only two registered undeveloped deposits **Górki** and **Jawor** in this region, whereas the previously extracted **Chmielnik** deposit has been removed from the ***Mineral Resources Datafile.***

Two types of ***bentonite shale*** are known in the Carpathian Mountains: variety containing ***sodium montmorillonite*** occur in **Trepcza** near **Sanok** (small deposit, abandoned), while slates with nearly 2m-thick inserts of ***bentonites*** occur in the **Polany** deposit near **Gorlice**.

The raw material similar to typical ***bentonites*** occurs in ***smectite weathering cover***, which was developed on some ***basalt*** deposits in Lower Silesia, e.g. in the vicinity of Złotoryja (**Krzeniów** deposit), Leśna (**Leśna-Miłoszów** deposit), and Jawor (**Męcinka** deposit). These are suitable for the production of bleaching clays, molding sands for the foundry industry, and catalysts.

Production

The total domestic production of ***bentonites*** and ***bleaching clays*** recorded by the **Central Statistical Office,** after a significant decline recorded in the statistics in 2009, began to recover progressively in the following years, reaching the level of almost 114,000 t in 2011 and slightly lower amount of 102,000 t in 2012 (Tab. 1).

Tab. 1. Bentonites and bleaching clays statistics in Poland — CN 2508 10

'000 t

Year	2008	2009	2010	2011	2012
Mine production[1]	3.0	3.0	2.2	0.9	0.8
Production of processed bentonites and bleaching clays	121.0	81.3	86.0	113.8	102.1
in which bleaching clays from **ZCh "Siarkopol" Tarnobrzeg**	*2.3*	*2.4*	*2.7*	*2.9*	*2.0[e]*
Imports[2]	174.9	122.5	156.2	207.8	229.2
Exports[2]	20.0	23.4	21.4	24.4	22.9

[1] crude bentonite

[2] crude bentonite and other grades together, including foundry and drilling ones

Source: ***The Central Statistical Office (GUS), producers' data***

The **"Bazalt" Mining and Production Plant** in **Wilków**, extracting ***bentonite*** accompanying basalt in the **Krzeniów** deposit, is recently the only ***raw bentonite*** producer in Poland. Small mining output at ca. 1,000–3,000 tpy was sold in crude form to the **PTP "Certech"** (Tab. 1).

The "**Zębiec" Mining and Metal Works** (near Starachowice — central Poland) is the traditional domestic producer and supplier of ***processed bentonite*** in various grades. The production is based on imported raw bentonites, mainly from Slovakia (from the **Stara Kremnicka-Jelsovy Potok** deposits), and — on irregular basis — from Ukraine. The company offers wide assortment of ***bentonites***, basically for ***foundry***, ***drilling***, and ***civil construction*** (e.g. ***hydro-insulating shielding***) and other of minor importance, i.e. ***pharmaceuticals***, ***nutritive***, ***animal feed***, ***pet litter***, etc. The supply of bentonites from this plant after significant reduction to about 16,000 t in 2009, due to a decline in demand in the foundry industry, showed a strong recovery to about 25,000 t in 2011 and to 30,000 t in 2012. Offered bentonite materials are sold mainly in the domestic market and in small quantities are exported, mainly to the Eastern Europe countries.

The next domestic bentonite supplier is the "**Certech" Co.** of **Niedomice** near Tarnów — the largest Polish producer of ***bentonite pet litter***, which offers it on a ***Super Benek*** trade mark. Since 2011, their production of bentonite for industrial applications (for geo-engineering construction, waterproofing, foundry and drilling) has significantly increased and now represent more than 30% of the sales of all products. Recently, the company has also expanded its range of grades for the ceramics industry, fertilizer and very fast growing sector of the production of feed (detoxification of feed and gas). Production of all types of bentonite, after the reduction in 2009 to 17,000 t, began to rapidly grow in the following years, reaching the level of more than 40,000 t in 2012. The company bases on raw materials imported from Slovakia (from the **Kopernica** and **Jelsovy Potok** deposits, and resently **Lastovce** deposit), supplemented by domestic raw bentonite from **Krzeniów** mine, by montmorillonite clay from **Bełchatów** lignite mine (as since 2010) and local ceramic clays in the last year. Volume of domestic raw materials used in the plant significantly increased from 10% to over 30% due to the development of the use of Bełchatów clays.

"Hekobentonity" Co. in **Korzeniów** near Dębica is the other supplier of ***processed bentonite***, mainly of ***drilling grade***. The production, based on raw bentonite imports from Slovakia (mainly from the **Brezina-Kuzmice** region), Ukraine, and India, after reduction to less then 6,000 t in 2009. In the period 2010-2012 exceeded 10,000 tpy, especially in 2011, when it approached to almost 12,000 t. The considerable part of production (about 40%) is sold abroad to European countries, mainly to Germany. **"Celpap" Ltd**. located in Wieliczka close to Cracow is the next supplier of ***bentonite pet litter***. The volume of its production is unknown, however, commissioning of new production plant in Jasło indicates an increase of demand for Celpap's products.

"CETCO Poland" Ltd. in **Szczytno** (NE Poland) is the next important producer of ***processed bentonite***, delivering mainly ***bentonite mat*** and ***hydro-insulating materials*** made of ***granulated sodium bentonite*** supplied basically by **AMCOL Int. Co.** from Wyoming, the US, and recently also from India. The level of production is unknown and can be estimated at 35,000-55,000 tpy.

The next producer of bentonite is the company **Süd-Chemie Polska** — a part of the German chemical group **Süd-Chemie AG** — which operates in Gdańsk. After the expansion of the capacity to ca. 60,000 tpy, the production increased, and - despite the crisis - remained on the stable level of ca. 30,000 tpy in the recent years. The bentonite mixes are manufactured basing on granulated materials from its own mines in Sardinia and Greece. The company delivers mainly foundry products (about 80-86% of company production) containing ***activated sodium bentonite*** (***Geko S***), and the mixture with pulverized activated carbon (***Ecosil***) used in the production of castings for the automotive industry. Their production, however, is recorded in a different position of **PKWiU** goods classification **(2466472010)** as a prepared binders and cores for casting molds. The company offers also products for drilling and construction — ***Bentonil*** types ***CF***, ***C2***, ***ASN***, ***XR*** in amount of about 4,000 tpy (ca. 13-14% of the supply). Increasing production capacity is connected with plans of introduction of new products for zoological application (pet liters), but currently these plans are deferred.

Besides ***foundry bentonites*** (***for molding sands***) and ***drilling bentonites***, another commodity produced from primary raw materials is ***montmorillonite type bleaching clay***. Its only producer until to the end of 2012, was the **"Siarkopol Tarnobrzeg" Chemical Plant Ltd.**, production of which was based on material imported from Slovakia. The production of these commodities, after the significant reduction to 2,900 t in 2011 (Tab. 1), was completed in 2012, due to strong competition of products imported from Germany Süd-Chemie. In the last year about 40-43% of their sales exported, while in the domestic market they are main custumed by comestible fats industry (23-28%).

Trade

Domestic demand for ***raw bentonite*** is almost entirely satisfied by imports. The level of imports has risen systematicaly in recent years, with the exception of 2009, when the significant reduction was noticed to less than 123,000 t (Tab. 1). Slovakia was traditionally the main supplier of bentonite. Since 2007 due to increased supplies from India (over 40,000 t), and since 2009 also from Turkey (over 30,000 t), the share of imports from Slovakia decreased to 40-42% (Tab. 2). Since 2010, in the geographical structure of imports the position of Slovakia as the dominant supplier of bentonite has strengthened again (Tab. 2). In 2011, from this direction came 45% of supply, and in 2012 - ca. 40%. Significant quantities of bentonite were also purchased in India (27% in 2012), Turkey (14%), Italy (10%) and Germany. The detailed structure of bentonite imports is difficult to ascertain, as all the grades, both crude and processed, are listed together under one item of Polish trade nomenclature (**CN 2508 10**). Majority of imports makes probably ***raw bentonite*** purchased by **ZGM "Zębiec**," **PTH "Certech",** and **"Heko-bentonity" Co** from Slovakia, what can be deduced from low unit values of importation i.e. 34–44 USD/t. The importation unit values for other countries are much higher e.g. Italy 91-115 USD/t (delivered for **Süd-Chemie**), Turkey (99-109 USD/t, probably the hydroinsulating grades imported for the Cetco Poland from the Amcol's Turkish company Bensan Activated Bentonite Co.), India (recently ca. 86-96 USD/t, probably raw bentonites with a high swelling capacity, mainly sodium - natural or activated, for cat litters production), as well as Germany (219–245 USD/t, delivered by **Süd-Chemie AG,** mainly foundry grades).

Tab. 2. Polish imports of bentonite and bleaching clays, by country — CN 2508 10

'000 t

Year	2008	2009	2010	2011	2012
Imports	**174.9**	**122.5**	**156.2**	**207.8**	**229.2**
Czech Republic	3.0	5.6	4.3	4.2	4.9
Denmark	0.2	0.2	0.1	0.1	–
Egypt	–	–	0.2	1.5	2.8
France	1.7	1.1	2.1	4.5	0.1
Germany	5.1	6.5	8.0	13.5	10.5
Hungary	3.4	1.2	1.3	1.6	1.0
India	42.3	0.1	10.2	37.6	63.0
Italy	18.1	14.7	25.3	14.5	22.1
Marocco	–	–	–	5.7	0.1
Slovakia	71.0	58.4	66.0	93.0	93.3
Turkey	5.0	33.3	35.8	28.4	29.9
Ukraine	3.3	0.5	0.8	1.0	0.6
United Kingdom	0.2	0.3	0.6	0.5	0.3
USA	21.0	0.1	0.2	0.6	0.1
Others	0.6	0.5	1.3	1.1	0.5

Source: ***The Central Statistical Office (GUS)***

Simultaneously, negligible exports of ***bentonites*** have also been recorded, basically to the neighbouring countries, e.g. Germany (in 2012: 48% of exports), Belarus (7%), and Russia (10%). The trade balance in these commodities has been always negative, despite of rising exports (Tab. 1 and 3).

Tab. 3. Value of bentonites and bleaching clays trade in Poland — CN 2508 10

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	18,703	26,696	23,231	27,276	26,500
Imports	44,183	38,751	46,522	57,293	64,374
Balance	**-25,480**	**-12,055**	**-23,291**	**-30,017**	**-37,874**

Source: ***The Central Statistical Office (GUS)***

The average unit values of ***bentonite*** imports to Poland from 2010 significantly decreased to the level of 275-300 PLN/t, as a result of a fall in prices of raw material imported from Slovakia in significant quantities (values presented in USD/t have declined systematically since 2008, due to the weakening of the Polish currency (Tab. 4).

Tab. 4. The unit values of bentonite and bleaching clays imports to Poland — CN 2508 10

Year	2008	2009	2010	2011	2012
PLN/t	252.6	316.4	297.8	275.8	280.8
USD/t	108.6	102.5	97.4	94.5	85.2

Source: ***The Central Statistical Office (GUS)***

Consumption

The total domestic consumption of ***processed bentonite*** can be only estimated basing on the information on domestic production, and importation of commodities of high unit values. Taking this into account the domestic consumption of ***processed bentonite*** in ***various grades*** can be estimated between 130,000 and 180,000 tpy in recent years.

The principal traditional end-use of ***processed bentonite*** is the ***foundry engineering*** (***molding sands***). Other important consumers are the ***construction*** and ***drilling*** industries, however of smaller significance. ***Crude bentonite*** is utilized in hydro-engineering and insulating works, which are important environmental applications of increasing significance in Poland. The very characteristic feature of recent years is very fast growing ***cat litter*** market. The lowest quality montmorillonite clays are suitable for the production of ***absorbing fertilizers***, which are used in agriculture and forestry for the reclamation and improvement of soils. Other minor uses, mainly of ***raw bentonite***, are the following: pelletizing of iron ore concentrates, wine clarification, sewage purification (as absorbent), and the ceramics and the enamel industry.

Another important use of bentonite commodities is ***bleaching clay*** manufacturing (Tab. 1). These products, supplied basically by **"Siarkopol" Tarnobrzeg**, are principally consumed in the comestible fats industry for processing of edible oils to remove impurities (ca. 40–50% of the sales), by petroleum chemistry (5–20%), cosmetics and the dyeing industry.

Companies involved in bentonites and bleaching clays production in Poland as of December 2012

- PGP “Bazalt” S.A. w Krzeniowie (“Bazalt” Joint Stock Co. in Krzeniów), 59–500 Złotoryja, P.O. Box 34, tel. +48 76 8783872, fax. +48 76 8783421, www.pgpbazalt.pl — *crude bentonite.*
- Zakłady Górniczo-Metalowe “Zębiec” S.A. w Zębcu (“Zębiec” Mining and Metal Works Joint Stock Company in Zębiec), 27–200 Starachowice, tel. +48 41 2767400, fax +48 41 2767500, www.zebiec.com.pl — *foundry bentonite, bentonite for hydro-insulating materials, drilling bentonite, pharmaceuticals, nutritive, for animal feed, building construction, cat litter*.
- PTH “Certech” S.J. w Niedomicach (“Certech” Co. in Niedomice), 33–132 Niedomice, ul. Fabryczna 36, tel./fax +48 14 6458703, www.certech.com.pl — *cat litter.*
- “Celpap” Sp. z o.o. (Celpap Ltd.), 32–020 Wieliczka, ul. Czarnochowska 21, tel. +48 12 2882708, fax +48 12 2881908, www.celpap.pl — *pet liter.*
- “Hekobentonity” Sp. z o.o. w Korzeniowie (“Hekobentonity” Ltd. of Korzeniów), 39–203 Nagoszyn, Korzeniów 42a, tel. +48 14 6818962, fax. +48 14 6818017, www.bentonit.pl — *bentonite drilling fluids*, *foundry bentonite*, *hydro-insulating materials.*
- “CETCO Poland” Sp. z o.o. w Szczytnie (“CETCO Poland” Ltd. in Szczytno), 12–100 Szczytno, Korpele 13A — Strefa, +48 89 6249279, fax +48 89 6249732, www.cetco.pl — *bentonite drilling fluids*, *bentonite mat*, *hydro-insulating materials.*
- “Süd-Chemie Polska” Sp. z o.o., (Süd-Chemie Polska Ltd. of Gdańsk), ul. Mariana Chodackiego 33, 80-555 Gdańsk, tel. +48 58 343 73 94, fax. +48 58 343 73 93, www.sud-chemie.com.pl — *foundry, drilling and construction bentonite.*

BERYLLIUM

Overview

The main primary source of **beryllium** (**Be**) is ***beryllium mineral***, occurring predominantly in pegmatite- and greisene-type deposits, from which it is recovered as **beryllium concentrate**, containing 11% BeO. The second source is ***bertrandite ore***, which forms a unique deposit in the **Spor Mts.** (the US). Both beryllium concentrate and bertrandite ore are processed into **beryllium hydroxide**, and then to **beryllium metal**, **beryllium oxide**, and **beryllium alloys**.

Beryllium mineral has been utilized since ancient times, as ***gems*** (***emeralds***). Now **beryllium commodities** are used mainly in armaments, and in the electronic, electrotechnical, and nuclear power industries. **Beryllium** is also an important alloy additive for copper, nickel, and aluminum.

Sources

Poland has no ***beryllium ore*** deposits. Somewhat higher concentrations have been found in the ***ash of hard coals*** from the **Upper Silesian Coal Basin** (approximate resources of 97,000 t Be), but no recovery method has been developed. Pegmatite occurring near **Bielawa** and **Dzierżoniów** (Lower Silesia) contains ***beryllium minerals***.

Production

There is currently no production of ***beryllium concentrates*** or ***beryllium*** in Poland.

Trade

Domestic demand is satisfied by imports of irregular amounts of ***beryllium commodities*** (metal, powders) – up to 35 kgpy, and continuous imports of ***beryllium products*** in the range 138–714 kgpy. Moreover, in 2010 occurred a huge re-exports of beryllium products, exceeding by almost six times imports volume (Tab. 1). In the years of 2010–2011 the sole supplier of ***beryllium commodities*** was Kazakhstan, but of ***beryllium products*** the main imports came from the EU countries, the US and Kazakhstan, while re-exports in 2010 were directed to Belgium and Switzerland.

The balance of ***beryllium commodities*** and ***products*** trade has been negative in recent years (Tab. 2) and depended on the volume of imports, what strongly influenced the unit value of imported beryllium commodities (Tab. 3).

Consumption

Domestic demand is met mainly by imported final products containing ***beryllium*** (probably a few tons of Be per year). Recently, ***beryllium commodities*** and ***products***

Tab. 1. Beryllium statistics in Poland

kg

Year	2008	2009	2010	2011	2012
Beryllium commodities[1] **CN 8112 12**					
Imports=Consumption[a]	–	–	35	27	–
Beryllium products **CN 8112 19**					
Imports	714	177	293	337	138
Exports	–	–	1,713	–	–
Consumption[a]	714	177	-1,420	337	138

[1] metal, powders

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of beryllium commodities and products trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Beryllium commodities[1] **CN 8112 12**					
Imports=**Balance**	–	–	**-289**	**-285**	–
Beryllium products **CN 8112 19**					
Exports	–	–	63	–	–
Imports	362	140	147	171	93
Balance	**-362**	**-140**	**-84**	**-171**	**-93**

[1] metal, powders

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit value of beryllium commodities and products imports to Poland

Year	2008	2009	2010	2011	2012
Beryllium commodities[1] **CN 8112 12**					
PLN/kg	–	–	8,249	10,549	–
USD/kg	–	–	2,683	3,655	–
Beryllium products **CN 8112 19**					
PLN/kg	507	791	502	508	675
USD/kg	224	258	168	173	206

[1] metal, powders

Source: ***The Central Statistical Office (GUS)***

are important, being imported in considerable amounts (Tab. 1, 2). These are probably electronic components, which find use in computer and data communications industries.

BISMUTH

Overview

Bismuth (**Bi**) is extracted primarily from ***bismuth-bearing ores*** of ***lead***, ***copper***, and ***tin***, and sporadically from separate deposits of ***bismuth ores***. This causes the supply of bismuth to be strongly related to the production volumes of other metals.

For hundreds of years, **bismuth compounds** have been used to treat gastric disorders. The pharmaceuticals and cosmetics industries continue to be the main consumers. Since the beginning of the 19th century, **bismuth metal** has been used as a component of printer's metals. It is the basic component of low melting alloys used in the production of fuses, thermometers, etc.

Sources

There are no perspectives for the discovery of ***bismuth ore*** deposits in Poland. The slight admixtures of ***bismuth*** occur in ***copper ore*** deposits in the **Fore-Sudetic Monocline**.

Production

Bismuth is not recovered from the only possible source — ***copper ore***.

Trade

Demand is satisfied by imports of ***bismuth metal***, ***powders*** and ***scrap***. In the years 2008–2012, imports varied between 18 and 33 tpy, coming mainly from Belgium, Germany, Italy, United Kingdom and France (in 2010), while the Netherlands, China, and Spain were smaller suppliers (Tab. 1). Moreover, in the same period exports varied between 0.6-3.2 tpy, and main buyers were Ukraine, Slovakia, Hungary and the US (Tab. 1). The trade balance of ***bismuth commodities*** has always been negative (Tab. 2), and the unit values of their imports in USD/t does not reflect the changes of prices in international markets (Tab. 3).

Consumption

Bismuth metal is applied in metallurgy (low melting alloys) and in electronics. ***Bismuth compounds*** are used in cosmetics and pharmaceuticals, as antiseptic agents, and also as medicine for gastropathy. However, these drugs are being eliminated in favour of antibiotics and other modern therapeutic agents. The detailed end-use demand of ***bismuth metal*** and ***bismuth compounds*** in Poland is not available.

Tab. 1. Polish imports of bismuth[1], by country — CN 8106

t Bi

Year	2008	2009	2010	2011	2012
Imports	**24.3**	**17.6**	**32.6**	**22.9**	**23.7**
Belgium	23.8	11.2	8.1	4.6	13.0
China	–	2.1	–	0.0	–
France	0.0	0.2	10.6	–	0.0
Germany	0.5	2.2	2.1	3.1	4.0
Italy	–	0.2	0.2	4.5	5.0
Netherlands	0.0	–	2.1	5.3	0.0
Spain	–	1.0	4.7	–	–
United Kingdom	–	0.7	4.8	5.4	1.6
Exports	**3.2**	**0.6**	**2.7**	**3.1**	**2.2**
Consumption[a]	**21.1**	**17.0**	**29.9**	**19.8**	**21.5**

[1] metal, powders, scraps

Source: ***The Central Statistical Office** (GUS)*

Tab. 2. Value of bismuth[1] trade in Poland — CN 8106

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	293	44	197	251	176
Imports	1,547	1,010	1,467	1,848	2,178
Balance	**-1,254**	**-966**	**-1,270**	**-1,597**	**-2,002**

[1] metal, powders, scraps

Source: ***The Central Statistical Office** (GUS)*

Tab. 3. Unit values of bismuth[1] imports to Poland — CN 8106

Year	2008	2009	2010	2011	2012
PLN/t	63,663	57,386	44,933	80,692	91,916
USD/t	27,684	18,853	14,818	27,955	28,050

[1] metal, powders, scraps

Source: ***The Central Statistical Office** (GUS)*

BORON

Overview

The most important minerals of **boron** (**B**) are borates of Mg, Ca, Na, and K, particularly ***borax***, ***colemanite***, ***ulexite***, ***kernite***, and others. They have been in use since ancient times, but large-scale consumption commenced in the 19th century, to provide chemicals needed by industries that manufacture glass and ceramics, pharmaceuticals, cosmetics, and chemicals. Boron is an indispensable element in NIB magnets (Neodymium – Iron – Boron). These powerful magnets are utilized in computers' hard drives, cell phones, medical equipment, toys, motors, wind turbines and audio systems (e.g. speakers). Boron is also used to control nuclear reactions and to modify electrical properties of silicon and germanium semiconductors.

Sources

Boron minerals (boracite, ascharite, and others) occur in unmined ***potassium salts*** accompanying the **Kłodawa salt** deposit in the **Kujawy** region. They contain 0.01–0.09% B. The resources are estimated at 6,000 t B.

Production

Boron minerals are not produced in Poland.

Trade

Domestic demand for ***boron minerals*** and ***compounds*** was almost entirely met by imports, which varied significantly year by year, from dozens to over thousand tpy (Tab. 1). Until 2011 it comprised in over 90% by ***boric acid*** imported from Turkey, while in 2012 the largest deliveries of that commodity came from Finland. ***Natural sodium borates*** and ***boric acid*** were also imported from Italy, and — on irregular basis — from Belgium, Germany, the Netherlands, Peru, and Iceland (Tab. 2). In 2008 and 2012, there were also registered the occasional exports (re-exports) of ***boric acid*** to Romania and Russia, and to the USA, respectively. In the last three years the deficit in boron minerals and compounds trade deepened significantly, following the growth in importation (Tab. 3). Another boron commodity imported to Poland was ***boron metal***, the majority of which originated usually from Germany and the United Kingdom (Tab. 2). In 2012 its importation jumped more than tenfold approaching 16,000 t following increased deliveries from Germany. The negative trade balance of ***boron metal*** deepened last year to -270,000 PLN (Tab. 3).

Tab. 1. Boron commodities statistics in Poland

Year	2008	2009	2010	2011	2012
Boron minerals [t] **CN 2528**					
Imports	1,348[1]	1,435	1,869	1,535	1,580
Exports	35[1]	–	0	–	8
Consumption[a]	1,313	1,435	1,869	1,535	1,572
Boron, metal [kg] **CN 2804 50 10**					
Imports = Consumption[a]	10	161	267	124	15,783

[1] natural boric acid

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of boron commodities, by country

Year	2008	2009	2010	2011	2012
Boron minerals CN 2528 [t]	**1,348**	**1,435**	**1,869**	**1,535**	**1,580**
Belgium	–	–	–	21	19
China	–	–	–	1	0
Finland	–	–	–	12	1,084
Germany	–	24	–	1	–
Iceland	17	–	–	–	–
Italy	25	44	25	54	39
Netherlands	–	–	–	–	13
Peru	–	–	–	–	20
Turkey	1,306	1,367	1,844	1,446	405
Boron, metal CN 2804 50 10 [kg]	**10**	**161**	**267**	**124**	**15,783**
China	–	–	–	3	–
Germany	–	158	101	–	15,752
Japan	3	–	1	–	–
Switzerland	–	–	–	4	–
United Kingdom	5	2	160	101	2
USA	1	–	3	16	29
Others	1	1	2	–	–

Source: ***The Central Statistical Office (GUS)***

In the years 2008-2012 the unit values of ***boron minerals*** importation to Poland varied according to the volume of deliveries and countries of the commodities origin (Tab. 4). In 2012 the unit costs of ***natural borates*** and ***boric acid*** achieved the highest value in the last five years, exceeding 700 USD/t. In the case of ***boron metal*** the importation unit values dropped distinctly to 5 USD/kg last year from over 7,500 USD/kg in 2008.

Tab. 3. Value of boron commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Boron minerals CN 2528					
Exports	101	0	0	0	10
Imports	1,615	2,254	2,170	2,246	3,709
Balance	**-1,514**	**-2,254**	**-2,170**	**-2,246**	**-3,699**
Boron, metal CN 2804 50 10					
Exports	0	0	0	0	0
Imports	8	650	76	22	272
Balance	**-8**	**-650**	**-76**	**-76**	**-272**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Unit values of boron commodities imports to Poland

Year	2008	2009	2010	2011	2012
Boron minerals CN 2528					
PLN/t	1,198	1,571	1,161	1,463	2,347
USD/t	467	485	380	504	722
Boron, metal CN 2804 50 10					
PLN/kg	16,998	786	284	175	17
USD/kg	7,555	247	90	61	5

Source: ***The Central Statistical Office (GUS)***

Consumption

The consumption pattern of boron commodities in Poland is difficult to ascertain. Nevertheless, it is assumed that the majority of ***boron compounds*** is utilised in the construction industry (as a component of insulation and reinforcement fibre glasses, borosilicate glass, and in frits and glazes of ceramic goods), as well as in detergents manufacturing (as a component of washing powder). They are also added as an essential micronutrient to fertilizers in the plant farming. In the last two years ***natural boron compounds*** consumption in Poland stabilized at the level of above 1,500 tpy, after three years of consecutive growth when it approached 1,870 tpy (Tab. 1). The contraction of demand for borates resulted from the slowdown of activities in the construction industry and ceramics. On the contrary, demand for ***boron metal*** jumped to almost 16,000 mt in 2012 from much lower levels in the previous years, probably as a result of green energy development, e.g. wind farms construction in Poland (Tab. 1).

BROMINE

Overview

Bromine (**Br**) is a non-metal belonging to the halides, widely found in nature. The main sources of bromine are ***salt brines*** containing ***bromides***, ***salt lakes***, and ***sea brines***. ***K-Mg chloride salts*** are of less importance.

The principal contemporary applications of **bromine** are the production of flame retardants, sanitary preparations as well as agriculture, the petrochemicals industry, drilling, etc.

Sources

Bromine and ***iodine/bromine brines*** of possible commercial significance occur in many places around the country. Some Zechstein and older Paleozoic waters contain 2–3 g/l of ***bromine***. However, until now only Tertiary ***brines*** have been utilized. The **Łapczyca** deposit, east of Cracow (static reserves of ca. 32 Mm^3) and the **Dębowiec** deposit in western Carpathians (reserves of 74,130 m^3/h), are of primary importance. Total investigated domestic reserves are estimated at 7,200 t of ***Br*** and 32.20 Mm^3 of ***iodine-bromine brines***, while static reserves in the so-called **Gdów bay**, i.e. on the area of 49 km^2 are estimated at ca. 76 Mm^3.

Production

There is no domestic pure ***bromine*** production. Only ***cosmetic*** and ***curative salts*** enriched in Br and J are obtained by simple pan evaporating method from Miocene highly saturated brines of the **Łapczyca** deposit by the **Iodine-Bromide Brine Processing Plant Salco**. These brines are extracted from the depth of 1,200 m below the ground level. Between 2008 and 2012 the salt production increased by 21%, exceeding 900 tons (Tab. 1). Small amounts of such salt have been also occasionally obtained from the **Dębowiec** deposit. The recovery of ***bromine*** and ***iodine*** from brines and salty waters, including those which are discharged into rivers and streams by some health resorts (e.g. Rabka) and by the coal mines of the Upper Silesian Coal Basin, has been under examination.

Tab. 1. Iodine-bromide salt production in Poland

t

Year	2008	2009	2010	2011	2012
Production	745	874	870	893	902

Source: ***producer's data***

Trade

As ***bromine*** is not produced in Poland, all the domestic demand is satisfied by imports. In the years 2008-2011 the volume of deliveries ranged between 6 and 17 tpy, while in 2012 it soared to 66 tons. Ukraine has been regular and almost exclusive supplier of bromine to Poland (Tab. 2). Reported exports in the range of 4-10 tpy, predominantly to the Czech Republic and Hungary, has been probably the re-exports of the commodity surpluses (Tab. 2). The trade balance of ***bromine*** was consistently negative. In 2012, following the importation increase, it deepened significantly (Tab. 2, 3).

Tab. 2. Bromine statistics in Poland — CN 2801 30 90

t

Year	2008	2009	2010	2011	2012
Imports	**11**	**6**	**17**	**11**	**66**
Ukraine	11	6	17	11	66
Others	–	0	0	0	0
Exports	**5**	**5**	**10**	**7**	**4**
Czech Republic	4	2	7	2	1
Hungary	–	3	3	4	2
Others	1	–	0	1	1
Consumption[a]	**6**	**1**	**7**	**4**	**62**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of bromine trade in Poland — CN 2801 30 90

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	49	72	136	143	96
Imports	109	74	193	185	1,313
Balance	**-60**	**-2**	**-57**	**-42**	**-1,217**

Source: ***The Central Statistical Office (GUS)***

In 2008-2012 the unit values of ***bromine*** imports to Poland almost doubled (in PLN/t). In USD/t these values increased by ca. 46%, which corresponded to the world prices (Tab. 4).

Tab. 4. Unit value of bromine imports to Poland — CN 2801 30 90

Year	2008	2009	2010	2011	2012
PLN/t	10,082	11,966	11,130	16,356	19,772
USD/t	4,175	3,995	3,643	5,942	6,106

Source: ***The Central Statistical Office (GUS)***

Consumption

Bromine is utilized basically in the form of compounds, for the production of flame retardants and sanitary preparations, in the pharmacy and cosmetics. In 2012 the apparent consumption increased up to 64 tons as a result of huge Ukrainian deliveries (Tab. 2).

Companies involved in bromine commodities production in Poland as of December 2012

- Zakład Przeróbki Solanek Jodowo-Bromowych Salco S.C. (Iodine-Bromide Brine Processing Plant Salco), 32–744 Łapczyca 445, tel. +48 14 6127519, fax. +48 14 6127922, www.salco.pl — *curative and cosmetic iodine-bromide salts*.

CADMIUM

Overview

Cadmium (**Cd**) is recovered as a byproduct of ***zinc*** refining, due to its association with zinc in concentrates of ***sphalerite*** (ZnS) and related sulphide ore minerals. Cadmium is used primarily for Ni-Cd batteries, while other uses, e.g. corrosion resistant coatings, pigments in thermoplastics, ceramics, glazes, etc. are limited due to cadmium toxicity.

Sources

Cadmium occurs as an associated element in the ***zinc*** and ***lead ores*** of the **Silesia-Cracow** deposits (0.01–0.05% Cd). The reserves of ***cadmium*** amount to 39,940 t, including around 15,780 t in deposits currently operated (as of 31 December 2012).

Production

The only domestic manufacturer of metallic cadmium is the **Miasteczko Śląskie Smelter**. ***Refined cadmium 99.95%*** is recovered from the waste Zn-Cd alloy generated in zinc rectification, as well as from cadmium-bearing slime coming from ZGH Bolesław zinc smelter. Upon 2008-2012 the production of refined cadmium varied from 600 to 370 tpy, generally showing the decreasing tendency, except for 2011 when it reached almost 530 tons (Tab. 1).

Tab. 1. Cadmium commodities statistics in Poland

t

Year	2008	2009	2010	2011	2012
Cadmium: metal, powder CN 8107 20, 8107 90					
Production	603	534	451	526	370
Imports	0	1	1	2	4
Exports	552	497[r]	449	526	370
Consumption[a]	51	38[r]	3	2	4
Cadmium waste and scrap					
CN 810730					
Imports	–	–	–	–	1
Exports	–	5	31	49	22

Cadmium oxide CN 2825 90 60					
Production	25	31	36	29	40
Imports	0	0	0	18	8
Exports	14	31	36	45	46

Source: ***The Central Statistical Office (GUS)***

Another important cadmium commodity produced in Poland is ***cadmium oxide*** (min. 98% CdO). It has been manufactured at the **Oława Smelter**, since 2008 being a division of **ZM Silesia (Impexmetal Group)**. In recent years the output of CdO has been gradually increasing (except 2011), approaching 40 t in 2012 (Tab. 1). The plant basically has utilized scrapped FeCd plates from giant NiCd accumulators, delivered by the **MarCo Ltd.** of **Rudniki**, and to a smaller degree — from ***metallic cadmium*** manufactured at **Miasteczko Śląskie Zinc Smelter**, as well as spent portable small-size NiCd batteries. In 2008 the plant got a new foreign recipient, i.e. the Czech's Bochemie a.s. of Bohumil — the producer of accumulator masses etc., which since then has become the major its customer. That has helped to survive the cadmium plant in new market circumstances, i.e. after implementation of the UE directive **REACH — Registration, Evaluation, and Authorization of Chemicals** in Poland (June 2007). According to current regulations referring to spent batteries management, their manufacturers are required to take responsibility for used rechargeable batteries and either recycle or dispose them in environmentally sound manner. As a result a number of companies involved in collecting of NiCd batteries emerged, e.g. **Reba**, **Eurobac**, **Clean Environment**, **Ekola**, **Polish Recycling Group Proeko**, etc. According to the EU directive **2006/66/EU** the index of small-dimension batteries collection until 2012 should reach 25%, and until 2016 — 45%, while the index of recycling of NiCd batteries and accumulators is expected to approach 75% in 2011.

Trade

Due to the development of domestic ***refined cadmium*** production, its importation to Poland has become insignificant. Small supplies, ranging in recent years from 1 to 4 tpy, originated basically from western European countries, i.e. France, Germany, Spain, and – on irregular basis – the USA (Tab. 1). Simultaneously, the exportation of cadmium, constituting the majority or even 100% of the Miasteczko Ślaskie output, varied from 370 to 550 tpy. Its principal recipients were China and Belgium. The trade balances of cadmium have been positive and have ranged from ca. 2 to 6 million PLN per annum (Tab. 2). Another important cadmium trade commodity used to be ***cadmium oxide*** (Tab. 1). Its exportation, which almost delayed in 2006-2007, in the following years revived, increasing most recently to 45-46 tpy. As a consequence, the value of cadmium oxide turnover started to grow, exceeding 330,000 PLN in 2012 (Tab. 2). An issue worth noting is the regular exportation of ***waste and scrap of unwrought cadmium and its powders*** from Poland that in recent years has ranged from 20 to 50 tpy (Tab. 1). Its only recipient has been Germany.

Tab. 2. Value of cadmium commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Cadmium: metal, powder CN 8107 20, 8107 90					
Exports	6,048[1]	4,887[r]	5,265	4,686	1,842
Imports	24	80[r]	67	84	108
Balance	**+6,024**	**+4,807[r]**	**+5,198**	**+4,602**	**+1,734**
Cadmium oxide CN 2825 90 60					
Exports	175	242	275	642	531
Imports	1	3	1	386	199
Balance	**+174**	**+239**	**+274**	**+256**	**+332**

[1] in 2008 the trade value of exports was given for **CN 8107**

Source: ***The Central Statistical Office (GUS)***

The unit values of ***cadmium metal*** exportation varied significantly depending on the volume of sales and the world price trends. They increased spectacularly in 2008 and 2010 due to high cadmium international prices, which over the last two years were declining as the market conditions for metals deteriorated (Tab. 3).

Tab. 3. Unit value of cadmium exports from Poland — CN 8107 20, 8107 90

Year	2008[1]	2009	2010	2011	2012
PLN/t	10,966	8,359[r]	11,728	8,832	5,036
USD/t	4,754	2,699[r]	3,841	3,002	1,543

[1] in 2008 the unit value of exports was given for **CN 8107**

Source: ***The Central Statistical Office (GUS)***

Consumption

The detailed consumption structure of ***cadmium*** in Poland is unknown. The demand is met mainly by domestic suppliers. ***Cadmium commodities*** used to be utilised in the production of bearing alloys, low-melting alloys, and soldering alloys, as well as pigments and coloring agents for special grades of glass. Another cadmium's main end-use has been in batteries but this sector has been in decline – nickel-cadmium batteries for use in laptop computers and mobile phones are being phased out in favour of lithium-ion units. In recent years worries over toxicity have spurred various legislative efforts, especially in the EU, to restrict the use of cadmium in most of its end-use applications. In PVC, jewellery and soldering it has been banned since 2011. The consumption of ***cadmium metal*** in Poland has declined to 2-4 tpy (Tab. 1). ***Cadmium oxide*** used to be utilised for the production of ***cadmium pigments*** at one of the major domestic manufacturer of chemicals — **Permedia S.A.** of **Lublin**, but this commodity usage has been ceased. Since 2008 the largest recipient of cadmium oxide made in Poland has become the **Bochemie Group** of the Czech Republic, which utilises that compound for manufacturing of accumulator masses.

Companies involved in cadmium commodities production in Poland as of December 2012

- Huta Cynku Miasteczko Śląskie (Miasteczko Śląskie Zinc Smelter), 42–610 Miasteczko Śląskie, ul. Hutnicza 17, tel. +48 32 2888444, fax +48 32 2851687, www.hcm.com.pl — *refined cadmium*.
- ZM Silesia S.A., Oddział Huta Oława (Metallurgical Plant Silesia Joint Stock Company, Oława Smelter Division), 55–200 Oława, ul. Sikorskiego 7, tel. +48 71 3187301, fax +48 71 3134035, hutaolawa.pl — *cadmium oxide.*

CALCIUM

Overview

Calcium (**Ca**) is one of the most common elements in the lithosphere. **Calcium metal** containing at least 98% Ca is obtained through the electrolysis of **fused calcium chloride**, or by using the aluminothermal method (roasting a mixture of ***pure calcium oxide*** with ***aluminum powder*** at 1,300^{o}C). **Calcium compounds** are produced from calcium minerals and rock, not from calcium metal.

Calcium is applied as a reducing agent in the production of uranium and as a source of hydrogen (***calcium hydride***), which is used in meteorology for sounding balloons. Due to its application in the nuclear industry, calcium is considered a strategic metal.

Sources

In spite of large reserves of ***limestone*** and ***calcite*** in Poland, ***calcium*** is not recovered.

Production

Calcium is not produced in Poland.

Trade

Domestic demand is entirely satisfied by variable amounts of imported ***calcium metal*** from China, Western Europe, Canada, and/or from Russia and Slovakia (Tab. 1). In the years 2008–2012, there was recorded re-exports of calcium metal: in the period 2008–2010 at the stable level of 13–17 tpy, but in the years 2011–2012 increasing significantly, up to the record of 260 t in 2012 (Tab. 1). Exports of ***calcium metal*** were directed mainly to Czech Republic, Slovakia, Romania (especially for 2012), Hungary, and few other countries. The balance of ***calcium metal*** trade in the years of 2009–2011 has been negative (Tab. 2), depending on the volume and value of imports, as well as on the volume and value of re-exports (Tab. 3). High exports volume recorded in 2008 and in 2012 has turned the trade balance into positive values (Tab. 2), despite the quite high difference between unit values of imports and of exports recorded by Central Statistical Office (Tab. 3).

Consumption

The consumption pattern in Poland is unclear (due to the lack of data). In recent years, it probably was not exceeding a few tpy. In period 2008–2009 and in 2012, apparent consumption was even negative (Tab. 1).

Tab. 1. Calcium metal statistics in Poland — CN 2805 12

t Ca

Year	2008	2009	2010	2011	2012
Imports	7.6	12.6	30.2	110.2	183.4
Exports	13.4	17.4	15.6	52.6	259.5
Consumption[a]	**-5.8**	**-4.8**	**14.6**	**57.6**	**-76.1**

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of calcium metal trade in Poland — CN 2805 12

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	141	164	137	515	2,476
Imports	107	194	387	1,291	2,335
Balance	**+34**	**-30**	**-250**	**-776**	**+141**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit value of calcium metal imports to Poland — CN 2805 12

Year	2008	2009	2010	2011	2012
PLN/t	14,079	15,397	12,842	11,712	12,732
USD/t	5,974	4,890	4,324	3,991	3,874

Source: ***The Central Statistical Office (GUS)***

CARBON BLACK

Overview

Carbon black consists of fine grains of carbon created by the incomplete combustion of ***acetylene***, ***natural gas*** (currently the main source) and ***naphthalene***, ***oils***, etc. This provides carbon black that can be used as a black pigment and in the rubber industry (90–95% of the entire consumption).

Sources

The main sources for ***carbon black*** production are natural gases. Acetylene, naphthalene, and others are of minor importance.

Production

The largest ***carbon black*** producer in Poland — since 2000 — is **Orion Engineered Carbons Ltd.** of Jasło (former **Evonik Carbon Black Polska Ltd.**), belonging to German chemical company **Evonik Industries AG** (main shareholder — **RAG AG** of **Essen**). It operates modernized, former Carbon Black Production Unit of the Jasło Oil Refinery. One old production line was modernized, another new production line was constructed. As a result, domestic production — after a few years of declining tendency — rose since 2004 to the level reported for the last time in the 1980s, i.e. over 36,000 t in 2008. Lower domestic demand in 2009 resulted in production decline to ca. 27,800 t. In the years 2010–2011 production recovered to ca. 45,000 t, while in 2012 r. it was sharply reduced to 11,100 t (Tab. 1).

Tab. 1. Carbon black statistics in Poland — CN 2803

‘000 t

Year	2008	2009	2010	2011	2012
Production	36.3	27.8	34.7	45.0	11.1
Imports	116.8	127.7	264.3	286.6	276.2
Exports	42.7	53.4	125.9	147.6	150.9
Consumption[a]	110.4	102.1	173.1	184.0	136.4

Source: ***The Central Statistical Office*** *(GUS)*

Trade

Poland traditionally is net importer of ***carbon blacks***. In the years 2004–2009 purchases on covering on carbon blacks domestic demand stabilized at 70,000–74,000 tpy.

The rest of imported carbon blacks, and maybe some part of domestic production were exported. In the years 2010-2012 significant changes occurred. ***Carbon black*** trade volumes radically changed: imports rose up to record volumen in 2011 – ca. 286,600 t, while exports (mainly re-exports) to 150,900 t in 2012 (Tab. 1). As a consequence, net imports rose to 138,400–139,000 t in 2010–2011, and decreased to 125,300 t in 2012. It is probable that a part of imported carbon black went into stocks (lack of data). Imports from Russia rose over two times, from the Czech Republic - three times, while minor quantities came from Ukraine, Hungary, Sweden and Germany (Tab. 2). However, Polish companies started to be important traders of cheap Russian, Czech, Ukrainian and Hungarian carbon black on the European market. The largest recipients of carbon black from Poland are Germany, France, the Czech Republic, Luxembourg and Slovakia (Tab. 3).

Tab. 2. Polish imports of carbon black, by country — CN 2803

'000 t

Year	2008	2009	2010	2011	2012
Imports	**116.8**	**127.7**	**264.3**	**286.6**	**276.2**
Belgium	0.3	0.1	0.0	0.3	0.0
China	0.1	0.0	0.1	1.2	1.6
Czech Republic	19.5	19.2	60.3	71.4	55.6
France	2.7	2.4	2.9	2.1	1.1
Germany	3.5	4.3	6.5	3.7	3.0
Hungary	10.6	6.7	10.3	22.2	14.9
Italy	0.3	2.4	0.9	1.8	1.5
Netherlands	0.2	0.3	0.2	0.1	0.0
Russia	58.3	76.1	145.2	155.9	178.3
Sweden	3.6	4.7	25.7	3.7	2.1
Thailand	–	0.0	0.3	1.2	1.1
Ukraine	13.6	9.3	10.5	20.8	16.2
United Kingdom	3.0	0.3	0.2	0.2	0.1
Others	1.1	1.9	1.2[r]	2.0	0.7

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Polish exports of carbon black, by country — CN 2803

'000 t

Year	2008	2009	2010	2011	2012
Exports	**42.7**	**53.4**	**125.9**	**147.6**	**150.9**
Austria	9.8	11.3	4.1	4.3	2.3
Belgium	0.5	0.7	1.8	1.7	1.7
Brazil	0.0	0.1	0.0	0.0	0.1
Czech Republic	3.3	8.6	17.8	13.5	4.9
Finland	0.1	–	0.1	1.8	1.3
France	3.3	8.2	14.6	17.0	16.8

Germany	10.1	13.0	48.8	55.8	64.5
Hungary	2.1	0.6	0.9	4.1	3.0
Italy	1.3	1.1	2.1	4.6	7.3
Latvia	0.0	0.1	3.0	0.0	0.1
Luxembourg	–	0.0	7.9	10.2	11.8
Netherlands	0.8	0.8	5.1	6.9	7.0
Portugal	0.0	0.1	0.0	0.3	3.2
Romania	0.2	0.4	–	0.3	2.7
Slovakia	5.0	6.0	10.1	12.2	4.4
Slovenia	–	0.0	7.3	8.9	7.5
South Africa, Republic of	4.5	0.2	0.0	0.8	–
Spain	0.5	0.4	0.2	0.3	4.8
Sweden	0.2	0.1	1.3	1.5	1.5
USA	0.0	0.0	–	0.0	3.2
Others	1.0[r]	1.7[r]	0.8[r]	3.4	2.8

Source: ***The Central Statistical Office*** *(GUS)*

The trade balance of ***carbon black*** in Poland has been consistently negative (Tab. 4). In the years 2010-2012, it deepened by ca. 91% due to rapid growth of imports volume and some growth of imports unit values, partly limited by higher exports unit values and some exports volume growth (Tab. 5).

Tab. 4. Value of carbon black trade in Poland — CN 2803

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	130,954	158,258	478,799	733,828	808,864
Imports	326,104	326,730	744,930	973,647	1,130,411
Balance	**-195,150**	**-168,472**	**-266,131**	**-239,819**	**-321,547**

Source: ***The Central Statistical Office*** *(GUS)*

Tab. 5. Average unit values of carbon black trade in Poland — CN 2803

Year	2008	2009	2010	2011	2012
Exports unit values					
PLN/t	3,067.1	2,965.3	3,803.5	4,972.2	5,359.9
USD/t	1,312.7	971.3	1,264.1	1,695.6	1,640.4
Imports unit values					
PLN/t	2,791.3	2,559.4	2,819.0	3,397.3	4,092.3
USD/t	1,186.0	836.1	935.9	1,154.2	1,253.2

Source: ***The Central Statistical Office*** *(GUS)*

Consumption

Carbon black is used primarily in the rubber industry as a ***filler***. The consumption volume of carbon black is strongly correlated with the production of ***rubber products*** (especially synthetic rubber).

Companies involved in carbon black production in Poland as of December 2012

- Orion Engineered Carbons Sp. z o.o. w Jaśle (Orion Engineered Carbons Ltd. of Jasło), ul. 3 Maja 83, 38–200 Jasło, tel. +48 13 446 63 90, fax. +48 13 446 64 97, www.orioncarbons.com — *carbon black*.

CEMENT

Overview

Cement is an important binding agent in concrete and mortars, and one of the critical materials in the construction industry. **Portland cement** is currently the most important type of cement. An important semi-product for the production of Portland cement is **cement clinker**, which is obtained by fusing a mixture of finely ground raw materials in a kiln at a temperature of about 1,400°C. The basic raw materials required for this production are, in order of importance, ***carbonate rocks*** (***limestone*** and ***marl***), ***clay materials*** (***clay***, ***silt***), and ***iron ore***. The clinker is ground with small amounts (typically 3–4%) of calcium sulfate, usually ***gypsum*** or ***anhydrite***, to make Portland cement. Besides the most common **Portland cement without additives**, a growing importance of **Portland cements with additives** is observed. Such additives, e.g. ***blast furnace slag***, ***blast furnace ash***, ***silica dust***, ***flow dust*** from power stations, ***tuff***, ***pozzolan***, and others, are used in these grades. Other grades of cement — apart from Portland cement — are of less importance. The most common are: **aluminous cement**, **Sorel cement**, **Roman cement**, etc.

Sources

Primary sources

The basic primary raw materials for ***cement clinker*** and — consequently — ***cement*** production are: ***limestones***, ***marls***, and ***clays***. Their deposits are geologically widespread and abundant in Poland. The ***limestone*** and ***marl*** deposits ***for cement industry*** are located mainly in the central and southern part of the country, where the majority of cement plants operate. The total resources of 70 deposits recognized for this industry amounted to 12,792 Mt (as of 31 December 2012), including 4,130 Mt in 18 developed deposits (including two operated periodically - Podgrodzie and Strzelce Opolskie I). The largest deposits are located in the Lubelskie voivodeship (3.4 billion t of Cretaceous chalk, marls) and the Świętokrzyskie voivodeship (2.2 billion t, mainly of Devonian and Jurassic limestones). Large reserves occur also in the Łódzkie and Mazowieckie voivodeships (1.9 and 1.5 billion t, respectively), while the smaller ones in the Kujawsko-Pomorskie voivodeship (northern Poland), as well as Opolskie and Śląskie voivodeships (southern Poland).

Clay deposits ***for cement industry*** are recognized in the same regions as limestone and marls. There are 29 deposits with resources over 276 Mt (as of 31 December 2012). In last two years extraction was carried out only in the **Izbica V**, **Lechówka dz. 104/1**, **Lechówka dz. 97/1, 101/1** deposits in 2011, while in 2012 also in the **Lechówka**

dz. 102/1 deposit. The level of such temporary exploitation indicates that secondary materials are the principal source of alumina-bearing raw materials for the cement industry.

Gypsum and ***anhydrite*** are important additives, which regulate binding time of cements. Their total consumption for this purpose rose to 758,900 t in 2010, in which about 59% makes the ***synthetic gypsum*** (***FGD gypsum***). Since 2009, the quantity of synthetic gypsum has exceeded the amount of natural gypsum used in the cement industry. Data from 2011 and 2012 are not available.

Secondary sources

The importance of secondary raw materials in the cement industry is still growing. Their shares in cement production are higher year by year. In 2010, ca. 4,809,600 t of various waste materials were used as recycled material for cement and clinker production (the data from 2011 and 2012 are not yet available). The most important waste materials for the cement and the cement clinker production are:

- ***limestone mining*** and ***processing wastes*** in cement-lime plants (e.g. at the Kujawy, Górażdże and Nowiny plants, in amount of 0.29-0.30 Mtpy);
- ***fly ash*** from power plant used in the majority of cement plant mainly to cement production, in small amount to clinkier production (in amount of 1.85-1.96 Mtpy);
- ***iron-bearing wastes*** (dusts, slimes, siderite, etc. e.g. at the Warta, Kujawy, Ożarów, Chełm plants, total of 0.23-0.25 Mtpy);
- ***carbonaceous shale*** (ca. 0.25 Mtpy, e.g. at the Warta, Górażdże, and Chełm plants);
- ***blast furnace slag*** (mainly for the production of metallurgical cement in amounts of 1.33-2.00 Mtpy consumed in the majority of plants);
- ***FGD gypsum*** (0.28-0.45 Mtpy, mainly in Górażdże, Kujawy, Warta and Odra lants).

Cement plants use industrial wastes not only as a raw material in the production of cement clinker and cement, but also as an ***alternative fuel*** for clinker burning. In 2004, almost 201,000 t of alternative fuels were spent, while in 2010 about 982,000 t. Their share in fuel generation in cement plants rose from less than 2% in 2001 to 39% in 2010.

Production

The occurrence of the majority of ***limestone*** and ***marl*** deposits ***for cement industry*** in the central and southern parts of the country determined location of cement plants (Tabs. 1 and 2). In 2012, there were 11 ***cement plants*** operating full production lines (including cement clinker kilns), and one **Górka** plant — the sole producer of high-alumina cement (which production was based on the limestones raw materials and imported bauxite and alumina). At the market worked also the cement mill - Ekocem in Dąbrowa Górnicza belonging to the Górażdże Group, and three marine or land terminals: **Warszawa** belonging to **Dyckerhoff Group** and two belonging to **Cemex Group** marine terminal in **Gdynia** and **Szczecin** (Tab. 2). The **Dyckerhoff Group** has also additional potential of cement mill located in **Detmarovice** near the border of the Czech Republic.

Tab. 1. Cement clinker and cement statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Cement clinker CN 2523 10					
Production	12,443	10,659	11,768	13,629	11,807
Imports	270	38	100	20	8
Exports	171	129	83	44	100
Consumption[a]	12,542	10,568	11,785	13,605	11,715
Cement CN 2523 21–90					
Production	17,207	15,537	15,812	18,993	15,919
• *Portland cement without additives*	*5,558*	*5,168*	*5,285*	*7,000*[s]	*5,900*[e]
• *Portland cement with additives*	*10,255*	*9,000*	*8,645*	*9,500*[s]	*7,900*[e]
• *metallurgical cement*	*1,147*	*1,369*	*1,592*	*1,300*[s]	*1,200*[e]
Imports	739	494	595	991	690
• *Portland cement*	*712*	*473*	*568*	*972*	*674*
• *metallurgical cement*	*27*	*21*	*27*	*19*	*15*
Exports	417	439	445	381	330
• *Portland cement*	*339*	404	423	363	302
• *metallurgical cement*	*78*	35	22	18	28
Change of stocks	25	*-130*	*-44*	*50*	.
Consumption	17,504	15,462	15,918	19,653	16,279

Source: ***The Central Statistical Office (GUS)***

Almost all currently operating cement plants, as a result of the privatization process, were undertaken by large international cement concerns (Tab. 2). The largest shares in the domestic cement market have: **HeidelbergCement** (24%), **Lafarge** (21%), **CRH** (17%), **Cemex** (15%), **Dyckerhoff** in structure of **Buzzi Unicem's** (9%), **Polen Zement** (8%), **Miebach Projekt** (4%), and **Nowa Huta** (under 2%). After a turbulent period of privatization and multiple changes of owners, since June 2010, the owner of the last one cement plant is Cementownia Kraków Nowa Huta Ltd.

At present, all cement plants operating in Poland have been practically completely modernised, with applying of the best available technologies. This resulted in increasing share of dry method of clinker production from under 40% in 1990 to 98% unchangeable from 2003. In 2010 in the Polish cement industry worked 18 lines of dry production method (including one in reserve) and 2 lines of wet production method. The production capacity of dry furnaces in the cement industry amounts to ca. 14.7 mln tpy of clinker, while the wet kilns only 0.9 mln t per year. The cement production capacity could reach 24 Mtpy. In the future due to disadvantageous market conditions, rising energy and fuels prices, and restrictions resulting from emissions trading system, a new investments expanding production capacity should not be expected.

Tab. 2. Structure of cement industry in Poland in 2012

Mt

Main owner	Company	Cement plants	Primary raw materials		Production[1]	
			Deposits	Output	Clinker	Cement
• **HeidelbergCement** (Germany)	**Górażdże Cement S.A.** **Ekocem Sp. z o.o.**	Górażdże Ekocem (Dąbrowa G.)[2]	Górażdże **(l)**, Opole-Folwark **(m)**, Strzelce Opolskie **(l)** –	4.31	2.44	3.71
• **Lafarge** (France)	**Lafarge Cement S.A.**	Małogoszcz Kujawy	Leśnica-Małogoszcz **(l)** Barcin-Piechcin-Pakość **(l)**	8.75	2.43	3.29
• **CRH** (Ireland)	**Grupa Ożarów S.A.**	Ożarów Rejowiec	Gliniany-Duranów **(m)** Rejowiec **(m)**	3.78	2.21	2.66
• **Cemex** (Mexico)	**Cementownia Chełm S.A.** **Cementownia Rudniki S.A.** **Cem-Con Szczecin, CBC Gdynia**	Chełm Rudniki Szczecin[3], Gdynia[3]	Chełm **(ch)** Latosówka-Rudniki II **(l)**, Rudniki-Jaskrów **(l)** –	2.60	1.82	2.11
• **Dyckerhoff/Buzzi Unicem's** (Italy/Germany)	**Cementownia Nowiny Sp. z o.o.**	Nowiny Warszawa[3]	Kowala **(l)** –	1.54	1.05	1.39
• **Polen Zement** (Germany)	**Cementownia Warta S.A.**	Warta	Działoszyn-Trębaczew **(l)**, Niwiska Górne-Grądy **(l)**	2.47	1.32	1.35
• **Miebach Projekt** (Germany)	**Cementownia Odra S.A.**	Odra	Odra II **(l)**	0.64	0.35	0.73
• **Cementownia Kraków Nowa Huta** (KEM)[4]	**Cementownia Nowa Huta**	Nowa Huta	Purchase of raw materials	–	0.08	0.27
• **Mapei** (Italy)	**Cementownia Górka Sp. z o.o.**	Górka	Purchase of raw materials and imports of bauxite	–	0.05	0.05

[1]*data from 2010 - the most recent data available from the* ***Association of Cement Producers*** *at the time of publication preparation,* [2] milling plants only, [3] land or marine terminal, [4] declared bankruptcy in 2008, and in 2009 the production was undertook based on the property of lease by the company EMC from Dąbrowa Górnicza

Legend: **(ch)** — chalk, **(l)** — limestone, **(m)** — marl

Source: ***Association of Cement Producers****,* ***Mineral Deposits Datafile****,* ***Central Statistical Office*** *(GUS)*

In the last five years the production of cement and clinker has shown considerable fluctuations (Tab 1). A significant decrease in production was recorded in 2009 when the level of cement production was reduced by almost 10% to 15.5 Mt, and was even more evident in the production of clinker - a fall of over 14% to 10.6 Mt (Tab. 1). In 2010, cement production level increased slightly less than 2% to 15.8 Mt, whereas the clinkier supply rose by more then 10% to 11.7 Mt (Tab 1). Due to the accumulation of many beneficial economic effects associated with the use of EU funds in infrastructure and with many investments in preparation for Euro 2012, in 2011 the significant recovery in cement production was recorded to the level of nearly 19 Mt (20% increase compared to 2011) and clinker production – to more than 13.6 Mt (Tab 1). However, in the next year, especially its second half, a significant slowdown in the Polish economy was recorded, with a decrease in the production of cement by 16% to 15.9 Mt. However this figure is still higher than the result obtained in 2010 (Tab. 1).

The commodity structure of cement production is dominated by ***Portland cement with additives*** (**CEM II**), which share in total cement production amounted to 53-56% shares in sales in last two years. ***Portland cement without additives (CEM I***) made about 34-39% of shares, and metallurgical cement (CEM III) only 10%. Due to implementation of large investments, the demand for cement with higher strength has increased year by year. Construction of large investments had an influence on increase of bulk cement sales to about 78% during last years.

Trade

The ***cement clinker*** is exported but in smaller amounts than cement. The level of clinker exports in the last five years, ranged from 44,000 to 171,000 tpy (Tab. 3). The main importers of Polish clinker are our eastern and southern neighbours: Czech Republic, Slovakia and Ukraine (Tab. 3).

Tab. 3. Polish cement clinker exports, by country — CN 2523 10

'000 t

Year	2008	2009	2010	2011	2012
Exports	**171**	**129**	**83**	**44**	**100**
Austria	–	0	–	0	–
Czech Republic	118	96	70	43	72
Estonia	18	–	–	–	–
Germany	1	1	–	1	2
Latvia	33	–	–	–	–
Lithuania	–	–	3	0	0
Slovakia	–	12	–	0	–
Ukraine	0	19	9	–	26

Source: ***The Central Statistical Office (GUS)***

The level of clinker imports, recently did not exceed 100,000 tpy, except of the 2008 when it increased to 270,000 t. Deliveries came primarily from Germany but in 2010 the Czech Republic became the most important supplier due to the very low unit values of clinker imported from this country (Tab. 4). The growth in imports resulted in a negative trade balance of the cement clinker, with two exceptions in 2008 and 2010 (the highest level of imports, Tab. 4), when it was positive (Tab. 7).

Tab. 4. Polish cement clinker imports, by country — CN 2523 10

'000 t

Year	2008	2009	2010	2011	2012
Imports	**270**	**37**	**100**	**20**	**8**
Czech Republic	7	10	82	–	–
Germany	263	27	18	17	8
Ukraine	–	–	–	3	–

Source: ***The Central Statistical Office (GUS)***

Poland has traditionally exported ***cement*** to many countries. The volume of sales during last four years ranged between 330,000–445,000 tpy. Similarly as in case of clinker, the main importers of Polish cement in recent years became neighbouring countries, especially Russia, the Czech Republic, Germany, and Slovakia (Tab. 5), although in 2009-2010 the significant amounts of cement have also been sold to Finland, Italy and Hungary.

Tab. 5. Polish exports of cement, by country — CN 2523 21–90

'000 t

Year	2008	2009	2010	2011	2012
Exports	**417**	**439**	**445**	**381**	**330**
Austria	3	5	9	9	3
Belgium	1	1	0	2	2
Belarus	1	2	1	1	4
Czech Republic	92	106	165	116	69
Finland	0	49	4	–	–
Germany	69	69	0	56	58
Hungary	7	19	1	1	1
Italy	22	23	22	24	21
Latvia	21	0	0	1	3
Lithuania	16	0	0	0	0
Netherlands	0	0	0	1	1
Norway	4	4	1	0	0
Russia	147	43	48	88	93
Slovakia	27	114	123	76	60
Ukraine	2	1	1	1	1
Others	5	3	10	5	14

Source: ***The Central Statistical Office (GUS)***

The last five years, except for 2009, has brought a significant increase in imports of cement, to over 500,000 tpy, with a maximum of 991,000 t in 2011. This significant growth of imports caused that the share of foreign suppliers in the domestic market reached more than 5% in 2011, and the volume of imports exceeded the volume of exports in the whole analyzed period, resulting in negative trade balance of this material, with exception for 2009, when the level of imports was relatively the lowest (Tab. 5, 6, 7). Regarding imports, the ***special types*** and the ***highest grades of cements*** predominated, purchased mainly from Germany (over 37%), Belarus and Slovakia, as well as from the Czech Republic in last year (Tab. 6).

Tab. 6. Polish imports of cement, by country — CN 2523 21–90

'000 t

Year	2008	2009	2010	2011	2012
Imports	**739**	**494**	**595**	**991**	**690**
Belgium	2	2	1	1	0
Belarus	3	120	137	107	15
Croatia	3	1	0	0	0
Czech Republic	56	23	87	249	146
Denmark	61	51	58	73	75
France	4	3	4	5	4
Germany	556	208	195	367	247
Lithuania	0	1	25	39	30
Slovakia	49	85	83	149	172
Ukraine	0	–	4	0	–
Others	4	1	1	1	1

Source: ***The Central Statistical Office (GUS)***

Tab. 7. Value of cement and cement clinker trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Cement clinker CN 2523 10					
Exports	32,824	28,241	16,199	7,915	18,046
Imports	38,613	13,100	17,621	5,373	2,309
Balance	**-5,789**	**+15,141**	**-1,422**	**+2,542**	**+15,737**
Cement CN 2523 21–90					
Exports	158,206	188,889	172,838	183,328	195,097
Imports	206,434	168,385	174,930	275,304	204,357
Balance	**-48,228**	**+20,504**	**-2,092**	**-91,976**	**-9,260**

Source: ***The Central Statistical Office (GUS)***

The average unit values of ***cement clinker*** for both imports and exports are distinctly higher than those produced in the country (Tab. 8). The average unit values of ***Portland cements*** imports were usually 13-16% lower than domestic prices, with exception for

2009 (Tab. 8). The average unit values of ***Portland cements*** exports usually lower than these in the domestic market until 2008, rose significantly to above 611 PLN/t in 2012 (Tab. 8). The small difference in unit values of imports and production observed until 2008 for ***metallurgical cements*** began significantly deepen from 2009 and in 2012 the exports unit values were over 10% higher than the domestic prices (Tab. 8). The average unit values in imports of metalurgical cements, usually higher than exports ones, in 2008 and 2011 almost doubled and in 2009 almost threefold exceeded the unit values of exports and domestic production (Tab. 8).

Tab. 8. Average unit values of cement and cement clinker production and trade in Poland

Year	2008	2009	2010	2011	2012
Cement clinker CN 2523 10					
Production average unit values					
— PLN/t	126.5	122.7	131.8	145.4	147.8
— USD/t	52.5	39.4	43.8	49.1	45.4
Exports average unit values					
— PLN/t	191.5	218.6	195.8	178.5	181.0
— USD/t	81.8	72.1	64.3	63.2	54.9
Imports average unit values					
— PLN/t	142.9	347.7	175.6	270.0	292.4
— USD/t	61.5	111.2	58.1	92.3	89.4
Portland cement CN 2523 29					
Production average unit values					
— PLN/t	283.8	286.0	260.9	271.6	266.2
— USD/t	117.8	91.8	86.7	91.7	81.7
Exports average unit values					
— PLN/t	256.3	444.7	398.6	487.3	611.1
— USD/t	111.8	143.8	131.5	168.0	187.0
Imports average unit values					
— PLN/t	232.6	283.7	229.8	234.3	231.6
— USD/t	100.9	91.0	74.9	80.5	71.3
Metallurgical cement CN 2523 90 10					
Production average unit values					
— PLN/t	237.4	215.2	196.6	.	277.5
— USD/t	98.5	69.1	65.3	.	85.2
Exports average unit values					
— PLN/t	238.7	261.7	210.3	327.2	305.4
— USD/t	103.3	81.1	68.2	113.2	93.5

Imports average unit values					
— PLN/t	482.4	786.4	440.3	372.6	327.4
— USD/t	201.7	249.8	144.7	127.6	100.6

Source: ***The Central Statistical Office (GUS)***

Consumption

The financial crisis, effects of which began to be felt by the industry in the end of 2008, caused a significant slowdown of growth, and lower levels of consumption by over 10% to 15.6 million tons in 2009 (Tab. 1). In 2010 the small reconstruction of cement consumption was recorded, and in 2011 it was dynamically recovered to record level of above 19.6 Mt, due to the intensification of structural investment and implementation of facilities connected with EURO 2012. However, in the second half of 2012, a significant slowdown in the dynamics of development of the industry was recorded, what resulted in drop of cement consumption to the level of 16.3 Mt, i.e. by more than 17% lower comparing to the record 2011. Per capita consumption resulting from this level was 422 kg in 2012 – the rate much lower than in the record of 2011, but higher than the average level of consumption for the residents of the EU (ca. 312 kg per capita). In 2012, almost all EU countries, except Estonia and Latvia, have recorded a significant decline in cement consumption, particularly evident for Spain (- 34%), Portugal (-27%), Italy (-22%), Netherlands (-16%), and the Czech Republic (-12%).

Companies involved in cement production in Poland as of December 2012

- “Górażdże Cement” S.A. w Choruli (“Górażdże-Cement” Joint Stock Co. of Chorula), ul. Cementowa 1, Chorula, 45–076 Opole, tel. +48 77 4530291, fax +48 77 4468103, www.gorazdze.pl — *clinker and cement* (Górażdże cement plant and Ekocem cement mills).
- Lafarge Cement S.A. w Małogoszczy (“Lafarge Cement Polska” Joint Stock Co. of Małogoszcz), ul. Warszawska 110, 28–366 Małogoszcz, tel. +48 41 3854100, fax +48 41 3854101, www.lafarge-cement.pl — *clinker and cement* (Małogoszcz and Kujawy cement plants).
- “Grupa Ożarów” S.A. w Ożarowie (“Grupa Ożarów” Joint Stock Co. of Ożarów), Karsy 77, 27–530 Ożarów, tel. +48 15 8391100, fax +48 15 8391108, www.ozarow.com.pl — *clinker and cement* (Ożarów and Rejowiec cement plants).
- “Cemex Polska” Sp. z o.o. w Warszawie (“Cemex Polska” Ltd. of Warsaw), Al. Jerozolimskie 212A, 02–486 Warszawa, tel. +48 22 5714100, fax +48 22 5714101, www.cemex.pl — *clinker and cement* (Chełm and Rudniki cement plants, Cem-Con Szczecin and Chełm Bałtyk Gdynia cement mills).
- Cementownia “Nowiny” Sp. z o.o. w Sitkówce (“Nowiny” Cement Plant Ltd. of Sitkówka), 26–052 Sitkówka-Nowiny, tel. +48 41 3466000, fax +48 41 3466488, www.dyckerhoff.pl — *clinker and cement* (Nowiny cement plant, Warszawa, Wysoka cement mills).
- Cementownia “Warta” S.A. w Trębaczewie (“Warta” Cement & Lime Works Joint Stock Co. of Trębaczew), Trębaczew, 98–355 Działoszyn, ul. Przemysłowa 17, tel. +48 43 8413003, fax +48 43 3111322, www.wartasa.com.pl — *clinker and cement* (Warta cement plant).

- Cementownia “Odra” S.A. w Opolu (“Odra” Cement Plant Joint Stock Co. of Opole), ul. Budowlanych 9, 45–202 Opole, tel. +48 77 4020899, fax +48 77 4542860, www.odrasa.com.pl — *clinker and cement* (Odra cement plant).
- Cementownia Kraków Nowa Huta Sp. z o.o. (Kraków Nowa Huta Cement Plant Ltd), ul. Cementowa 2, 31–983 Kraków, tel./fax +48 12 6810542, www.cementowniakrakow.pl — *clinker and cement* (Nowa Huta cement plant).
- Górka Cement Sp. z o.o. (“Górka” Cement Plant Ltd.), 32–540 Trzebinia, ul. 22 Lipca 58, tel. + 48 32 6121069, fax +48 32 6323450, www.gorka.com.pl — *high-alumina cement* (Górka cement plant).

CESIUM

Overview

The main source of **cesium** (**Cs**) is ***pollucite***, which occurs mainly in pegmatitic deposits. **Pollucite concentrates**, containing approx. 20% Cs_2O, are obtained as co-products in the processing of ***beryllium-*** and ***lithium-bearing ores***. Pollucite concentrate is chemically transformed into **cesium chloride** or **cesium hydroxide**, then electrolytically reduced to **cesium metal**. Another way to obtain this metal is to reduce molten **cesium hydroxide** with ***calcium metal*** or ***magnesium metal***.

The primary applications of **cesium**, usually as compounds, are in electronics, photo-electric equipment, the glass-making industry, chemistry, the production of synthetic rubber, and the manufacture of basic batteries resistant to low temperatures.

Sources

Poland has no ***cesium-bearing*** mineral deposits.

Production

There is no ***cesium commodities*** production in Poland.

Trade

Domestic demand is entirely satisfied by imports, which are not recorded by the **Central Statistical Office** (**GUS**).

Consumption

The structure of demand for ***cesium*** and ***cesium compounds*** in Poland is not known. They are probably used in the electronics, glass-making, and chemical industries.

CHALK AND RELATED PRODUCTS

Overview

Chalkstone (**whiting chalk**) is a sedimentary rock composed mainly of very fine calcite skeletons (ca. 0.001 mm). It is used in its natural state or washed. Commercial **washed chalk**, also known as **technical chalk**, has numerous applications. The best quality grades are used in the production of pharmaceuticals, cosmetics, paper, rubber, chemicals, ceramic whiteware, paint and varnishes, putty, and stoppers. Inferior grades are utilized in cement production and agriculture. Two main substitutes for higher grades of chalk are: **ground calcium carbonate** (**GCC**) obtained from high purity ***limestone***, ***marbles*** or ***calcite***, and **precipitated calcium carbonate** (**PCC**) produced in reaction of ***lime milk*** and gaseous CO_2. The current world production of GCC and PCC surpasses over ten times the world natural chalk supply.

Sources

Chalk occurs in Cretaceous in the eastern part of the **Lublin Plateau** (Chełm region). Chalk from the **Chełm** deposit is classified as the ***limestone*** for the cement industry and mined for the needs of the **Chełm** and **Rejowiec** cement plants (see: **CEMENT**), being also partly utilized in the construction, agriculture, and chemical industry.

Chalk is known also in isolated Cretaceous floats in Quaternary clay sediments in the **Podlasie** area (NE Poland), particularly in the **Kornica** and **Mielnik** regions. These deposits are rather small, but the raw material is utilized in accordance to its specific properties. There are 19 recognized deposits, including 6 deposits being in operation (as of 31 December 2012). Ca. 92% of the total reserves, i.e. 37.1 Mt, are in the **Kornica** region, while only 8% in **Mielnik** region.

Production

In spite of the presence of large, easily accessible deposits of ***chalk*** in Poland, the production is not very well developed. Currently, it is carried on almost entirely by **Omya Ltd.** of **Warsaw**, a subsidiary of Swiss company **Omya**. It operates the **Mielnik** mine and plant, which have been modernized in the late 1990s. The mining output and production level increased eight times since 2000, to over 96,000 t in 2007, with reduction in the next three years to ca. 50,000 tpy. In the years 2011-2012 it recovered to 91,200 t in 2012. The plant produces only less than 10,000 tpy of ***technical chalk*** and ***whiting chalk***, each. Lower quality ***fodder chalk*** and ***fertilizer chalk*** constitute the majority of total production.

A few smaller deposits of chalk in the **Kornica** region are occasionally exploited by private individuals. Raw material from these deposits is used only for ***fertilizer chalk,***

fodder chalk and low-quality ***whiting chalk***. Their combined production - from 4 small mines - rose to ca. 40,500 t in 2012. The largest producer in this region is **Koszelowskie Zakłady Kredowe (Koszelowskie Chalk Works)** in **Koszelówka**. Total production of ***chalk products*** on the basis of ***chalk*** recently varied in the range 60,000-130,000 tpy (Tab. 1).

Deficiency of domestic natural chalk products resulted in development of production of so-called "chalk" (precisely: ***ground calcium carbonate — GCC***), obtained by milling of high quality ***limestone***. Total production of ground calcium carbonate in Poland increased to ca. 780,000 t in 2008, with reduction by 35% in the next two years and revival to over 740,000 t in 2012 (Tab. 1). Some lime works are the main producers of GCC grades, e.g. ***technical chalk*** (used mainly as filler in chemical and ceramics industry) — the **Trzuskawica Lime Works**, the **Lhoist Bukowa**, the **Lhoist Opolwap**; ***whiting chalk*** — the **Lhoist Bukowa**; and — in the largest amounts — ***fodder chalk*** in the **Trzuskawica Lime Works**, the **Lhoist Bukowa** and the **Lhoist ZW Wojcieszów**. Other important producers of GCC grades are: the **Labtar** of **Tarnów Opolski**, **ZPSM Minerał** of **Wałcz**, **APG** of **Sokołów** near Kielce, **Techmot** of **Opole**, **JARO** of **Jaroszów**, and others.

Tab. 1. Statistics of chalk and related products[1] in Poland — CN 2509

'000 t

Year	2008	2009	2010	2011	2012
Mining output[2]	73.9	79.5	58.9	112.0	131.8
Production, total	780.2	676.8	500.0	614.4	741.7
Imports	69.8	45.8	91.9	98.9	153.4
Exports	5.2	2.7	4.9	4.5	6.3
Consumption[a]	844.8	719.9	587.0	708.8	891.8

[1] total production of chalk and GCC, production of PCC is not included

[2] mining output of chalk from Mielnik deposit and smaller deposits near Kornica

Source: ***The Statistical Office (GUS), Mineral Resources Datafile***

Production of ***precipitated calcium carbonate*** (***PCC***) in Poland is a separate topic. Since the mid-1990s, **Minerals Technologies Inc.** (**MTI**) — the world leader in the production of PCC for the paper industry — has operated so-called satellite PCC plant near the largest Polish paper plant in **Kwidzyn** (currently: **Specialty Minerals Poland Ltd.**). It is believed that its production capacity amounts to 50,000 tpy. It supplies PCC not only to Kwidzyn plant, but also to some minor paper plants.

Trade

Chalk of various quality, as well as high quality ***GCC*** and ***PCC*** grades are traditionally imported. For many years, mainly ***washed chalk pieces*** or ***powder*** had to be imported, traditionally from **Rügen** (Germany). In 2010, it constituted ca. 60% of total imports of chalk and related products (item **CN 2509**) to Poland, with reduction to under 40% in 2012. Supplies of lower quality chalk from Denmark (except of 2009) and - recently - the UK - were also very significant (Tab. 2). Imports of ***GCC*** and marginal amounts of ***PCC***

rose to ca. 13,400 t in 2008, in 2009 they amounted to 10,800 t, in 2010 - 11,700 t, in 2011 - 9,400 t, and in 2012 - 9,800 t. Slovenia, Spain, and France are the main suppliers (Tab. 2).

Tab. 2. Polish imports of chalk and related products, by country — CN 2509

'000 t

Year	2008	2009	2010	2011	2012
Imports	**69.8**	**45.8**	**91.9**	**98.9**	**153.4**
Denmark	15.4	0.0	24.9	32.1	58.2
France	1.6	2.1	2.8	2.5	2.5
Germany	41.0	35.0	55.3	47.1	56.6
Slovenia	5.1	5.3	5.8	5.0	5.1
Spain	2.7	1.7	1.5	0.7	1.3
United Kingdom	2.6	0.6	0.5	10.3	28.8
Others	1.4	1.1	1.1	1.2	0.9

Source: ***The Central Statistical Office (GUS)***

Exports of ***chalk and related products*** from Poland has minor importance, but since 2007 it has risen to 3,000-6,000 tpy (Tab. 1). The majority of these has been probably ***GCC*** from **Trzuskawica** and/or **Bukowa** lime plants.

The trade balance of these commodities is consistently negative, recently varying between 14-21 million PLN/y (Tab. 3). Average unit values of ***chalk and related products*** imports to Poland are variable, depending on various share of cheaper chalk from Germany (ca. 60 USD/t) and Denmark and the UK (<30 USD/t) in total imports. ***GCC*** grades imported from other countries have commonly unit values at a range of 230–700 USD/t. Unit values of imported ***chalk and related products*** are a few times higher than average prices of domestic grades, varying between 30-40 USD/t (Tab. 4). Prices of domestic ***fodder chalk*** from Opole and Kielce vicinity amounts to 70–100 PLN/t (25–40 USD/t), while ***technical chalk*** (***GCC***) prices — even over 250-300 PLN/t (90-100 USD/t).

Tab. 3. Value of chalk and related products trade in Poland — CN 2509

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	2,026	1,418	2,104	2,157	6,325
Imports	17,068	15,080	20,908	21,377	27,086
Balance	**-15,042**	**-13,662**	**-18,804**	**-19,220**	**-20,761**

Source: ***The Central Statistical Office (GUS)***

Consumption

Domestic demand for all grades of ***natural chalk*** and ***ground calcium carbonate*** in Poland ranged between under 600,000 and almost 900,000 tpy (Tab. 1). However, it should be emphasized that consumption of higher grades of natural chalk and GCC (whiting, technical) amounts to only ca. 100,000-120,000 tpy, whereas consumption of fodder and fertilizer chalk makes the balance. Technical chalk and GCC is used as extender in

Tab. 4. Average unit values of domestic and imported chalk grades — CN 2509

Year	2008	2009	2010	2011	2012
Average production unit values					
PLN/t	80.7	96.2	121.1	114.7	112.1
USD/t	35.2	30.6	39.8	39.6	34.1
Average imports unit values					
PLN/t	244.5	329.4	227.6	216.3	176.6
USD/t	106.8	104.9	74.7	74.9	53.7

Source: ***The Central Statistical Office (GUS)***

the paper, paint and coatings, plastic, rubber, ceramic and chemical industries. Further development of these industries is indicating consumption growth of these grades.

PCC plant in Kwidzyn practically covers current demand of the Polish paper industry for PCC, and will continue to do it in the nearest future.

Principal companies involved in chalk and related products production in Poland as of December 2012

- Omya Sp. z o.o. w Warszawie, Zakład w Mielniku (Omya Ltd. of Warsaw, Mielnik Plant); 17–307 Mielnik, ul. Przemysłowa 1, tel. +48 85 6565080, fax +48 85 6577275, www.omya.pl — *whiting, technical, fodder and fertilizer chalk.*
- Koszelewskie Zakłady Kredowe w Koszelówce (Koszelówka Chalk Works of Koszelówka), 08-205 Kornica, Koszelówka 9A, tel./fax +48 83 3588786, www.kzkpolska.com — *fertilizer chalk, fodder chalk, technical chalk.*
- Zakłady Przemysłu Wapienniczego Trzuskawica S.A., Zakład Sitkówka (ZPW Trzuskawica Joint Stock Co., Sitkówka Plant), 26–052 Sitkówka, tel. +48 41 3469130, fax +48 41 3469139, www.trzuskawica.pl — *technical chalk (GCC), fodder chalk.*
- Lhoist Opolwap S.A. w Tarnowie Opolskim (Lhoist Opolwap Joint Stock Co. of Tarnów Opolski), 46–050 Tarnów Opolski, ul. Świerczewskiego 5, tel. +48 77 4516376, fax +48 77 4516377, www.lhoist.pl — *technical chalk (GCC).*
- Lhoist Bukowa Sp. z o.o. w Bukowej (Lhoist Bukowa Ltd. of Bukowa), 29–105 Krasocin, ul. Osiedlowa 10, tel. +48 41 3889105, fax +48 41 3889106, www.lhoist.pl — *technical chalk (GCC), whiting chalk (GCC), fodder chalk.*
- Zakład Wapienniczy Wojcieszów Sp. z o.o. w Wojcieszowie (ZW Wojcieszów Ltd. of Wojcieszów), 59–550 Wojcieszów, ul. Bolesława Chrobrego 77B, tel. +48 75 7512261, fax +48 75 7512339, www.lhoist.pl — *fodder chalk.*

CHROMIUM (CHROMITES)

Overview

The only sources of **chromium** (**Cr**) are deposits of ***chromites***, mainly of magmatic, occasionally of latheritic types. Chromium is traditionally used as an alloy constituent of steel (with **ferrochromium** as intermediate), and in alloys with other metals. **Chromites** also find application in the chemical and refractory industries, as well as in foundries. In particular, the producers of refractory materials are now using less chromite, due to technological and environmental limitations.

Sources

Poland has no deposits of ***chromites***, nor any prospects for their discovery.

Production

Due to the lack of deposits, no ***chromite*** production is carried on in Poland. Until the end of 1998 imported ***metallurgical chromites*** were processed into ***ferrochromium*** at the **"Łaziska" Smelter**, but later on this production was stopped due to the economic reasons.

Trade

Domestic demand for chromium commodities is satisfied by imports, mainly of ***chromites***, and in the years 2008–2012 their imports were at the stable level of 27–38 ktpy, with reduction to only 11 kt in 2009 (Tab. 1). Recently, the main imports sources are the Republic of South Africa, and — except of 2009 — the Czech Republic (dealer), with small amounts coming from Kazakhstan, Turkey and Pakistan, partly through German and Dutch dealers (Tabs. 1 and 2). Surpluses of stocks were exported to the Czech Republic, Sweden, Switzerland and Germany.

Variable amounts of ***ferrochromium*** were also imported: 5,700–14,000 tpy (Tab. 1). The ***chromium metal*** was imported from Russia, Western Europe, China, the US and - in 2009 - from Slovakia (Tab. 3).

The trade balance of ***chromites*** in Poland is negative, as the demand is met entirely by imports (Tab. 4). The trade balance in ***ferrochromium*** has been increasingly negative up to 2008, mainly due to increasing imports and rise of prices on international markets, but in 2009 lower imports and lower prices caused the improvement of trade balance value, which amounted to almost 29 million PLN. In the years 2010–2012 the trade balance increased, and has been followed by increased imports, but did not exceed the value of 52 million PLN (Tab. 4). The value of trade in other ***chromium commodities*** is of minor

Tab. 1. Chromium commodities statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Chromites CN 2610					
Imports	37.8	11.5	27.6	31.8	27.3
Exports	0.1	0.1	0.4	0.4	0.5
Consumption[a]	37.7	11.4	27.2	31.4	26.8
Ferrochromium CN 7202 41–49					
Imports	14.0	5.7	7.9	7.7	9.4
Exports	1.8	0.4	0.7	0.3	0.5
Consumption[a]	12.2	5.3	7.2	7.4	8.9
Chromium metal and powder [t] CN 8112 21					
Imports	141.3	98.1	55.8	81.6	46.4
Exports	33.1	98.3	26.5	13.3	0.0
Consumption[a]	108.2	-0.2	29.3	68.3	46.4
Sodium dichromate CN 2841 30					
Imports	1.4	1.9	1.8	1.1	0.7
Exports	0.1	0.3	0.1	0.0	0.0
Consumption[a]	1.3	1.6	1.7	1.1	0.7

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of chromites, by country — CN 2610

'000 t

Year	2008	2009	2010	2011	2012
Imports	**37.8**	**11.5**	**27.6**	**31.8**	**27.2**
Albania	–	–	–	0.0	–
China	1.2	–	0.3	–	–
Czech Republic	19.4	0.2	16.6	17.9	15.2
Germany	3.9	1.6	1.6	1.9	0.6
India	–	–	0.2	–	–
Italy	0.0	0.0	0.2	0.2	0.0
Kazakhstan	0.2	0.4	0.6	–	–
Netherlands	0.4	1.1	0.4	0.5	0.7
Oman	0.4	0.2	0.3	0.1	0.1
Pakistan	0.1	–	–	–	1.3
South Africa, Republic of	11.8	7.6	7.1	9.4	7.9
Turkey	0.4	0.4	0.2	1.7	1.2
United Arab Emirates	–	–	0.1	–	0.1

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Polish imports of chromium metal and powder, by country — CN 8112 21

t

Year	2008	2009	2010	2011	2012
Imports	**141.3**	**98.1**	**55.8**	**81.6**	**46.4**
Belgium	36.4	7.5	2.0	52.2	1.0
Brazil	3.0	–	–	–	–
Bulgaria	–	–	–	–	1.1
China	0.0	2.0	–	–	5.0
Czech Republic	8.5	–	–	–	0.0
France	1.0	–	0.0	0.1	4.0
Germany	15.9	2.5	6.8	16.5	10.5
Italy	7.3	2.6	6.5	2.0	8.3
Latvia	3.0	–	–	–	–
Netherlands	34.0	2.0	27.5	5.0	–
Russia	6.0	3.0	–	3.5	11.0
Slovakia	–	69.2	–	–	–
Spain	21.0	–	2.0	–	0.0
Sweden	5.0	8.0	2.0	–	–
United Kingdom	0.0	0.1	8.0	2.1	5.2
USA	0.1	1.2	1.0	0.2	0.3

Source: ***The Central Statistical Office (GUS)***

importance. The total balance of ***chromium commodities*** trade in Poland was negative, at ca. 131 million PLN in 2008, in 2009 was improved and amounted to 53.4 million PLN, but in period 2010–2011 increased again to 79.3 million PLN, with slight decrease in 2012 (Tab. 4). The deciding influence had unit values of their imports to Poland (Tab. 5), which depended mostly on the quantity of purchased material, their sources and quality.

Consumption

The Polish demand for ***chromites*** decreased as a result of abandoned ***ferrochromium*** production at the **"Łaziska" Smelter** in 1998, and — of minor importance — a steady decline in chromite consumption in the refractory sector.

In the last years, a particularly important role in this demand is played by the **"Alwernia" Chemical Plant** near Cracow, which consumes ca. 8,000–12,000 tpy of chromites. Currently the **"Alwernia" Chemical Plant** produces ***chromium trioxide*** (green) and ***basic chrome sulphate***. Information on production volumes of that chromium compounds is not available, but total production is estimated at ca. 12,000 tpy Cr_2O_3. Ca. 500–2,000 tpy of ***chromium trioxide*** is exported.

The chromite consumers in the refractory sector are the **"Ropczyce" Magnesite Works** and the **"ArcelorMittal Refractories" Ltd.** in Kraków, at a total amount of several thousand tpy of chromites. These chromites are used for ***chromite-magnesite*** and ***magnesite-chromite refractories***, but their production is constantly declining. Foundries also consume small quantities of non-metallurgical chromite.

Tab. 4. Value of chromium commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Chromites CN 2610					
Exports	113	210	551	3,418	1,076
Imports	27,567	16,961	18,365	28,953	26,815
Balance	**-27,454**	**-16,751**	**-17,814**	**-25,535**	**-25,739**
Ferrochromium CN 7202 41–49					
Exports	15,923	2,214	4,202	2,192	4,304
Imports	112,463	31,114	47,216	50,448	55,589
Balance	**-96,540**	**-28,900**	**-43,014**	**-48,256**	**-51,285**
Chromium metal and powder CN 8112 21					
Exports	825	326	701	516	380
Imports	1,967	967	1,191	2,167	1,518
Balance	**-1,142**	**-641**	**-490**	**-1,651**	**-1,138**
Chromium wastes and scrap CN 8112 22					
Exports	3,074	947	13,566	7,265	5,583
Imports	4,022	1,349	7,855	4,425	1
Balance	**-948**	**-402**	**+5,711**	**+2,840**	**+5,582**
Sodium dichromate CN 2841 30					
Exports	283	1,240	375	159	202
Imports	5,444	7,928	8,784	6,901	3,785
Balance	**-5,161**	**-6,688**	**-8,409**	**-6,742**	**-3,583**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Unit values of chromium commodities imports to Poland

Year	2008	2009	2010	2011	2012
Chromites CN 2610					
PLN/t	729.3	1,474.3	665.4	909.2	983.8
USD/t	311.2	473.9	221.0	308.2	310.4
Ferrochromium CN 7202 41–49					
PLN/t	8,033.1	5,430.1	5,960.0	6,554.9	5,911.4
USD/t	3,523.3	1,743.9	1,991.6	2,247.5	1,813.0
Chromium metal and powder CN 8112 21					
PLN/t	13,920.7	9,861.2	21,353.2	25,550.8	32,710.6
USD/t	6,245.0	3,098.5	7,040.6	9,044.1	9,962.9

Sodium dichromate CN 2841 30					
PLN/t	3,888.6	4,230.6	4,850.1	6,057.3	5,518.2
USD/t	1,635.6	1,336.5	1,611.9	1,988.7	1,690.1

Source: ***The Central Statistical Office (GUS)***

Company involved in chromium commodities production in Poland as of December 2012

- Zakłady Chemiczne "Alwernia" S.A. w Alwernii ("Alwernia" Chemical Plant Joint Stock Co. of Alwernia), ul. Olszewskiego 25, 32–066 Alwernia, tel. +48 12 2589135, fax +48 12 2832188, www.alwernia.com.pl — *chromium trioxide (green), basic chrome sulphate*.

CLAYS AND RELATED MATERIALS FOR BUILDING CERAMICS

Overview

Raw materials for building ceramics (“red” ceramics) are provided by many **clay minerals**, such as ***clay***, ***loam***, ***mudstone***, and ***shale***, as well as ***clay loess*** and waste materials from coal and ore mines. The suitability of these materials depends on their plasticity after they are mixed with water. If the plasticity is too high, the mix is corrected by adding such ingredients as sand, crushed brick, and — lately — fly ash and sawdust. Of particular value are the moderately plastic materials, lacking such detrimental ingredients as marl, pyrite, or water-soluble sulfides, which cause stains on the surface of the final product. After firing, the body of the product should be porous but strong, and resistant to atmospheric influences.

Sources

Poland is rich in ***clay minerals for building ceramics***. Throughout the country there are over 1,230 deposits, the total resources of which are approximately 2,032 Mm^3 (as of 31 December, 2012). However, ca. 36% of the entire domestic resources are recognized in the **Legnica Eastern Field** *lignite* deposit, where clays occur in interlayers and overburden. Reserves of developed deposits amount to ca. 13% of total domestic resources. Generally speaking, large resources are recognized in the southern and central part of Poland (a few types of Tertiary clays), with minor importance of northern Poland (Quaternary clays).

In recent years, ***fly ash*** from power plants and central heating plants has also been used in the production of building materials. Many manufacturers utilize fly ash, even up to 80% by weight of the technological batch mix. ***Slag*** and ***slag-ash mixes***, as well as ***waste from hard coal*** and ***lignite mines***, are also used to manufacture building ceramics (provided they meet the requirements, particularly in respect to radioactivity and heavy metal content).

Production

The mining output of ***clays for building ceramics*** has fluctuated from 2.4 to 2.7 Mm^3py until 2007. Between 2008 and 2012 its fluctuations were very strong, with maximum almost 3.3 Mm^3 in 2008, and minimum ca. 1.8 Mm^3 in 2012, being related to domestic demand for building ceramics (Tab. 1, 2). It was concentrated in Świętokrzyskie, Dolnośląskie, Pomorskie, Śląskie, Małopolskie, Mazowieckie, and Podkarpackie voivodeship. In recent years, output of clays in all voivodeships strongly fluctuated (Tab. 1).

Tab. 1. Mining output of clay minerals for building ceramics in Poland

'000 m^3

Year	2008	2009	2010	2011	2012
Mining output, total	**3,267**	**2,640**	**2,157**	**2,309**	**1,835**
Dolnośląskie	443	257	261	209	266
Małopolskie	273	201	283	284	167
Mazowieckie	403	241	272	284	134
Opolskie	138	169	75	116	104
Podkarpackie	437	289	186	353	138
Pomorskie	108	179	169	150	207
Śląskie	375	390	236	232	187
Świętokrzyskie	392	409	269	286	328
Warmińsko-Mazurskie	135	80	72	31	16
Wielkopolskie	126	67	86	69	65
Other 6 voivodeships	437	358	248	295	223

Source: ***Mineral Resources Datafile***

The mining output of ***clays for building ceramics*** reflects only in a part the changes in building ceramics production, because the share of secondary materials used for this production is increasing. Mining is conducted by large ***ceramics enterprises*** (often with the participation of foreign investors), as well as small ***brickyards***. Extracted clays are entirely used in plants located quite near the deposits (see: **Consumption**).

The most important deposits of clays for building ceramics, currently extracted, are as follows:

- **Kąty Wrocławskie I**, **Kunice III**, **Miękinia** and **Paczków** in southwestern Poland;
- **Gnaszyn**, **Patoka**, **Czerwone Osiedle**, and **Sierakowice** in Upper Silesia;
- **Wola Rzędzińska**, **Oleśnica 1**, **Kolbuszowa-Kupno, Markowicze**, and **Hadykówka** in southeastern Poland;
- **Brzostów**, **Pałęgi, Kozów** and **Chełsty** in central Poland;
- **Tadeuszów-Rudzienko,** and **Lewkowo Stare** in northeastern Poland;
- **Lębork** and **Nowa Wieś Lęborska** in northwestern Poland.

Trade

Due to transportation costs and their common occurrence, the ***raw materials*** for red ceramic production are generally not traded internationally, and are of local or regional importance only. However, ceramic construction materials such as ***bricks***, ***tiles***, etc. are traditionally traded, mainly between neighboring countries.

Consumption

Ceramic building materials include a very broad range of products used primarily in residential and industrial construction. Generally speaking, they may be divided into ***non-fired materials***, obtained by processing sand-lime mixes in autoclaves (see: **SAND FOR LIME-SAND PRODUCTS AND CELLULAR CONCRETE**), and ***fired materials***. The latter include ***sintered products — stoneware for sewage systems*** and ***acid-***

proof stoneware, ***stoneware tile*** (see: **CLAYS, CERAMIC AND REFRACTORY**), ***clinker brick*** and ***pavement brick*** — and ***porous products***: ***light building aggregates*** (see: **AGGREGATES, MINERAL**) and ***wall and roof elements***. The last group, due to the color of the burnt products, is called ***"red ceramics".*** The most important are ***thick-walled wall elements*** (e.g. common brick), and ***thin-walled wall elements*** (such as hollow brick, cavity brick, cored brick, hollow masonry units, ceramic wall plates, structural tiles), ***roofing materials*** (such as various roofing tiles, e.g. pantile, plain tile, ridge tile), ***thin-walled floor tiles*** (e.g. structural-floor tiles), and ***thin-walled drainage pipes*** of various diameters and lengths, preferably used for pipe drainage purposes in land improvement work.

Production of ***building ceramics*** in Poland, after significant reduction being a result of crisis in construction sector in the beginning of decade, reported significant development, especially in 2007 and 2008. It was especially well seen in case of ***structural-wall tiles, face bricks***, as well as of ***ceramic roofing tiles***. Due to next crisis in construction sector, their production in 2009 was almost 20% lower than in 2007. After temporary recovery in 2010 and 2011, it diminished again in 2012 (Tab. 2).

Tab. 2. Production of building ceramics in Poland

million units

Year	2008	2009	2010	2011	2012
Ceramic wall elements, total[1]	**2,093**	**1,763**	**1,865**	**1,995**	**1,688**
• *Face bricks*	*175*	*267*	*238*	*241*	*185*
• *Structural-wall tiles*	*1,712*	*1,438*	*1,575*	*1,662*	*1,469*
Structural floor tiles	**7**	**6**	**10**	**12**	**10**
Ceramic roofing materials	**188**	**127**	**159**	**162**	**152**
Drain pipes	**0**	**0**	**1**	**1**	**1**

[1] calculated as ordinary brick units

Source: ***The Central Statistical Office (GUS)***

Domestic building ceramics industry in the last twenty years changed profoundly, due to important technological improvements, large investments (also greenfield plants) and concentration of building ceramics production, which is conducted both by domestic and foreign investors. The most important foreign investors in this industry are:

- Austrian company **Wienerberger** (the largest building ceramics producer in the world) with the largest plants in **Lębork**, **Złocieniec**, **Toruń**, **Dobre** near Mińsk Mazowiecki, **Zielonka** near Warsaw, **Konin-Honoratka**, **Gnaszyn** near Częstochowa, **Kraków-Łęg** and **Kraków-Zesławice**, **Kolbuszowa-Kupno**, **Oleśnica** near Staszów, **Kunice** near Legnica and **Jankowa Żagańska** (currently the largest building ceramics producer in Poland, over 60% of domestic production, mainly ***structural-wall tiles*** and ***clinker bricks***, but also ***ceramic roofing tiles***);
- Austrian company **Leier** with large plants in **Wola Rzędzińska** near Tarnów and **Markowicze** near Biłgoraj, delivering mainly ***structural-wall tiles*** and ***ceramic structural floor tiles***;
- German company **Roeben** with a modern plant in **Środa Śląska** near Wrocław, the

largest domestic producer of ***ceramic roofing tiles*** and significant producer of ***clinker brick***;

- Irish company **CRH** (being also important cement, aggregates, and concrete producer), owner of **CRH Klinkier** group with plants in **Patoka** near Lubliniec, **CERG** in **Gliwice**, and **Gozdnica** near Żary (the largest domestic producer of ***clinker products***), since 2007 it is also owner of **Cerabud Krotoszyn** with three plants: **Brzostów** and **Witaszyce** (***structural wall-tiles***) and **Krotoszyn** (***roofing elements***);
- French company **Monier** (previously: **Lafarge Dachy**) with large plant of ***ceramic roofing tiles*** in **Przysucha**.

Among domestic investors in the building ceramics industry, the most important is — undoubtedly — **Wacław Jopek Building Ceramics Plant**, which currently operates four plants: in **Bytom** (***ceramic roofing tiles***), **Radziejowice** near Warsaw (***face bricks***), **Paczków** (***structural-wall tiles***), as well as in **Sierakowice** near Gliwice (***clinker brick***). Other important brick producers are: **Cerpol-Kozłowice** in **Kozłowice** near Olesno, **Lewkowo** near Białystok, **Hadykówka** near Rzeszów, as well as the only plant utilizing clayey waste after hard coal beneficiation — **Ekoklinkier** in **Bogdanka** near Lublin.

Imports of ***structural bricks***, ***wall-*** and ***floor tiles*** dynamically rose to almost 1 million t in 2007 and over 800,000 t in 2008, due to temporary deficit of such products on the domestic market being a result of intensified demand. However, in the last years they were reduced to under 400,000 tpy (Tab. 3). They were coming primarily from Germany, Slovakia, Latvia and the Czech Republic. Exports of such products were significantly reduction in the last four years (Tab. 3). They were sold primarily to Ukraine, Russia, and Lithuania. In the case of ***roofing tiles*** and ***other roofing elements***, exports exceeded 80,000 tpy again in 2010 (Tab. 3). These originated mainly from a few modern plants in western Poland, being sold to Germany, the Czech Republic and — recently — the UK and Ukraine. Imports of ***roofing ceramic elements*** were very substantial, jumping to almost 290,000 tpy in 2011 (Tab. 3). They were imported primarily from Germany, Latvia, Slovakia, the Czech Republic and Hungary.

Tab. 3. Building (structural) ceramics trade in Poland

'000 t

Year	2008	2009	2010	2011	2012
Structural wall- and floor tiles, bricks CN 6904					
Imports	800.7	450.1	477.8	441.3	355.8
Exports	100.5	68.1	52.4	69.5	76.6
Roofing tiles and other roofing elements CN 6905					
Imports	218.9	229.5	268.7	289.2	235.4
Exports	78.5	76.2	85.1	105.5	107.6

Source: ***The Central Statistical Office (GUS)***

The trade balance of ***structural bricks, wall-*** and ***floor tiles***, as well as of ***roofing tiles*** and ***other roofing elements***, is negative for years. In 2009 and again in 2012 it was improved due to lower imports volume. In 2008 and in 2010-2011 the trade balance achieved record negative values as a result of significant, temporary growth of building ceramics imports to Poland (Tab. 4).

Tab. 4. Value of building (structural) ceramics trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Structural wall- and floor tiles, bricks CN 6904					
Exports	46,132	25,061	19,120	26,815	32,895
Imports	175,367	107,592	107,397	96,231	84,567
Balance	**-129,235**	**-82,531**	**-88,277**	**-69,416**	**-51,672**
Roofing tiles and other roofing elements CN 6905					
Exports	35,461	57,964	59,767	80,518	86,898
Imports	199,806	192,306	212,854	261,434	219,851
Balance	**-164,345**	**-134,342**	**-153,087**	**-180,916**	**-132,953**

Source: ***The Central Statistical Office (GUS)***

Principal companies involved in manufacturing of building ceramics products in Poland, as of December 2012

- "Wienerberger" Ceramika Budowlana Sp. z o.o. ("Wieneberger" Building Ceramics Ltd.), ul. Ostrobramska 79, 04–175 Warszawa, tel. +48 22 5142100, fax +48 22 5142103, www.wienerberger.pl.
- "Leier Polska" S.A. w Woli Rzędzińskiej ("Leier Polska" Joint Stock Co. of Wola Rzędzińska), 33–150 Wola Rzędzińska 155A, tel. +48 14 6313700, fax +48 14 6313600, www.leier.pl.
- "Roeben Polska" z o.o. w Środzie Śląskiej ("Roeben Polska" Ltd. of Środa Śląska), ul. Rakoszycka 2, 55–300 Środa Śląska, tel. +48 71 3978100, fax +48 71 3978111, www.roben.pl.
- CRH Klinkier Sp. z o.o. w Gliwicach (CRH Klinkier Ltd. Of Gliwice), ul. Pszczyńska 309, 44–100 Gliwice, tel. +48 32 2394100, fax +48 32 2394102, www.crh-klinkier.pl.
- Fabryka Ceramiki Budowlanej "Wacław Jopek" ("Wacław Jopek" Building Ceramics Plant), ul. Łokietka 10, 41–935 Bytom, tel. +48 32 3969105, fax +48 32 3969104, www.jopek.pl.
- "Cerpol-Kozłowice" Sp. z o.o. w Kozłowicach ("Cerpol-Kozłowice" Ltd. of Kozłowice), ul. Nowa 4, 46–310 Gorzów Śląski, tel. +48 34 3593067, fax +48 34 3593087, www.kozlowice.pl.
- Zakład Ceramiki Budowlanej "Ekoklinkier" w Bogdance ("Ekoklinkier" Building Ceramic Plant of Bogdanka), Bogdanka, 21–013 Puchaczów, tel. +48 81 4625591, fax +48 81 4625634, www.ekoklinkier.pl.
- "Monier" Sp. z o.o., Zakład w Skrzyńsku ("Monier" Ltd., Skrzyńsko Plant), Skrzyńsko, ul. Przemysłowa 25, 26–400 Przysucha, tel. +48 48 6708700, fax +48 48 6708701, www.monier.pl.

CLAYS, CERAMIC AND REFRACTORY

Overview

Ceramic and **refractory clays** are a large and diverse group of clayey raw materials, where ***kaolinite*** is the main clay mineral, with minor importance of other clay minerals — ***illite*** and ***smectites***. Ceramic clays from various deposits represent very differentiated quality parameters. Depending on their quality parameters and mineralogical composition, they can find diverse applications in the ceramic industry. e.g. production of ceramic tiles, sanitaryware, semi-vitreous china-ware, stoneware goods, chamotte refractories, etc.

In Poland, three groups of ceramic clays are commonly distinguished: **white-firing clays** (**ball clays**), **stoneware clays** (**clays for stoneware production**), and **refractory clays**. It is a result of their technological usefulness and direction of the recognition of their deposits. However, such classification must be flexible, as e.g. refractory clays can be used for chamotte refractories, but also for ceramic tiles, sanitaryware, etc.

White-firing clays (**ball clays**), sometimes also known as **kaolinite clays**, are the most noble varieties of ceramic clays. They commonly find use in the production of ***faience and gres porcellanato tiles***, ***semi-vitreous china-ware***, and ***sanitaryware***, sometimes also for ***china-ware goods***. They should contain no more than 2.0–2.5% Fe_2O_3+TiO_2, with bending strength minimum 1.5 MPa. Their main component is kaolinite, with dickite, illite, fine-grained quartz and — sometimes — muscovite as other important minerals.

Stoneware clays are the group of clays with very good sintering properties in the temperature range 1,000–1,300°C. They show very small water absorption after firing at 1,300°C (max. 4%) and high bending strength after drying (>2 MPa, highly plastic varieties >3 MPa). Traditional uses of stoneware clays for the production of such stoneware goods as: ***sewage pipes***, ***sanitary products***, ***chemical stoneware***, ***pottery***, have decreasing importance. Increasing amounts of such clays are consumed for ***ceramic tiles*** of color body.

Refractory clays are represented by kaolinite or kaolinite-illite clays. They are traditionally used for ***chamotte refractories***, but lately also for ***ceramic tiles*** and ***sanitaryware*** production. Depending on Al_2O_3 content, four grades are distinguished — $\mathbf{G_1}$**-**$\mathbf{G_4}$ — with refractoriness between 1,650–1,750°C. Iron content in such clays is commonly at the level of 2–3%. Kaolinite content in the best grades (e.g. G_1) is commonly over 70%, with illite and fine-grained quartz as other important minerals. **Refractory shale** is non-plastic kaolinite rock, related to **refractory clay** and possessing similar refractory properties. Such shale is used entirely in refractory applications, i.e. ***chamotte*** production. Currently, they are not produced in Poland and do not have economic importance.

Sources

White-firing clays (***ball clays***) occur in lenses and irregular seams in Cretaceous clayley-sandy rocks near **Bolesławiec** in Lower Silesia. There are 6 recognized deposits of total economic reserves 59.1 Mt (as of 31 December 2012), with one — **Janina I** — currently extracted. This type of clays frequently occurs together with ***stoneware clay***, and — sometimes — ***refractory clay*** as accompanying minerals in lignite deposits (**Turów**, **Bełchatów**), but their reserves are not currently estimated. Since 2006, sandy-clay sediments from **Czerwona Woda** deposit (recognized as ***foundry sand*** deposit) started to be a source for production of white-firing clay raw material.

Deposits of ***stoneware clay*** are very common in Poland. Their reserves occur primarily in the northern periphery of the **Świętokrzyskie Mountains** (e.g. ***Baranów clays*** of Triassic age near Suchedniów, ***Opoczno clays*** of Jurassic age near Opoczno and Przysucha), and in the **Lower Silesia** (so-called ***Bolesławiec clays*** of Cretaceous and Tertiary age near **Bolesławiec**, some varieties of so-called ***Poznań clays*** of Tertiary age near **Żary** and **Wrocław**). Additionally, stoneware-type clay accompanies ***lignite*** at the **Turów** and **Bełchatów** deposits. The total reserves of ***stoneware clays*** in Poland amounted to 77.1 Mt, 7% of which in 2 deposits currently operated (as of 31 December 2012). The sources for the production of stoneware ceramics have been also deposits of raw material classified as ***clay for building ceramics***, e.g. **Chełsty** near Opoczno, **Kozów**, **Pałęgi**, and **Szkucin** near Końskie, **Patoka** near Lubliniec, **Ołdrzychów** and **Słowiany** near Bolesławiec, **Gozdnica** and **Jasień** near Żary.

In Poland, deposits of ***refractory clay*** are known and exploited in the **Lower Silesia** region (near Strzegom, Bolesławiec, Żary, and Turoszów), as well as in the NE part of the **Świętokrzyskie Mountains**. The total reserves of refractory clays amounted to 54.7 Mt (as of 31 December 2012). The most important are four deposits of the so-called ***Jaroszów clay*** in the **Strzegom** area, containing highly plastic clay of types G_1-G_4, possessing good sintering properties. Only one of them — **Rusko-Jaroszów** — is being exploited. These deposits together comprise 80% of Poland's refractory clay reserves. The deposits of refractory clays in other regions — near **Żary** in Lower Silesia and near **Opoczno** in the Świętokrzyskie Mountains — contain only types G_3-G_4 of ***refractory clays***. Reserves of ***refractory shale*** were recognized only in the **Nowa Ruda** ***hard coal*** deposit (Lower Silesian Coal Basin), and amounted to 11.2 Mt. Due to liquidation of **Nowa Ruda Hard Coal Mine**, these reserves were deleted in 2000. Refractory shale also occurs in some ***coal*** deposits in the Upper Silesian Coal Basin, e.g. **Ziemowit** (1.4 Mt of uneconomic reserves) and **Siersza**.

Production

Since 2003, **Ekoceramika**'s mine and processing plant in **Suszki** nearby the **Janina I** deposit (Tab. 1), is the largest ***white-firing clays*** producer in Poland, delivering ***beneficiated*** (***washed***) ***white-firing clay JB1W***. Its production varied between 30,000-40,000 tpy in the last years. In 2006, next new ***washed white-firing CWW clay*** started to be produced in the **Czerwona Woda** plant by **BZMO** company. Its production amounted up to 10,000 tpy in recent years. ***White-firing clays*** from the **Turów** lignite deposit are extracted irregularly. They are dumped and sold as white-firing varieties of ***raw TG-3 clay*** in variable amounts. They are also processed to a small extent by **Surmin-Kaolin** of **Nowogrodziec**, being blended with some kaolin semi-products to manufacture ***white-firing clay granulate*** in ***TC1/WB*** grade. In recent years, its production was ca. 2,500 tpy. Total domestic supplies of ***white-firing clays*** in Poland in recent years varied notably between 35,000 and 70,000 tpy (Tab. 2).

Tab. 1. Mining output of ceramic and refractory clays in Poland

'000 t

Year	2008	2009	2010	2011	2012
White firing clays (ball clays)					
Total output	**122**	**142**	**160**	**131**	**94**
• Janina I	122	142	160	131	94
Refractory clays					
Total output	**149**	**98**	**71**	**109**	**92**
• Rusko-Jaroszów	126	98	71	109	92
• Kryzmanówka (Zapniów)	23	–	–	–	–
Stoneware clays					
Total output	**225**	**162**	**185**	**215**	**177**
• Baranów	14	11	18	24	13
• Kraniec	24	–	–	–	–
• Paszkowice (Żarnów II)	28	26	24	14	–
• Zebrzydowa Zachód	159	125	143	177	164
Clays for building ceramics with properties of stoneware clays ['000 m^3][1]					
Total output	**288**	**212**	**194**	**179**	**175**
• Chełsty	32	29	24	33	31
• Gozdnica	49	49	28	3	17
• Jasień II	8	12	6	–	–
• Kozów	25	19	21	24	22
• Lipie Śląskie - Lisowice	1	–	1	1	5
• Mirostowice Dolne S	–	25	–	–	–
• Ołdrzychów	1	0	1	–	–
• Pałęgi	73	2	47	44	61
• Patoka	70	61	45	54	24
• Słowiany	9	–	2	–	–
• Szkucin	19	14	18	19	15
• Woźniki Śląskie	1	1	1	1	0

[1] used — in the large part — for stoneware goods production (mainly stoneware tiles)

Source: ***Mineral Resources Datafile***

Recently, the mining output of ***stoneware clays*** varied between 162,000 and 225,000 tpy. Extraction of **Gozdnica, Kraniec, Zebrzydowa** and **Paszkowice** deposits was abandoned, while in 2008 new **Zebrzydowa Zachód** mine (**Ekoceramika Co.**) was opened (Tab. 1). For the production of ***stoneware*** and ***clinker products***, large amounts of clays

Tab. 2. Ceramic and refractory clays statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Production					
White firing clays (ball clays) **CN 2507 00 80**	55.7	41.7	69.8	48.4	35.0
Stoneware clays[1] **CN 2508 30**	906.4	646.2	721.1	1,291.6	736.5
Refractory clays **CN 2508 40**	169.2	114.7	81.7	136.4	118.9
Imports					
White firing clays (ball clays) **CN 2507 00 80**	13.1	9.4	13.4	9.2	15.7
Refractory clays[2] **CN 2508 30**	313.9	212.6	248.2	313.6	259.5
Stoneware clays **CN 2508 40**	103.5	71.5	77.4	125.0	133.5
Exports					
White firing clays (ball clays) **CN 2507 00 80**	0.1	0.0	1.1	1.2	0.7
Refractory clays **CN 2508 30**	16.2	11.7	14.2	13.9	9.9
Stoneware clays **CN 2508 40**	2.0	12.0	14.9	13.7	11.8
Burnt refractory clays CN 2508 70 10					
Production[3]	49.4	35.0	25.2	37.7	30.6
Imports	6.6	4.0	7.3	6.5	8.5
Exports	0.1	0.2	0.3	0.4	0.5
Consumption[a]	55.9	38.8	32.2	43.8	39.1

[1] sold production reported by the Central Statistical Office under the item **PKWiU 08122250** — ***Common clays (for building etc.)***

[2] probably ball clays constitute the majority of it, mistakenly reported under this item

[3] production from **JARO** only

Source: ***The Central Statistical Office (GUS), producers' data***

from deposits of raw material classified as ***clay for building ceramics*** are used, e.g. ***red Triassic clays*** from **Patoka** near Lubliniec, **Chełsty** near Opoczno, **Kozów**, **Pałęgi** and **Szkucin** near Końskie, as well as ***Miopliocene Poznań clays*** from **Ołdrzychów** near Bolesławiec, **Gozdnica**, and **Jasień** near Żary. The total mining output from these deposits was — in general — increasing, up to almost 290,000 m^3py (over 570,000 tpy) in 2008, with huge reduction to 175,000 m^3 in 2012. Moreover, increasing amounts of ***refractory clays*** find use as ceramic clays for stoneware ceramics: ca. 90% of clays from **Kryzmanówka** mine in **Zapniów** (until 2009, when the mine was closed down) and ca. 50% of clays from **Rusko-Jaroszów** mine.

There is a lack of official data on the domestic production of ***stoneware clays***. The Central Statistical Office reports production of the item **PKWiU 08122250** — ***Common clays (for building etc.)***, which includes also ***clays for building ceramics***. The last one is — in general — consumed on site in the nearby ceramic plants. On the contrary, the majority of ***stoneware clays*** production is sold by their producers to consumers. So, data on sold production of clays reported under the item **08122250** can illustrate the probable level of domestic production of ***stoneware clays***. It varied between ca. 720,000 and 1,290,000 t in recent years (Tab. 2).

The extraction and production of ***refractory clay*** has been continuously increasing, as a result of demand recovery for ***chamotte refractories***, as well as their increasing use in non-refractory uses. This tendency has been reversed since 2009 (Tab. 1, 2). Recently, its production varied between 82,000 and 136,000 tpy. 85–90% (from 2009: 100%) of the material was supplied from the **Rusko-Jaroszów** deposit operated by **JARO S.A.** of **Jaroszów**. This is the only plant which delivers refractory clays of G_1 and G_2 types (over 60% of their raw clay production). Clay from **Kryzmanówka** (**Zapniów**) deposit in the Świętokrzyskie Mountains, operated by **F. Jopek Ceramika Co.** and delivered this clay mostly for the production of ***gres ceramic tiles*** and ***sanitaryware***, was closed in 2009. ***Refractory shale*** (***raw and burnt***) was not produced in Poland since 1980. It is still mined together with ***hard coal*** in some **Upper Silesian** coal mines (e.g. **Ziemowit** mine — ca. 100,000 tpy), but after beneficiation of the coal, the shale is considered waste material and dumped. ***Burnt refractory clay*** is an important intermediate product for ***chamotte refractories*** production. **JARO S.A.** of **Jaroszów** is its sole domestic producer. The level of its production after recovery up to 54,300 t in 2007, was hardly reduced 25,200-37,700 tpy in the last years due to high energy prices and crisis in the steel industry - the main consumer of chamotte refractories (Tab. 2).

Trade

In case of clay commodities, international trade is reported commonly only for ***white-firing clays*** (***ball clays***) and the best grades of ***refractory clays***. ***Stoneware clays*** trade has marginal importance due to their abundant domestic reserves and production. ***Refractory clays*** trade is reported under the item **CN 2508 30** (***refractory clays***), while ***white-firing clays*** (***ball clays***) trade should be reported under the item **CN 2507 00 80** (***kaolinitic clays***). Under the item **CN 2507 00 80**, only small portion of ***white-firing clays*** imports to Poland is reported. Imports of ***white-firing clays*** from Ukraine are registered in the position **CN 2508 30** (***refractory clays***), while their imports from Germany and the Czech Republic — under the item **CN 2508 40** (***other clays***).

Since the middle 1990s, the systematic increase in ***ceramic clays*** importation to Poland has been observed. That was a result of the growing appetite of the ***ceramic tile*** and ***ceramic sanitaryware*** producers for ***white-*** and ***light-firing clays***. Also ***refractory industry*** imported some amounts of competitive Ukrainian ***refractory clays***. In 2008, total deliveries of ***ceramic clays*** (including refractory clays) to Poland approached 430,500 t. In 2009, these imports were reduced by over 30%, primarily due to crisis in the building materials industry, but in 2010 and 2011 they recovered to record 447,800 t in 2011, with some reduction in 2012 (Tab. 3). It is estimated that over 90% of that was oriented to the ceramic tile and sanitaryware industry, while up to 10% (30,000–40,000 tpy) — to

Tab. 3. Imports of ceramic and refractory clays to Poland, by country

'000 t

Year	2008	2009	2010	2011	2012
Ceramic clays, total	**430.5**	**293.5**	**339.0**	**447.8**	**408.8**
China	0.8	–	–	0.6	0.4
Czech Republic	5.8	7.4	11.4	22.2	18.1
Germany	103.0	64.0	66.2	111.8	132.6
Italy	0.2	0.1	0.0	0.0	0.0
Portugal	–	3.6	0.2	–	–
Spain	1.5	1.7	1.6	2.1	2.5
Ukraine	306.9	209.2	250.4	306.4	251.1
United Kingdom	7.3	5.2	8.3	3.5	3.1
USA	3.7	1.8	0.4	0.4	0.5
Others	1.5	0.5	0.5	0.8	0.5
Ball clays (kaolinitic clays)[1] CN 2507 00 80	**13.1**	**9.4**	**13.4**	**9.2**	**15.7**
Czech Republic	0.6	0.2	0.2	0.3	0.9
Germany	0.5	2.2	4.1	4.4	11.1
Ukraine	0.1	0.3	0.3	0.2	–
United Kingdom	7.3	4.9	8.2	3.5	3.0
USA	3.6	1.6	0.3	0.3	0.4
Others	1.0	2.0	0.0	0.5	0.3
Refractory clays CN 2508 30	**313.9**	**212.6**	**248.2**	**313.6**	**259.5**
China	0.8	–	–	0.6	0.4
Czech Republic	2.8	1.0	0.7	0.7	0.8
Germany	6.9	4.5	7.3	10.2	11.1
Ukraine[2]	303.4	206.8	239.9	302.1	247.2
United Kingdom	0.0	0.3	0.0	0.0	0.0
Stoneware clays and other clays CN 2508 40	**103.5**	**71.5**	**77.4**	**125.0**	**133.5**
Czech Republic	2.4	6.2	10.5	21.2	16.5
Germany	95.6	57.3	54.8	97.2	110.4
Italy	0.1	0.0	0.0	0.0	0.0
Portugal	–	3.6	0.2	–	–
Spain	1.4	1.4	1.5	1.9	2.3
Ukraine	3.4	2.1	10.2	4.1	3.9
Others	0.6	0.9	0.3	0.6	0.4

[1] except for kaolin — CN **2507 00 20** (see: **KAOLIN**)

[2] the majority is supposed to be white-firing clays (ball clays), which are classified here by mistake

Source: ***The Central Statistical Office (GUS)***

the refractory industry. In recent years the major suppliers were: Ukraine and Germany (93-95% of total deliveries), while the minor — the United Kingdom, the Czech Republic, the US, and — occasionally — Italy, Spain, Portugal and others (Tab. 3). Ukrainian clays, which originated basically from Donieck region, were delivered mainly by two companies: **Vesco** and **Donbas Clays**, while German clays — by **Stephan Schmidt Meißen** and **Kaolin und Tonwerke Seilitz-Löthain** (**WBB Group**) located in Saxony region. The principal deliveries from the United Kingdom came from **WBB Minerals** and **Imerys**, and from the Czech Republic — **LB Minerals** (**Lasselsberger Group**). Imports of ***burnt clay*** varied between 4,000–8,500 tpy in recent years, coming from Ukraine the Czech Republic, the US, France and Germany (Tab. 2).

Some small amounts of ***ceramic clays*** are also exported from Poland. These are mainly ***raw refractory clays*** from Rusko-Jaroszów mine (under 20,000 tpy), sold primarily to the Czech Republic, Germany, Hungary, Macedonia and Switzerland, but since 2009 - also stoneware clay exported to Germany, Russia, and Ukraine (Tab. 4). Marginal amounts of ***burnt refractory clays*** are also exported (Tab. 2).

Tab. 4. Exports of ceramic and refractory clays from Poland, by country

'000 t

Year	2008	2009	2010	2011	2012
Ceramic clays, total	**18.3**	**23.7**	**30.2**	**28.8**	**22.4**
Czech Republic	9.5	5.1	9.5	8.0	4.1
Germany	5.5	12.4	5.4	10.7	10.0
Hungary	0.3	0.2	0.1	0.2	0.2
Macedonia	0.5	0.3	0.3	0.2	0.2
Russia	–	3.2	9.1	2.1	0.6
Switzerland	1.6	0.8	0.9	1.3	0.9
Ukraine	–	–	3.6	4.6	5.1
Others	0.9	0.9	1.3	1.7	0.8
Ball clays (kaolinitic clays)[1] CN 2507 00 80	**0.1**	**0.0**	**1.1**	**1.2**	**0.7**
Belarus	–	–	–	–	0.5
Czech Republic	0.1	0.0	0.8	1.1	0.2
Others	0.0	0.0	0.3	0.1	0.0
Refractory clays CN 2508 30	**16.2**	**11.7**	**14.2**	**13.9**	**9.9**
Czech Republic	9.4	5.1	8.7	6.9	3.9
Germany	4.1	5.1	3.9	5.0	4.7
Hungary	0.3	0.2	0.1	0.2	0.2
Macedonia	0.5	0.3	0.3	0.2	0.2
Switzerland	1.6	0.8	0.9	1.3	0.9
Others	0.3	0.2	0.3	0.3	0.0
Stoneware clays and other clays CN 2508 40	**2.0**	**12.0**	**14.9**	**13.7**	**11.8**
Germany	1.4	7.3	1.5	5.6	5.3
Russia	–	3.2	9.1	2.1	0.6
Ukraine	–	–	3.6	4.6	5.1
Others	0.6	1.5	0.7	1.4	0.8

[1] except for kaolin — CN **2507 00 20** (see: **KAOLIN**)

Source: ***The Central Statistical Office (GUS)***

The trade balance of all groups of ***ceramic clays*** has been constantly negative. In recent years, following the increase in importation, the trade deficit has deepened, approaching — in sum — over 115 million PLN in 2012 (Tab. 5).

Tab. 5. Value of trade of ceramic and refractory clays in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Ball clays (kaolinitic clays) CN 2507 00 80					
Exports	38	20	467	700	174
Imports	6,905	5,657	7,193	6,623	8,349
Balance	**-6,867**	**-5,637**	**-6,726**	**-5,923**	**-8,175**
Refractory clays CN 2508 30					
Exports	5,371	5,092	5,227	5,660	4,753
Imports	54,442	41,808	57,431	81,924	79,875
Balance	**-49,071**	**-36,716**	**-52,204**	**-76,264**	**-75,122**
Stoneware clays and other clays CN 2508 40					
Exports	624	2,809	6,841	7,434	6,701
Imports	19,811	18,897	17,657	30,561	30,622
Balance	**-19,187**	**-16,088**	**-10,816**	**-23,127**	**-23,921**
Burnt refractory clays and shale CN 2508 70 10					
Exports	66	107	177	173	236
Imports	6,015	4,711	6,997	5,903	7,984
Balance	**-5,949**	**-4,604**	**-6,820**	**-5,730**	**-7,748**

Source: ***The Central Statistical Office (GUS)***

Average unit values of ***raw refractory clay*** exported from Poland were stable in recent years at 40–50 USD/t, with jump to 120-180 USD/t since 2008 (Tab. 4). Average unit values of ***raw refractory clay*** and ***white-firing clays*** imported to Poland under the item **CN 2508 30** were increasing from 27 USD/t in 2004 to 94 USD/t in 2012, primarily due to important price increase of commonly cheap Ukrainian grades. Unit values of ***stoneware clays*** imports, reported in the item **CN 2508 40** and coming primarily from Saxony (Germany), were stable (75–85 USD/t), with significant reduction in 2012 down to 70 USD/t. Unit values of ***kaolinite clays*** imports, reported in the item **CN 2507 00 80** and coming primarily from the UK — are commonly a few times higher (Tab. 6). The average unit values of ***burnt refractory clay*** imports rose strongly to ca. 380 USD/t in the years 2008-9, with 25% reduction in the next three years (Tab. 6).

Consumption

Ceramic clays are used for manufacture of numerous ceramic products. The most important of them are: faience, porcelain, stoneware and clinker tiles, sanitaryware, semi-

Tab. 6. Average unit values of ceramic and refractory clays trade in Poland

Year	2008	2009	2010	2011	2012
Ball clays (kaolinitic clays) CN 2507 00 80					
Imports unit values					
— PLN/t	527.7	603.5	536.0	722.4	530.6
— USD/t	223.2	190.8	177.5	244.8	162.0
Stoneware clays and other clays CN 2508 40					
Imports unit values					
— PLN/t	191.3	264.3	228.2	244.5	229.3
— USD/t	81.4	85.3	75.8	83.0	70.3
Refractory clays CN 2508 30					
Exports unit values					
— PLN/t	332.2	437.0	366.9	544.3	479.7
— USD/t	139.5	139.4	121.6	183.9	147.3
Imports unit values					
— PLN/t	173.4	196.6	231.4	261.3	307.7
— USD/t	73.7	65.2	76.3	88.2	94.2
Burnt refractory clays CN 2508 70 10					
Imports unit values					
— PLN/t	886.6	1,163.6	952.3	911.6	940.2
— USD/t	379.7	385.9	314.7	313.3	289.3

Source: ***The Central Statistical Office (GUS)***

vitreous china-ware, other stoneware products, refractory chamotte products, refractory mortars, and mixes.

Ceramic tiles are the main ceramic products, where ***ceramic clays*** are currently used. These are both ***white-firing clays*** and ***stoneware clays***. However, production of ***faience tiles*** — where ***white-firing clays*** with poor sintering properties are primarily used — has declining tendency. On the contrary, there is continuous increasing tendency of manufacture of ***stoneware tiles*** (with stoneware clays as one of the main components), as well as ***porcelain tiles*** (***gres tiles***), where ***white-*** or ***light-firing clays*** with good sintering properties find use. In Poland, production of ***unglazed*** and ***glazed stoneware tiles*** and ***gres tiles*** is carried on. Their total production rose by over 180% since 2000 to ca. 1.9 Mt in 2008. In the next four years, it varied between 1.76-1.96 Mtpy, depending on domestic demand and possibilites of export sales development (Tab. 7). Production capacities of ceramic tiles achieved the level of over 140 Mm^2py (over 2.2 Mtpy), including over 60 Mm^2py of ***gres tiles***. The major domestic producers of ***ceramic tiles*** in 2012 were: **Cersanit Capital Group**[1], which controls two ceramic tiles companies: **Opoczno I Ltd.** operating

[1] in January 2012 Cersanit S.A. changed the name into: Rovese S.A.

4 plants in Opoczno (total capacities 27 Mm^2py), and **Cersanit III S.A.** in Wałbrzych (capacities 19 Mm^2py), as well as **Paradyż Group** (5 plants of combined capacity of 38 Mm^2py in the Tomaszów Mazowiecki and Opoczno vicinity). Minor producers are: **Ceramika Tubądzin** (2 plants: in Tubądzin and Ozorków), **Ceramika Nowa Gala Capital Group** (**Ceramika Nowa Gala S.A.** in Końskie and **Ceramika Gres S.A.** near Końskie), **Końskie Capital Group** (plants: **Ceramika Końskie, Cer-Rol, CerArt Studio, Star-Gres**), **Polcolorit Capital Group** (**Polcolorit S.A.** and **Ceramika Marconi** plants in Piechowice near Jelenia Góra), **Cerkolor Ltd.** (3 plants: in Parczówek, Czeladź and Żelachowice), **Franciszek Jopek** in Zabrze, and **Ceramika Pilch** in Jasienica. ***Clinker tiles***, produced on the basis of ***color stoneware clays***, are currently also included in the group of ***ceramic tiles***. They are offered by ca. 10 Polish factories, among which the largest are: **Cerrad** in Radom, **Ceramika Tarona** in Tarczyn near Warsaw, **Ceramika Przyborsk** near Bolesławiec, and **ZPC Przysucha** in Przysucha.

Tab. 7. Ceramic tiles statistics in Poland – 6907 90 20–80, 6908 90 91–99

'000 t

Year	2008	2009	2010	2011	2012
Production, total	**1,932.2**	**1,758.6**	**1,789.4**	**1,960.2**	**1,836.9**
• Stoneware, gres and similar tiles, unglazed	386.0	284.5	343.0	421.1	380.4
• Faience tiles, unglazed	228.7	175.5	138.2	142.9	144.6
• Stoneware, gres and faience tiles, glazed	1,257.5	1,198.6	1,308.2	1,396.2	1311.9
Imports, total	**256.8**	**191.8**	**188.5**	**191.3**	**179.5**
• Stoneware, gres and similar tiles, unglazed	48.0	34.0	34.2	29.1	27.4
• Faience tiles, unglazed	59.7	50.8	58.1	57.3	53.4
• Stoneware, gres and similar tiles, glazed	73.6	54.4	54.4	95.6	90.9
• Faience tiles, glazed	55.5	52.6	41.8	9.3	7.8
Exports, total	**466.3**	**329.5**	**433.8**	**518.8**	**586.7**
• Stoneware, gres and similar tiles, unglazed	123.7	91.5	129.4	48.7	55.9
• Faience tiles, unglazed	85.0	60.4	63.1	167.0	166.9
• Stoneware, gres and similar tiles, glazed	35.0	36.2	60.2	256.7	321.6
• Faience tiles, glazed	222.6	141.4	171.1	46.4	42.3
Consumption, total	**1,722.7**	**1,620.9**	**1,554.1**	**1,632.7**	**1,429.7**

Source: ***The Central Statistical Office (GUS)***

The development of domestic ***ceramic tiles*** sector was reflected by reduced importation coupled with increased foreign sales in the last years. Since 2004, ceramic tiles exports have been higher than their imports for the first time. However, due to economic crisis in the neighboring countries, tiles exports in 2009 fell by almost 30%, with imoprtant recovery in 2010 and record export level in 2011 and 2012 (Tab. 7). The main Polish tiles recipients currently are: Romania, Slovakia, Germany (each over 10%), Ukraine, Russia, the Czech Republic, Lithuania, Hungary (each 6-9%), and over 20 other countries. Principal deliveries to Poland are coming from Italy, China and Spain, with smaller quantities being purchased in Germany, and the Czech Republic. The share of imported tiles in the supplies to the domestic market decreased from 40% in 1999 to 11-12% in recent years. As a result, their trade balance significantly changed, from –945 million PLN in 2000 to +350 million PLN in 2012 (Tab. 8).

Tab. 8. Value of trade of the main ceramic products in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Ceramic tiles CN 6907 90 20–80, 6908 90 91–99					
Exports	590,637	414,714	485,144	615,467	714,038
Imports	511,840	396,307	360,763	391,783	363,543
Balance	**+78,797**	**+18,407**	**+124,381**	**+223,684**	**+350,495**
Ceramic sanitaryware CN 6910					
Exports	414,253	361,343	378,346	400,003	415,994
Imports	152,827	144,961	143,250	142,055	146,341
Balance	**+261,426**	**+216,382**	**+235,096**	**+257,948**	**+269,653**
Semi-vitreous china-ware CN 6912 00 10,90					
Exports	14,273	24,015	35,232	66,564	78,915
Imports	66,771	61,586	52,248	104,467	119,268
Balance	**-52,498**	**-37,571**	**-17,016**	**-37,903**	**-40,353**

Source: ***The Central Statistical Office (GUS)***

White-firing clays, along with ***kaolin*** and ***stoneware clays***, are also utilized for the production of ***ceramic sanitaryware***. Currently, there are seven producers of ***ceramic sanitaryware*** in Poland, but two of them dominate: **Cersanit I Ltd.** (a part of **Cersanit Capital Group**, a plant in **Krasnystaw** with a capacity of 3.2 million pieces per year), and **Sanitec Koło Ltd.** (3 plants in **Koło**, **Włocławek**, and **Ozorków**, total capacities ca. 3.0 million pieces per year). Each of these companies has ca. 40% share in the domestic production. The other producers are: **Roca Sanitario** in **Gliwice**, **Hybner S.A.** in **Środa Śląska**, **Deger Ceramika Ltd.** in **Jezuicka Struga** near **Inowrocław,** and **Ceramika Pilch** in **Jasienica** near **Bielsko-Biała**. In the years 2000-2008 the total production of sanitaryware in Poland has increased by almost 140%, what was coupled with a revival in exportation, the share of which increased up to 75–80% of the total output. However, since 2009 - due to decline of exports and domestic demand - sanitaryware production declined by 25% to 83,700 t in 2012 (Tab. 9). Among the principal recipients were Germany, France, the United Kingdom, Italy, Ukraine, Russia, the Czech Republic, Slovakia, Estonia, etc. The trade balance has been improving year by year, approaching +294 million PLN in 2007, with some reduction to +216 million PLN in 2009 and rise to almost +270 million PLN in 2012 (Tab. 8).

Tab. 9. Ceramic sanitaryware statistics in Poland — CN 6910

'000 t

Year	2008	2009	2010	2011	2012
Production	111.4	89.1	93.8	93.3	83.7
Imports	24.1	18.6	20.2	19.6	18.0
Exports	85.2	59.3	67.6	70.3	67.0
Consumption[a]	50.3	48.4	46.4	42.6	34.7

Source: ***The Central Statistical Office (GUS)***

Production of ***semi-vitreous china-ware***, i.e. ***table pottery goods*** and — in lesser amounts — ***fancy goods***, recently somewhat recovered to almost 2,000 tpy, primarily in Tułowice plant (new company **Ceramika Tułowice**). However, domestic market is still dominated by the Chinese ***semi-vitreous china-ware***, which were even partly re-exported from Poland to the Western European countries (Tab. 10).

Tab. 10. Semi-vitreous china-ware statistics in Poland — CN 6912 00 10,90

'000 t

Year	2008	2009	2010	2011	2012
Production	2.9	1.9	1.7	1.7	1.9
Imports	15.4	9.8	9.3	18.4	18.3
Exports	1.1	1.3	1.7	4.2	5.7
Consumption[a]	17.2	10.4	9.3	15.9	14.5

Source: ***The Central Statistical Office (GUS)***

In contrast to the ***stoneware tiles***, the production of ***other stoneware products***, especially of ***acid-resistant*** and ***electrotechnical stoneware ceramics***, and ***sanitary stoneware goods***, has generally declined (Tab. 11). The primary Polish ***stoneware*** manufacturers are: the **Bolesławiec Ceramic Plant** and smaller pottery manufactures in Bolesławiec area, delivering ***table and garden stoneware***, ***pots and barrels*** (so-called ***Bolesławiec ceramics***), the **Marywil Stoneware Plant** in **Suchedniów** and the **Ziębice** plant, specialized in ***acid-resistant stoneware goods*** as well as ***stoneware sewage pipes***. The trade in these commodities has been marginal, with except of ***pottery***. Pottery imports amounted to ca. 6,400 t in 2012, their exports ca. 1,100 t, while trade balance started to be negative: -29.3 million PLN in 2012.

Tab. 11. Other stoneware goods production in Poland

'000 t

Year	2008	2009	2010	2011	2012
Chemical and electrotechnical stoneware	1.2	0.6	0.8	7.5	7.3
Pottery	1.7	0.6	0.7	0.6	0.6
Sewage pipes, sanitary products	1.2	1.1	0.8	1.4	1.7

Source: ***The Central Statistical Office (GUS)***

The level of ***raw refractory clay*** consumption in Polish refractory industry in recent years was estimated at ca. 110,000–130,000 tpy, with ca. 70,000–90,000 tpy coming from domestic sources, and 30,000-40,000 tpy from imports. ***Raw refractory clay*** produced in Poland was consumed in a half for burnt refractory clay production (entirely in **JARO S.A.**), and in a half — directly in refractory industry. Both raw and burnt refractory clays are used mainly for the production of ***chamotte products — bricks*** and ***shapes*** (Tab. 12), as well as for ***refractory mortars*** and ***mixes***. Demand for ***raw refractory clay*** in the refractory industry in 2009 and 2010, due to crisis in iron and steel industry, fell probably by a half, i.e. to 50,000-60,000 tpy, while demand for ***burnt refractory clay*** also by almost a half to ca. 32,000 tpy. In 2011 and 2012, these levels of demand recovered by almost 30% due to some improvement of market situation in iron and steel industry and other industries being main chamotte refractories consumers.

Tab. 12. Production of the main chamotte refractories in Poland

'000 t

Year	2008	2009	2010	2011	2012
Chamotte bricks	57.5	35.5	37.4	40.4	47.3
Chamotte shapes[1]	8.8	7.7	7.7	7.6	10.4

[1] crucibles, nozzles, pipes etc.

Source: ***The Central Statistical Office (GUS)***

Major companies involved in ceramic and refractory clays production in Poland as of December 2012

- "Ekoceramika" Sp. z o.o. ("Ekoceramika" Ltd.), 59–700 Bolesławiec, Suszki 80, tel. +48 75 7841120, fax +48 75 7841121, www.ekoceramika.pl — *white-firing and stoneware clays* (Janina and Zebrzydowa mines).
- Bolesławieckie Zakłady Materiałów Ogniotrwałych Sp. z o.o. (Bolesławiec Refractory Works Ltd.), 59–700 Bolesławiec, u. Kościuszki 8, tel./fax +48 75 7323661, www.bzmo.com.pl — *white-firing clays* (Czerwona Woda mine and plant).
- Kopalnie Surowców Mineralnych "Surmin-Kaolin" S.A. ("Surmin-Kaolin" Minerals Mines Joint Stock Co.), ul. Kaolinowa 35, 59–730 Nowogrodziec, tel. +48 75 7350044, fax +48 75 7350043, www.surmin-kaolin.com.pl — *granulate of white- firing clays* (Nowogrodziec plant).
- JARO" S.A. w Jaroszowie ("JARO" Joint Stock Co. of Jaroszów), 58–120 Jaroszów, tel. +48 74 8549810, fax +48 74 8558024, www.jaro.pl — *raw refractory clay, burnt refractory clay* (Jaroszów mine and plant).
- "Glinkop" Sp. z o.o. ("Glinkop" Ltd.), 26–330 Żarnów, Paszkowice 57A, tel./fax +48 44 7577012, www.glinkop.pl — *stoneware clays* (Chełsty mines).
- Gozdnickie Zakłady Ceramiki Budowlanej Sp. z o.o. (Gozdnica Building Ceramics Plants Ltd.), ul. Świerczewskiego, 68–130 Gozdnica, tel. +48 68 3601922, fax +48 68 3601923, www.crh-klinkier.pl — *stoneware clay* (Gozdnica and Jasień mines).
- "Patoka Industries" Sp. z o.o. ("Patoka Industries" Ltd.), ul. Ceramiczna 23, 42–793 Panoszów, tel. +48 34 3538068, fax +48 34 3538017, www.crh-klinkier.pl — *stoneware clay* (Patoka mine).

COBALT

Overview

Cobalt (**Co**) occurs together with Ni and Cu in polymetallic ores, sometimes as an isomorphous admixture. It is occasionally obtained in the form of **Cu-Co** or **Ni-Co mixed concentrates**, but the principal method for the production of **cobalt metal** is the pyrometallurgical processing of ***Co-bearing copper*** and ***nickel concentrates***, ***pyrite***, and ***latheritic nickel ores***. It is also successfully recovered from ***Co-bearing slag***, ***matte***, or ***alloys***, which are hydrometallurgically processed into **cobalt hydroxide**. This is the raw material for the production of **cobalt metal**, **cobalt oxides**, and other **cobalt compounds**.

Currently, **cobalt** is utilized primarily as a metallic matrix for heat-resistant and soft paramagnetic alloys containing Cr, Mo, Ni, Nb, and W (rarely Mn, Ta, Ti, and V), which are used in the mechanical and electrotechnical industries. To a lesser extent it is applied for the production of chemical and ceramic compounds.

Sources

In Poland ***cobalt*** occurs as an accompanying element in ***copper ore*** deposits of the **Fore-Sudetic Monocline**. Its total estimated reserves, as of December 2012, were 123,520 t Co, including 98,950 t Co in deposits extracted by the **KGHM Polska Miedź S.A.** Potential source of ***cobalt*** are deposits of ***hard coal*** in the **Upper Silesia Coal Basin** (approximate reserves of 400,000 t).

Production

The amount of ***cobalt*** in the output of ***copper ore*** has ranged from 1,510 to 5,050 tpy (1,770 tons in 2012). The richest in cobalt has been the ore extracted at the **Lubin-Małomice** mine (82–250 g/t). In course of the ore beneficiation, 130–930 ppm of Co passes into ***copper concentrate***. During smelting, approx. 80% of that amount is lost in converter slag, which contains 1–2% Co. Despite many years of research, up to date any technology for ***cobalt metal*** recovery from the shaft furnace slag of **Głogów I** and **Legnica** smelters has not been implemented. The interest in this conception has revived with the commissioning of the new KGHM's subsidiary **KGHM Ecoren**, which has been established to process copper ore treatment tailings, which contain many valuable elements, including ***rhenium***, ***cobalt***, and ***nickel***. In recent years the innovative technology for hydrometallurgical purification of ***raw nickel sulfate*** produced by the KGHM, with possible extraction of ***cobalt sulfate***, has been developed. Another forward-looking solution has been formulation of spherical powders of ***rhenium-based alloys*** with ***cobalt and nickel***. The potential recipients of these innovative products are the aerospace industry and space technology.

Trade

The demand for ***cobalt commodities*** in Poland is entirely satisfied by imports (Tab. 1). Until 2008 the major supplier of ***cobalt matte*** and ***powder*** were the United States, while in the following years Germany emerged as the main source of these commodities (Tab. 2). The volume of total deliveries ranged from 33 to 39 tpy, showing a declining tendency. Simultaneously, small amounts of ***cobalt matte*** and ***powder*** were exported (possible re-exports of excess shipments). Another commodities imported to Poland on regular basis have been ***cobalt oxide*** and ***hydroxide***. These compounds were purchased basically from Finland and Belgium, and — incidentally — from the United Kingdom, Germany, Italy, Ukraine, and others (Tab. 3). In 2011 that usually two-digit deliveries crested to 110 tons due to occasional large purchase from the United Kingdom. In 2010 small amount of cobalt in the form of ***scrap*** and ***Co-bearing waste*** was also exported, mainly to the United Kingdom and Germany (Tab. 1).

Tab. 1. Trade in cobalt commodities

t

Year	2008	2009	2010	2011	2012
Cobalt oxide and hydroxide CN 2822 00					
Imports	37	14	18	110	15
Exports	8	6	8	3	1
Cobalt matte, cobalt, cobalt powders CN 8105 20					
Imports	39	39	34	33	33
Exports	5	1	4	3	1
Cobalt wastes and scrap CN 8105 30					
Imports	0	–	–	–	–
Exports	0	0	1	–	0

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of cobalt, by country — CN 8105 20

t Co

Year	2008	2009	2010	2011	2012
Imports	**39**	**39**	**34**	**33**	**33**
Belgium	3	1	1	2	2
China	–	1	0	0	0
Canada	–	1	1	1	1
Finland	1	1	–	–	1
France	2	2	–	–	1
Germany	7	12	20	20	15
Netherlands	7	11	3	3	2
United Kingdom	–	–	2	2	1
USA	18	9	7	4	9
Others	2	1	–	1	1

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Polish imports of cobalt oxide and hydroxide, by country — CN 2822 00

t

Year	2008	2009	2010	2011	2012
Imports	**37**	**14**	**18**	**110**	**15**
Belgium	3	1	3	6	4
Finland	26	10	8	12	5
Germany	5	–	0	–	0
Italy	–	–	6	8	5
Ukraine	–	–	–	11	–
United Kingdom	1	–	0	72	0
Others	2	3	1	1	1

Source: ***The Central Statistical Office (GUS)***

The combined trade balance of major ***cobalt commodities*** in Poland was always negative. In the last three years the deficit in the trade of ***cobalt metal*** amounted to 3.1-4.1 million PLN/y, showing a slight improvement as compared to 2008. That resulted from changes in volume and unit value of importation, as well as from the metal price fluctuations (Tabs. 4, 5). Over last five years the balances of ***cobalt oxide*** and ***hydroxide*** trade were changing in the wider interval, i.e. between -0.9 and -4.2 million PLN. The exceptions in the last five years were positive financial results in ***cobalt scrap*** turnover, particularly in 2010 (Tab. 4).

Tab. 4. Value of cobalt commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Cobalt oxide and hydroxide CN 2822 00					
Exports	1,142	547	838	309	137
Imports	5,367	1,473	1,929	3,050	1,420
Balance	**-4,225**	**-926**	**-1,091**	**-2,741**	**-1,283**
Cobalt matte, cobalt, cobalt powders CN 8105 20					
Exports	592	183	598	385	143
Imports	5,477	4,194	3,717	4,264	4,273
Balance	**-4,885**	**-4,011**	**-3,119**	**-3,879**	**-4,130**
Cobalt wastes and scrap CN 8105 30					
Exports	0	3	58	0	5
Imports	0	0	0	0	0
Balance	**0**	**+3**	**+58**	**0**	**+5**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Unit value of cobalt metal and cobalt oxide imports to Poland

Year	2008	2009	2010	2011	2012
Cobalt metal CN 8105 20					
PLN/t	145,063	107,530	109,309	128,421	128,324
USD/t	63,228	34,269	36,052	44,520	39,252
Cobalt oxide and oxide CN 2822 00					
PLN/t	187,764	105,184	108,961	27,729	95,323
USD/t	59,572	34,379	35,998	9,343	28,951

Source: ***The Central Statistical Office*** *(GUS)*

Consumption

In Poland, ***cobalt metal*** is primarily utilised for the production of cobalt steel, cutting tools made of sintered carbides, etc. ***Cobalt oxides*** and ***hydroxides***, which are regularly imported in significant quantities, are utilized as ceramic pigments, for making overglaze and underglaze ceramic colors, and as drying agents for paints, varnishes and printer's ink. The end-use distribution of cobalt commodities in Poland is difficult to ascertain.

COKE

Overview

Coke is a solid substance containing 96–98% of C and small amounts of O_2, H_2, N_2, and S. It is obtained from the thermal decomposition of ***hard coal*** and, to a lesser extent, ***brown coal***, ***peat***, and heavy semi-products recovered from the processing of ***crude oil***. Of the greatest significance in the world economy is the **coke** produced in cokeries from ***coking coal***, the so-called **blast-furnace coke** and **foundry coke**. The main application of blast-furnace coke is to reduce oxide iron ores. It is also widely used as a fuel in steel-making and non-ferrous metal smelters, as well as in foundries, lime production, etc. The lower grades of coke (**commercial coke**) are used to heat dwellings, greenhouses, etc.

Other types of coke include **pitch coke**, obtained from ***coal*** or ***peat pitch***; **petroleum coke**, made of the ***heavy residue of petroleum***; **peat coke**, produced in low-temperature ***peat*** carbonization plants; **semi-coke**, produced by low carbonization of ***brown*** and ***hard coal***; and others. These are used in the chemical industry to produce ***coal electrodes***, ***anode masses***, ***electrographite***, ***silicon carbide***, and many other products.

Production

Poland is among the leading manufacturers of ***coke*** from ***coking coal***. Due to decreasing domestic demand from 1998, especially in the steel-making industry, the production depends heavily on export contracts, which make currently ca. 60–71% of sales. Higher demand of foreign consumers resulted in important increase of domestic ***coke*** production in 2006–2008 and again in 2010 after deep drop in 2009. In the years 2011–2012 domestic coke production was reduced by ca. 9%, due to lower demand for ***blast-furnace coke,*** production of which decreased by 17% (Tab. 1). In case of ***commercial coke*** in 2011 significant growth was reported, with 5% reduction in 2012. Only production of other types of coke, especially ***foundry coke***, was continuously increasing (Tab. 1).

There are presently 9 cokeries in operation, with total capacities of ca. 10.8 Mtpy of coke. They are located mainly near hard coal mines or steelworks. In 2011, significant consolidation processes took place. **Kombinat Koksochemiczny Zabrze S.A.** (**KK Zabrze**, Coke and Coal Chemical Group Zabrze Joint Stock Co.) and **Wałbrzyskie Zakłady Koksownicze Victoria S.A.** (**WZK Victoria**, Wałbrzych Coke Works Victoria Joint Stock Co.) were incorporated by State Treasury into **Jastrzębska Spółka Węglowa S.A.** (**JSW**, Jastrzębie Coal Company Joint Stock Co.). Now, two strong coke producing groups are active. The largest one is **JSW** with **Koksownia Przyjaźń Sp. z o.o. w Dąbrowie Górniczej** (**ZK Przyjaźń**, Coke Plant Przyjaźń Ltd. of Dąbrowa Górnicza), **KK Zabrze** (three smaller cokeries — Jadwiga, Radlin, and Dębieńsko) and **WZK**

Tab. 1. Coke statistics in Poland — CN 2704

'000 t

Year	2008	2009	2010	2011	2012
Production	10,075	7,091	9,738	9,377	8,893
— *blast furnace coke*	*7,616*	*5,305*	*7,200*	*6,417*	*5,979*
— *commercial coke*	*1,643*	*1,314*	*1,791*	*2,186*	*2,075*
— *other types*	*816*	*472*	*747*	*774*	*839*
Imports	85	55	137	147	138
Exports	6,120	4,813	6,683	6,492	6,391
Change in stocks	524	-360	134[r,e]	55	-145[e]
Consumption	3,516	2,693	3,058[r]	2,977	2,783

Source: ***The Central Statistical Office (GUS)***

Victoria, with total capacities of 5.1 Mtpy of coke, including 3.4 Mtpy in ZK Przyjaźń and 1.2 Mtpy in KK Zabrze. The second group is **ArcelorMittal Poland S.A**. with **Zdzieszowice Unit — Coke Works Zdzieszowice** in **Zdzieszowice** and **Kraków Unit** — coke plant at the steelworks in Kraków. Their total capacities are 4.8 Mtpy of coke, including 4.2 Mtpy in Zdzieszowice Unit. These two groups together supply over 91% of the domestic ***coke*** production, with higher share of ArcelorMittal Poland. There are two independent cokeries: **Częstochowa Nowa** coking plant at the **ISD Huta Częstochowa** steelworks – capacity 0.6 Mtpy, and **CARBO-KOKS** of **Bytom** (at the steelworks in Bytom**) –** capacity 0.2 Mtpy. Their technical state is various. Up till now, almost all cokeries were partly modernized. Moreover, trzy new coke batteries were constructed in **Zdzieszowice** (2006), **Przyjaźń** (2007) and **Częstochowa Nowa** (2011) cokeries.

Trade

Since 2009, Poland became the world's largest exporter of ***blast-furnace coke***. It was traditionally sold primarily to EU European countries, with Germany, Austria and Romania as the main customers, but periodically also to overseas customers, such as the US, Algeria, Brazil and India or some non-EU European countries like Norway, Ukraine and Serbia (Tab. 2). Imports of ***coke*** were marginal, recently coming primarily from the Czech Republic, Russia and Ukraine. The balance of ***coke*** trade is highly positive (Tab. 3), and correlates to exports volumes and unit values (Tab. 2, 4). So, in 2009 coke exports volume was reduced by over 20%, while unit values - reduced by 30% (in PLN/t terms), so positive trade balance was reduced by 45%, but it still amounted almost 3.3 billion PLN. In the years 2010–2011 situation reversed: exports volumes rose by 35%, unit values by 83%, and trade balance by 147% to over 8.0 billion PLN. However, in 2012 exports unit values were reduced by 20%, while trade balance – by 22% to 6.3 billion PLN (Tab. 3).

Tab. 2. Polish exports of coke, by country — CN 2704

'000 t

Year	2008	2009	2010	2011	2012
Exports	**6,120**	**4,813**	**6,683**	**6,492**	**6,391**
Algeria	113	85	172	327	132
Austria	972	568	831	976	1,010

Belarus	36	18	34	45	50
Belgium	53	47	114	13	26
Brazil	–	–	–	44	275
Canada	165	–	–	21	–
Croatia	–	0	4	6	9
Czech Republic	385	451	556	413	435
Denmark	–	9	20	14	8
Egypt	21	14	19	35	25
Finland	216	141	194	236	145
France	255	356	274	173	109
Germany	1,708	1,379	2,138	2,262	1,870
Hungary	16	0	6	7	7
Iceland	21	20	12	21	21
India	–	419	44	85	368
Iran	–	84	–	–	–
Italy	1	10	5	7	12
Lithuania	3	2	1	1	0
Macedonia	3	–	2	–	–
Mexico	–	14	9	76	87
Netherlands	25	19	25	43	36
Norway	283	138	220	239	272
Pakistan	41	99	48	28	30
Romania	680	521	826	672	759
Russia	11	0	4	23	67
Serbia	105	53	175	24	5
Slovakia	238	198	460	387	92
Slovenia	1	2	5	7	6
South Africa, Republic of	0	23	33	41	22
Spain	56	13	17	17	13
Sweden	45	17	87	37	27
Ukraine	548	107	151	97	448
United Kingdom	55	3	24	23	10
USA	60	–	170	86	–
Others	4[r]	3[r]	3[r]	6	15

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of coke trade in Poland — CN 2704

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	5,981,230	3,293,094	6,943,693	8,135,876	6,358,049
Imports	82,344	35,019	87,264	99,329	102,238
Balance	**+5,898,886**	**+3,258,075**	**+6,856,429**	**+8,036,547**	**+6,255,811**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of coke exports from Poland — CN 2704

Year	2008	2009	2010	2011	2012
PLN/t	977.7	684.2	1,039.0	1,253.3	994.9
USD/t	418.5	224.5	342.4	429.3	303.9

Source: ***The Central Statistical Office (GUS)***

Consumption

After long-term declining tendency, in the years 2001–2004 coke consumption in Poland stabilized at ca. 5 Mtpy. In 2005, next long-term decreasing tendency started, though some temporary growth was reported in the years 2006–2007 and 2010. In 2012, domestic coke demand amounted to only 2.8 Mt (Tab. 5).

In the domestic structure of coke consumption, industry dominates (ca. 98% in 2012), while the rest is used in households, agriculture, transportation and construction, other users (trade, services, etc.).

Tab. 5. Structure of coke consumption in Poland

'000 t

Year	2008	2009	2010	2011	2012
Consumption	**3,516**	**2,693**	**3,058^{r}**	**2,977**	**2,783^{e}**
• energy transformation	2,631	1,632	1,935	1,983	1,914
• direct consumption	795	777	809	994	1,029
• balance losses and differences	90	284	315^{r}	–	-160^{e}

Source: ***The Central Statistical Office (GUS)***

According to the world trends, industry remains the main consumer of coke. In 2012 it was used directly as fuel in the production process — 78% of total domestic use of coke as fuel. In the industry, iron and steel production, foundry and nonferrous metals production dominate. Other industrial uses are: manufacture of chemical products, production of cement, ceramics, glass, lime etc. Coke is also used as fuel in households.

By-products

An important by-product obtained in the course of coke production is ***raw coke-oven gas***, which after consecutive purification and cooling operations provides ***crude tar***, ***crude benzol***, etc., and ***purified coke-oven gas***. In 2011–2012 cokeries produced respectively: 4,100 and 3,800 Mm^3 of ***coke-oven gas***; 405,000 and 376,000 t of ***crude tar***; 112,000 and 103,000 t of ***crude benzol***; 34,000 and 17,000 t of ***ammonium sulfate***. The by-products are further processed, mainly at chemical plants.

Companies involved in coke production in Poland, as of December 2012

- ArcelorMittal Poland S.A. Oddział w Zdzieszowicach (ArcelorMittal Poland S.A., Zdzieszowice Unit); ul. Powstańców Śląskich 1, 47–330 Zdzieszowice, tel. +48 77 4841000, fax +48 77 4841414, www.zkz.com.pl — *blast furnace coke, stabilized coke, foundry coke, commercial coke, crude benzol, crude tar, ammonium sulfate.*

- Koksownia Przyjaźń Sp. z o.o. w Dąbrowie Górniczej (Coke Plant Przyjaźń Ltd. of Dąbrowa Górnicza); ul. Koksownicza 1, 42–523 Dąbrowa Górnicza; tel. +48 32 7575000, fax +48 32 7575010, www.przyjazn.com.pl — *blast furnace coke, stabilized coke, commercial coke, crude benzol, crude tar, sulfur.*
- Kombinat Koksochemiczny Zabrze S.A. w Zabrzu (Zabrze Coke and Coal Chemical Group Joint Stock Co. of Zabrze); ul. Pawliczka 1, 41–800 Zabrze, tel. +48 32 2711231, fax +48 32 2718207, www.kkzabrze.com.pl — *blast furnace coke, stabilized coke, foundry coke, commercial coke, crude benzol, crude tar, ammonium sulfate, sulfur.*
- ArcelorMittal Poland S.A. Oddział w Krakowie (ArcelorMittal Poland S.A., Kraków Unit); ul. Ujastek 1, 30–969 Kraków; tel. +48 12 2902000, fax +48 12 2904023, www.arcellormittal.com/poland — *blast furnace coke.*
- Koksownia Częstochowa Nowa Sp. z o.o. w Częstochowie (Częstochowa Nowa Ltd. Coking Plant of Częstochowa); ul. Kucelińska 22, 42–200 Częstochowa; tel. +48 34 3231261, fax +48 34 3231271, www.isd-hsc.com.pl — *blast furnace coke, commercial coke.*
- Wałbrzyskie Zakłady Koksownicze Victoria S.A. w Wałbrzychu (Wałbrzych Coke Works Victoria Joint Stock Co. of Wałbrzych); ul. Beethovena 14, 58–302 Wałbrzych, tel. +48 74 8425440, fax +48 74 8425879, www.wzkvictoria.pl — *blast furnace coke, commercial coke, crude benzol, crude tar, ammonium sulfate.*
- CARBO-KOKS Sp. z o.o. w Bytomiu (CARBO-KOKS Ltd. of Bytom); ul. Konstytucji 61, 41–905 Bytom, tel. +48 32 7884661, tel./fax +48 32 7884662, www.carbo-koks.pl — *commercial coke, crude tar.*

CONCRETE AND CONCRETE PRODUCTS

Overview

Concrete is a building material consisting of mixed aggregate, cement and water. According to the European standard EN 206–1, the main types of concrete are distinguished: **ordinary**, **lightweight**, and **heavy**. The first has compact structure and bulk density range between 2,000 kg/m^3 to 2,600 kg/m^3; the second is characterized by bulk density between 800 kg/m^3 to 2,000 kg/m^3; the last, with density above 2,600 kg/m^3, is used mainly as radiation shielding (against gamma radiation, X-rays, neutron radiation). Its high volume density is obtained by utilizing ***heavy fillers*** (natural and artificial), e.g. barite, magnetite, ferrophosphorus, and lead.

Lightweight concrete is based on lightweight aggregates, e.g. made of ***ash-gravelite***, ***gravelite***, and similar materials or with special techniques aimed at increasing their porosity. The group is dominated by the ***autoclaved aerated concrete*** (**AAC**) with density range between 300 to 1,000 kg/m^3. The main ingredients used for its manufacture are: natural quartz sand or fly ash, burnt lime, and water, with small amounts of aluminum in form of powder or paste, which in contact with calcium hydrate generates the porous structure of concrete. The porous products are hardened in autoclaves in water vapour in the temperature of ca. 190^{o}C and pressure ca. 1.2 MPa. The autoclaved aerated concretes are good thermal insulators, are non-flammable, but have lower strength then ordinary concrete.

Sources

The typical components for ***concrete*** production are ***cement*** as binding agents and various ***aggregates*** used as fillers. Type of concrete depends on specific gravity of aggregates, as well as on technology used. Various type of aggregates: natural ***sand & gravel***, ***crushed aggregates***, ***artificial aggregates***, and ***recycled aggregates*** are utilized for ***ordinary concrete*** production. In the case of ***lightweight concrete***, ***lightweight aggregates*** are used. For ***cellular concretes***, the basic aggregate is ***quartz sand***, often replaced by or mixed with ***fly ash***. Besides cement, quick lime is also utilized to their production.

Production

Total production of ***concrete products***, both ***ordinary*** and ***cellular***, after period of steady growth until 2007, significantly decreased to the level of about 13 Mm^3 in 2009 as a consequence economic crisis (Tab. 1). In 2010 and 2011 its production has began to recover by over 8% a year, to its high record value of more than 15.3 Mm^3 in 2011, due to the development of the construction industry, stimulated by utilisation of EU funds in the construction sector (mainly road construction) and implementation of investments connected with EURO 2012. However, the same factors contributed to the decline in concrete products production in 2012, especially in the second half of that year immediately after the EURO 2012, so that 2012 ended with nearly 13% decrease in production down to ca. 13.3 Mm^3 (Tab. 1).

Tab. 1. Concrete and concrete products statistics in Poland

Year	2008	2009	2010	2011	2012
Production **[‘000 m^3]**					
Concrete products PKWiU 2661	**14,755**	**12,955**	**14,019**	**15,309**	**13,342**
• wall products for building construction	7,015	6,121	6,694	6,828	6,023
— *including* lightweight concrete products	5,211	*4,668*	*4,599*	*4,831*	*4,313*
• *in which* AAC products	*4,901*	*4,403*	*4,409*	*4,553*	*4,085*
• concrete products for road construction	4,790	4,666	5,005	6,000	5,219
• prefabricated concrete elements for construction	2,643	2,168	2,320	2,481	2,100
Precast ready-mix concrete PKWiU 266310	**17,913**	**16,398**	**19,208**	**24,388**	**19,945**
— *including* ordinary ready-mix concrete	16,855	15,833	16,535	21,460	18,480
PKWiU 2663100010					
Imports **[‘000 t]** **CN 6810**	**413**	**194**	**204**	**232**	**120**
Exports **[‘000 t]** **CN 6810**	**471**	**449**	**279**	**314**	**430**

Source: ***The Central Statistical Office (GUS)***

The group of concrete products includes three significant subgroups, in respect to their production quantity, such as: wall concrete products, concrete products for road construction, and large and medium prefabricated elements for construction.

The group of ***wall products for building construction*** is the most significant in terms of production volume between all subgroups manufacturing concrete products, but their share in the total supply decreased slightly in the last two years from 47% to 45% due to the increased dominance of the production of paving stones thanks to intensification of road projects. After 2009, when the production level decreased by over 13% to just over 6 Mm^3, in the next two years there has been a significant increase over the 6.8 Mm^3 in the 2011 (Tab. 1). The year 2012 brought a decline in production in this group as in the whole industry. The similar trend was recorded in case of products from autoclaved aerated concrete (AAC), which share almost 68% of all products for walls with concrete. The AAC products are currently manufactured in 30 plants. Seven plants use ***fly ash*** from the nearby power plants or heating plants in their production (Łagisza, Bielsko-Biała, Kozienice, Oświęcim, Skawina Warszawa and Stalowa Wola); the remaining plants (about 70% of domestic supply) utilize ***natural quartz sand***. The largest cellular concrete producers are: **Solbet** (leader with 33% share of market and production capacity reaching 2 Mm^3 per year, and with the largest plant in Polska and Europe in Solec Kujawski), **Grupa Prefabet** (five plants), **Xella Polska** (six plants) and **H+H Polska** (five plants). In result of extensive modernization the capacity of domestic plants rose significantly to about 8 Mm^3 annually. In 2010, 30 plants of cellular concrete in Poland produced a total of 4.4 Mm^3 of AAC, of which 1.4 Mm^3 - five plants of **Solbet** company. Among the various grades of ***cellular concrete*** produced in Poland, the most popular mark is 600 (volume density of 600 kg/m^3), accounting for 80% of production; the share of mark 700 is below 10%, while the 500, 400, and 300 marks make up the rest of production. Almost all producers of cellular concrete products (12 companies), as well as the majority of large manufacturers of ordinary concrete products (24 companies), belong to **Concrete Production Association** (**SPB**). Since 1996 association is a member of **European Autoclaved Aerated Concrete Association** (**EAACA**), which promote the interests of producers of autoclaved aerated concrete (AAC) in 17 countries of Europe. Since 2007, **Concrete Production Association** is also the member of the ***Bureau International du Beton Manufacture*** (***BIBM***).

The second important group of products is ***products for road construction***, especially ***concrete paving stones*** made from vibropressed concrete, being a cheap alternative for granite pitcher and road clinker. It is estimated that their domestic production constitutes ca. 80% of the total output of ***concrete products for road construction***. Their total production level is difficult to ascertain because the **Central Statistical Office** reports the production only in companies with minimum 10 employees. Production of paving concrete bricks, registered by Central Statistical Office (item **236115020** of **PKWiU** nomenclature) showed a similar trend as the whole concrete products industry during the analyzed period. In 2011 the most significant almost 20% production increase was registered – up to 6.0 Mm^3, due to the implementation of several infrastructure projects in road construction funded by the EU (Tab. 1). The year 2012 has brought a significant 13% decrease in production down to 5.2 Mm^3. The share of ***concrete products for road construction*** in the total supply of concrete products rose during last two years to almost 40%. In 1994, the producers of these products established the **Association of Pavement Blocks Producents** (**SPBKD**), which currently includes 24 producing companies, 9 supporting companies (in which 2 foreign). Development of concrete paving stones and cellular concrete production places Poland among their top manufacturers in Europe.

Production of large and medium ***prefabricated concrete elements for construction*** is a subject of the biggest fluctuation. Their share in total concrete products supply was reduced recently to ca. 15–16%. After a significant drop in production in 2009, following two years have brought considerable 7% annual growth to over 2.4 Mm^3 in 2011, with its reduction in 2012 (Tab. 1).

The total ***concrete*** supply (both concrete mix prepared and consumed directly in the construction site — so called ***household concrete***, and produced for commercial purposes — called ***ready-mix concrete***) is difficult to ascertain. The **Central Statistical Office** reports only the production of ***ordinary ready-mix concrete*** in companies with minimum 10 employees. The level of its production according to GUS data increased in recent years to a level of almost 17 Mm^3 in 2008, while the total production of the ***precast ready-mix concrete*** in the same year reached levels of nearly 18 Mm^3 (Tab. 1). The year 2009, where the crisis began to be clearly felt in the construction sector, has brought more than 6% decrease in production of ready-mixed concrete to a level of 15.8 Mm^3, while the production of ***precast ready-mix concrete*** has reached nearly 16.4 Mm^3 (Tab. 1). A slight revival production to 16.5 Mm^3 occurred in 2010, thanks to the implementation of road projects financed from EU funds. The next 2011 year, associated with the most intense preparations for EURO 2012 and the accumulation of many investments, brought the record production of ready-mixed concrete up to ca. 21.5 Mm^3, and precast ready-mix concrete - 24.4 Mm^3, but already in 2012 - especially in the second half of year - a clear reduction in investment was observed, and thus a fall in concrete demand and production was reported (Tab. 1). According to **SPBT** estimates production of concrete in Poland in 2011 could be higher possibly reaching 23.7 Mm^3, while only 19.5 Mm^3 in 2012. To their production in 2012, about 16.1 Mt of cement was used, with an average content of cement 288 kg/m^3 of concrete. The structure of concrete production since 2011 has been dominated by a grades C25/30-C30/37 (35% of the sales in 2012 and 52% in 2011), but lower strength concrete grades (C16/20-C20/25), as well as above C35/45 grade made about 25% and 27% share of market in 2011 and 19% and 18% in 2012, respectively. Concrete with strength adequate for classes C25/30-C30/37 in recent years made about 55-58% of all concrete production in the European Union and more than 61% of the Member States ERMCO.

Currently, more than 950 concrete producers operate in Poland, including 220 associated in the ***Ready Mixed Producers Association*** (**SPBT**). This organisation has worked since 1999, and since 2001 is a member of **ERMCO** (***European Ready Mixed Concrete Organization***). Production of SPBT members reached constantly over 41% the total ready mixed concrete supply during last years. The most important members are both large cement and concrete producers, belonging to international companies such as: **Bosta Beton**, **HeidelbergCement**, **Cemex Polska**, **Dyckerhoff**, **Lafarge**, **Thomas Beton**, and smaller ones, e.g.: **Agrobud Ltd.** of Koszalin, **Elektrobet** from Lublin, **Rebet** of Białystok or **Wibro-Cem** from Lubartów.

Bosta Beton belonging to the Irish **CRH** concern, after overtaking of **Behaton** and **Schwenk**, ranks the leading place among domestic producers. The company operates 40 plants, mainly in central part of Poland. The second ranked **Górażdże Beton** (a part of **HeidelbergCement** group) has 50 plants in the western, southern and central part of Poland (including 17 plants of **BT Topbeton** company), with total production capacity about 2 Mm^3py. In case of **Cemex Polska**, ready-mix concrete is manufactured in 40 factories, including 6 mobile mixing plants, in almost all voivodeships except of Kujawsko-Pomorskie, Świętokrzyskie and Podkarpackie voivodeships. **Dyckerhoff Beton Polska** belonging to **Buzzi Unicem Group** has currently 26 plants in four devision mainly in southern and central Poland. **Lafarge Beton Ltd.**, after overtake plants of **Res-Bet Rzeszów** and **BM Beton Rabowice**, is currently the owner of 26 stationary facilities and 5 mobile mixing plants. **Thomas Beton Ltd.** is the owner of 13 facilities, located in Warsaw and northern Poland. The smaller potential have: **JD Trade Group Ltd.** of Opole with 7 factories in Lower and Upper Silesia region and Warsaw, and **TH Beton Ltd.** of Wrocław with five facilities in Śląskie, Dolnośląskie and Małopolskie voivodeships. Recently, mobile concrete mixing plants became more popular, because of possibility of a rapid delivery of ready-mix concrete into the construction of roads and highways.

Trade

The quality of some Polish concrete products, comparable to the quality of foreign products and certified for their conformity with foreign standards, has stimulated foreign trade. Exports after significant decrease in period of 2009-2010, rose about 37% and reached 430,000 t in 2012 (Tab. 1). In last two years, the ***prefabricated concrete elements for construction and civil engineering*** have begun to dominate in the structure of exports (32-33% of total exports), being delivered mainly to Germany (35-59%) and Latvia (6-29%). Almost an equal share (29-32%) in the total export sales had ***wall concrete bricks and blocks*** at the same time, exported mainly to Russia (22-33%), Slovakia (23-27%), Ukraine, and Lithuania. Imports, after increase to over 400,000 tpy, stabilized at the level of 190,000-230,000 tpy, with the exception of 2012 (Tab. 1). As in the case of exports in the last two years in the imports structure ***prefabricated concrete elements for construction and civil engineering*** dominated (30-40% of total imports), coming mainly from Germany and the Czech Republic, and in 2011 also from Denmark. Due to domination of exports over imports, the trade balance has remained positive (Tab. 2).

Tab. 2. Value of concrete products trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	338,389	405,902	333,106	431,937	545,521
Imports	177,898	113,431	114,541	139,218	104,273
Balance	**+160,491**	**+292,471**	**+218,565**	**+292719**	**+441248**

Source: ***The Central Statistical Office (GUS)***

Consumption

The structure of ***concrete products*** consumption is not well known, but it is supposed to be similar to cement usage. The share of the non-residential building construction, as well as transport infrastructure has recently risen in the structure of concrete consumption. As consequence of technological changes in the construction sector, the development of ready-mix concrete market with the diminish of large concrete elements production could be notice.

It is worth mentioning that ready-mixed concrete consumption in Poland in last year reached 0.51 m^3 per capita and came close to the average for the European Union ERMCO members.

COPPER

Overview

Copper (**Cu**) forms many minerals, of which ***copper sulfide*** is the most important. Its principal primary sources are ***copper ore*** or ***Cu-Zn-Pb***, ***Ni-Cu ore*** deposits. **Copper concentrates** or **mixed concentrates** obtained in course of flotation process are treated by pyrometallurgical and hydrometallurgical methods to extract **copper metal**. Considerable quantities of copper are also recovered by ***solvent extraction/electrowinning*** process (**SX/EW**) and also from scrap and waste.

Copper is widely used in manufacturing of alloys with zinc, nickel, aluminum, beryllium, tin, silicon, and manganese. The main consumers, critical for overall demand, are electrotechnology and electronics.

Sources

The primary source of ***copper*** in Poland is ***sulfide ore*** rich in ***chalcocite***, ***bornite***, and ***chalcopyrite***, occurring in 14 deposits of stratoidal type. These deposits are located in Lower Silesia in two geological units: the **North Sudetic Syncline** and the **Fore-Sudetic Monocline**. In 2012 total reserves of the ore were 1,793 Mt, including 34 Mt of ***copper***. Around 82% of these reserves were in deposits currently operated by **KGHM Polska Miedź** — the only domestic producer of primary copper. The average content of metal in run-off-mine decreased from 1.68% in 2009 to 1.59% in 2012.

Copper ore contains many accompanying elements, e.g. ***silver***, ***gold***, ***arsenic***, ***lead***, ***zinc***, ***cobalt***, ***nickel***, ***vanadium***, ***molybdenum***, ***selenium***, ***rhenium***, and ***platinum***. The approximate reserves of these metals were as follows (as of 31 December 2012): Ag — 104,900 t; Pb — 1,596,770 t; Co — 123,520 t; Ni — 65,360 t; V — 157,480 t; Mo — 71,290 t; Zn — 320,560 t. Among above mentioned elements, ***silver***, ***gold***, ***lead***, ***selenium***, ***nickel*** in the form of ***nickel sulfate***, ***platinum-palladium slime***, and ***rhenium***, have been recovered.

The share of ***old scrap*** utilized in the production of refined copper in KGHM has recently averaged 14% per year, whereas the amount of ***anode scrap*** (new scrap) recharged to refining has approached 16–18% py in each of the KGHM' smelters. ***Scrap*** of ***copper*** and ***copper alloys*** (brass and bronze) were also processed at the following plants: **Będzin Smelter** (in liquidation), **Łabędy Non-ferrous Metals Mill** (a division of **KGHM Polska Miedź**), and the **Dziedzice Metals Mill** (**Impexmetal Group**).

Copper Ore and Concentrates

Production

Copper ore is extracted in the Lubin-Głogów Copper District at mines operated by the **KGHM Polska Miedź S.A.**, i.e.:

- **Lubin** (mining capacity over 7 Mtpy of ore) — the mine termination planned in 2030;
- **Polkowice-Sieroszowice** (capacity ca. 11 Mtpy, in course of build-out) — the life-span — 2040;
- **Rudna** (capacity over 12 Mtpy, the extraction at the depth of more than 1150 m) — probable end of production in 2025.

In recent years the content of metal in the ore mined decreased to around 480,000 tpy, while the total output of copper ore averaged 29-30 Mtpy (Tab. 1). That resulted from the extraction of poorer parts of the deposits. Prospects for domestic copper mining industry have been prolonged by additional 40–50 years as in 2004 KGHM was granted the concession (valid through 2054) for the extraction of the ore from new area — **Głogów Głęboki-Przemysłowy**. The construction of the new mine was commenced in 2006 and should be finished in 2015. It is expected to reach full mining capacity by 2020 and then it should provide around 25% of the total copper ore output in the KGHM. There are also another projects for new reserve base development in progress, i.e. **Radwanice-Gaworzyce**, adjacent to existing mines, as well as near **Bolesławiec** in **Synklina Grodziecka**. To expand existing reserve base, there are plans for exploration in other areas in Poland, i.e.: **Retków-Ścinawa**, **Głogów**, **Bytom Odrzański**, and **Kulów-Luboszyce**. According to current development strategy of the **KGHM Polska Miedź Capital Group** until 2018, the company will be also involved in foreign copper projects such as: **Weisswasser** in Saxony/Germany, **Afton-Ajax** (***Cu-Au***) in Canada (acquisition of 51% shares in 2010), **Malmbjerg Molybdenum** (***Mo***) in Greenland, as well as **Quadra FNX Mining Ltd**. of Canada (takeover in 2012) that managed deposits and projects in the USA (***Cu-Au ore*** **Robinson**, ***Cu*** **Carlota**), Canada (***Cu-Ni-Au-Pt-Pd*** **Levack/Morrison**, ***Cu-Ni-Au-Pt-Pd*** **Podolsky**, ***Cu-Ni-Au-Pt-Pd*** **McCreedy West**), and Chile (***Cu*** **Franke**, ***Cu-Au-Mo*** **Sierra Gorda**). The mentioned investments should help KGHM to increase the output of copper by 25% and to lower average cost of the production.

Tab. 1. Copper ore and concentrate statistics in Poland — CN 2603 00

'000 t Cu

Year	2008	2009	2010	2011	2012
Mining output	482.0	499.5	480.6	479.3	479.3
Concentrate production	429.4	439.0	425.4	426.7	427.1
Imports of concentrate	18.7	23.4	11.4	14.3	17.7
Exports of concentrate	0.0	0.0	0.0	0.0	0.0
Concentrate consumption	448.1	462.4	436.8	441.0	444.8

Source: ***The Central Statistical Office (GUS), KGHM Polska Miedź S.A.***

Copper concentrates are produced at three processing plants that are forming the **KGHM's Division** called the **Ore Enrichment Plants** (production capacity of c.a. 1.9

Mtpy of concentrate), i.e.:

- **Lubin** — rated processing capacity of 7.6 Mtpy of ore;
- **Polkowice** — rated processing capacity of 9.1 Mtpy of ore;
- **Rudna** — rated processing capacity of 16.3 Mtpy of ore.

In recent years the total production of copper concentrate has usually amounted to 425,000-429,000 tpy (Tab. 1). In 2009 it incidentally increased to 439,000 tons due to slight improvement of the ore mineralization. The concentrates contained ave. 23% Cu, varying between ca. 14% and 26% depending on the plant. The unit production cost of copper in concentrate, which was 1,389 USD/t in 2011, last year more than doubled, reaching 2,954 USD/t. That was the consequence of the tax imposition on Cu-Ag ore mining since April 2012 and cheaper valuation of silver in by-products (lower quotations in 2012).

A small, additional output of copper-silver-bearing concentrates (ca. 1 Mtpy) has come from the KGHM's division — **Ecoren S.A.** The source materials for copper recovery have been spent bricks from metallurgical furnaces relining, which are replaced twice a year, at the Głogów, Legnica, and Cedynia smelters. Annually there have been 3 Mtpy of lining utilised. The material has been crushed down to 0.1 mm and processed in the course of gravity separation and flotation. The mixed Cu-Ag concentrate is metallurgically treated at the KGHM smelters.

In course of copper ore processing there are huge amounts of tailings generated, ca. 93 –94% of the overall mass of extracted ore. In recent years their volume has ranged from 20 Mt to 27 Mtpy. The majority of these tailings are collected in the **Żelazny Most** settling pond (total area – 13.94 km^2, the capacity 700 Mm^3, possible expansion to 1,100 Mm^3). Large portion of them (ca. 75%) is utilized for geological backfilling, heightening the pond's dams and sealing up its top.

Trade

The ***copper concentrates*** have been traded on a limited scale (Tab. 1). However, in recent years their importation, that varied between 11,000 and 23,000 tpy, supplemented domestic supplies of concentrates in order to utilize the smelters' production capacities. The major deliveries came regularly from Chile (23% of the total in 2012), joined and last year overtaken by Morocco (43% in 2012). Negligible quantities of copper concentrates were also exported. The trade balances were always negative, fluctuating in broad limits, from 211 to 357 million PLN (Tab. 2).

Tab. 2. Value of copper concentrates trade in Poland — CN 2603 00

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	37	46	8	2	21
Imports	332,941	288,235	211,119	356,878	329,440
Balance	**-332,904**	**-288,189**	**-211,111**	**-356,876**	**-329,419**

Source: ***The Central Statistical Office (GUS)***

Consumption

In the last five years the apparent consumption of ***copper concentrates*** ranged from around 440,000 to 460,000 tpy (Tab. 1).

Refined Copper

Production

Copper concentrates from KGHM's mining operations, as well as other ***copper-bearing materials*** (wastes, scrap), are smelted into ***copper blister/converter*** (98.5–99.0% Cu) and fire-refined into ***anode copper*** at the KGHM's copper smelters, i.e.:

- **Legnica** (shaft furnace technology); nominal capacity 132 ktpy of ***anode copper*** graded at 99.2% Cu;
- **Głogów I** (shaft furnace technology); nominal capacity 220 ktpy of ***anode copper*** graded at 99.0% Cu;
- **Głogów II** (flash smelting technology, to be updated); nominal capacity ca. 300 ktpy of ***anode copper*** graded at 99.3% Cu;
- Negligible quantities of anode copper from secondary materials have been also irregularly manufactured at the **Łabędy Non-ferrous Metals Mill**.

The total production of ***blister & converter copper***, which dropped to 515 kt in 2009, in the following three years leveled at around 550 ktpy, i.e. ca. 7% higher than in the worst year of the analyzed period (Tab. 3). That was a result of increased consumption of raw materials of foreign origin at the KGHM' metallurgical units. Simultaneously, the production of ***anode copper*** jumped by around 14%, i.e. from 574 to 656 kt in 2012. The **Legnica** and **Głogów I** smelters have utilized the obsolete shaft furnace technology for the production of ***converter copper*** (98.5% Cu). However, these smelters are to be reconstructed in order to increase output of copper to 600 ktpy, and to reduce the unit production costs and negative impact on the environment. There have been thorough investment projects prepared that included: the replacement of the shaft technology by modern flash smelting process at the **Głogów I** smelter (the capacity of 250 ktpy of ***blister copper***), and a new furnace treating exclusively copper scrap, the construction of which has been planned in place of the old shaft furnace at the **Legnica**. The latter one, of the capacity of 135-200 ktpy, should be launched in 2017. The third KGHM's metallurgical unit — the **Głogów II** has used flash smelting technology, based on a modified license of **Outokumpu Oy**, for direct one-stage smelting of concentrates into ***blister copper*** (98.7% Cu). Slag rich in copper (11–15% Cu) is processed in an electric furnace to obtain additional quantities of ***blister copper***, which are also treated in rotary anode furnaces to produce ***anode copper*** (99.3% Cu). The average yield of the process approaches 98%. The modernization of the flash furnace at the **Głogów II** complex, which has been also considered, is expected to result in increasing the refined copper capacity and the recovery of accompanying elements, i.e. ***silver***, ***lead***, and ***rhenium***.

Tab. 3. Copper-smelter production in Poland — CN 7402 00

'000 t Cu

Year	2008	2009	2010	2011	2012
Blister and converter copper	**537.0**	**515.1**	**548.1**	**550.1**	**549.0**
— primary	492.9	457.5	469.7	481.9	466.7
— secondary	44.1	57.6	78.4	68.2	82.3
Anode copper	**599.2**	**574.3**	**625.5**	**645.2**	**656.0**

*Source: **KGHM Polska Miedź S.A., the Central Statistical Office (GUS)***

Anode copper produced in both technologies is treated in an electrolytic refining process (yield approx. 98%) at the following **KGHM**'s refineries:

- **Legnica** — capacity of around 93 ktpy of Cu in ***cathodes*** and 35 ktpy in ***continuous cast billets*** — also processes ***scrap*** (both new and old one);
- **Głogów I** and **Głogów II** — total capacity of 550 ktpy of ***refined copper*** basically from its own ***anode copper***, but also from some ***scrap*** (80 and 110 ktpy in the last two years, respectively).

In the last five years the total KGHM's production of ***refined copper*** (Tab. 4) reached the lowest point of 503 kt in 2009 and the highest one (ever recorded), i.e. 571 kt in 2011 (including around 125 kt manufactured from foreign components of the charge) following the record LME copper quotations (8,811 USD/t). In 2012 the production was only slightly lower (by 1%) thanks to increased supplies of foreign copper-bearing raw materials (scrap, blister copper and imported concentrates) that resulted in the output of almost 150 kt of refined copper, i.e. 26% of the total.

Tab. 4. Refined copper statistics in Poland — CN 7403 11–19

'000 t Cu

Year	2008	2009	2010	2011	2012
Production	526.8	502.5	547.1	571.0	565.8
Imports	6.6	13.9	27.2	12.5	20.3
Exports	296.6	313.5	313.4	327.7	333.3
Consumption[a]	236.8	202.9	260.9	255.8	252.8

Source: ***The Central Statistical Office (GUS), KGHM Polska Miedź S.A.***

One of the company's principal products, obtained from copper cathodes, is high quality ***copper wire rod*** manufactured at the **Cedynia Copper Rolling Mill**, a division of KGHM, operating the **Contirod** installation (**Union Miniere**). In the last three years its production amounted to 230-240 ktpy, 50-60% of which was traded internationally. Another high quality copper product manufactured at the mill has been ***oxygen-free copper rod — Cu-OFE*** (with the oxygen content reduced from 200 ppm to 3 ppm). It is suitable for the production of light-gauge wire of diameter below 0.1 mm. The technology called **Upcast** is licenced by the **Outokumpu Oy**. Since 2010, when the Upcast installation reached its full capacity, the output of ***oxygen-free copper rod*** ranged 13-15 ktpy. Since May 2008 there has been also a new product offered, i.e. wire with silver additive (***CuAg wire***) characterized by increased heat and wear resistance. Its output has recently ranged from 900 to 1,200 tpy.

Trade

Poland is one of the world's leading exporters of ***refined copper cathodes***, and ***copper semi-products***, of which ***copper wire rod*** is one of the most important (Tabs. 5 and 8). ***Copper cathodes*** (min. 99.95% Cu) manufactured at the KGHM's refineries is quoted at the **LME** as ***Grade A copper*** under the brand names ***HML*** (**Legnica**), ***HMG-B*** (**Głogów II**) and ***HMG-S*** (**Głogów I**). They have been sold by the company's trade agencies: **KGHM Metraco** supported by **KGHM Kupferhandels** in Vienna (in liquidation), **KGHM Polish Copper** in London (until 2011), and **KGHM** (**Shanghai**) **Copper Trading** in China.

Tab. 5. Polish exports of refined copper, by country

'000 t Cu

Year	2008	2009	2010	2011	2012
Exports	**296.6**	**313.5**	**313.4**	**327.7**	**333.3**
• ***cathodes* CN 7403 11**	***289.3***	***310.1***	***307.2***	***316.0***	***319.0***
• ***ingots for wire* CN 7403 12**	***6.3***	***2.2***	***4.9***	***8.6***	***9.3***
• ***continuous cast billet* CN 7403 13**	–	–	–	–	***0.3***
• ***other* CN 7403 19**	***1.0***	***1.2***	***1.3***	***3.1***	***4.7***
Austria	5.7	4.2	6.9	7.5	7.3
Belgium	–	1.2	3.0	1.1	6.0
Bermuda Islands	17.6	–	–	–	–
Bulgaria	–	1.3	1.8	2.2	1.8
China	67.0	97.4	79.2	94.1	76.0
Czech Republic	3.1	2.6	0.7	0.2	0.2
Egypt	3.3	8.5	2.5	2.0	–
Finland	–	12.0	–	–	–
France	74.4	42.1	19.9	21.1	27.5
Germany	56.9	109.5	136.0	134.5	137.8
Greece	5.5	–	–	–	–
Italy	11.6	18.5	33.6	43.8	45.0
Korea Republic	–	–	–	1.3	2.7
Malaysia	–	–	–	1.0	3.0
Netherlands	17.6	7.3	–	3.0	9.4
Singapore	–	–	–	6.5	–
Slovakia	15.0	1.3	25.5	1.8	5.8
Switzerland	1.4	1.0	1.1	0.2	0.1
Taiwan	0.7	1.0	0.6	0.3	0.2
Turkey	1.9	–	–	3.1	8.2
Ukraine	3.0	1.0	0.0	0.5	–
United Kingdom	9.0	1.4	–	–	–
Vietnam	–	–	–	–	1.3
Others	2.9	3.2	2.6	2.4	1.0

Source: ***The Central Statistical Office (GUS)***

In the last five years the foreign sales of ***refined copper*** from Poland were systematically increasing up to 333 kt in 2012. Among numerous recipients of this commodity, Germany and China were the largest ones (Tab. 5).

The unit values of ***copper cathodes*** exportation from Poland followed the changes in quotations of copper grade A on the LME. In 2011-2012 they were higher by 65 and 48% (USD/t), respectively, as compared to the critical 2009 (Tab. 6). Similar tendencies were observed in the case of exported ***ingots for wire***.

Tab. 6. The unit values of refined copper exports from Poland

Year	2008	2009	2010	2011	2012
Cathodes CN 7403 11					
PLN/t	15,678	16,304	22,897	26,046	26,057
USD/t	6,648	5,378	7,630	8,889	7,972
Ingots for wire CN 7403 12					
PLN/t	16,507	15,803	23,919	26,625	26,640
USD/t	7,036	5,076	7,966	9,062	8,113

Source: ***The Central Statistical Office*** *(GUS)*

Some quantities of ***refined copper***, in the range of 7-27 ktpy, have been also imported to Poland. In recent years the major foreign suppliers have been Germany and the Czech Republic (Tab. 7). There have been also large amounts of ***nonrefined copper*** and ***copper scrap*** imported to Poland to supplement the domestic charge for refined copper manufacturing (Tab. 8).

Tab. 7. Polish imports of refined copper, by country

'000 t Cu

Year	2008	2009	2010	2011	2012
Total imports	**6.6**	**13.9**	**27.2**	**12.5**	**20.3**
• ***cathodes*** **CN 7403 11**	***3.6***	***13.1***	***24.8***	***11.7***	***15.3***
• ***ingots for wire*** **CN 7403 12**	–	–	–	–	***1.2***
• ***continuous cast billet*** **CN 7403 13**	***0.0***	***0.0***	***0.1***	***0.1***	***2.3***
• ***others*** **CN 7403 19**	***3.0***	***0.8***	***2.3***	***0.7***	***1.5***
Austria	–	–	1.2	0.1	0.1
Belgium	0.7	–	0.4	2.8	0.6
Bulgaria	0.6	–	–	–	–
Chile	0.1	7.5	–	–	0.1
Czech Republic	–	–	10.9	2.0	7.3
Congo D. R.	1.5	2.5	1.0	1.9	1.0
Germany	2.6	1.0	10.8	2.4	7.6
Italy	–	–	–	0.3	0.2
Latvia	–	–	–	–	2.0
Russia	0.0	0.6	0.3	–	0.1
Slovakia	–	–	–	–	0.4
Ukraine	–	0.7	0.8	0.2	–
Zambia	0.5	0.7	0.2	–	–
Zimbabwe	–	–	–	2.0	0.4
Others	0.6	0.9	1.6	0.8	0.5

Source: ***The Central Statistical Office*** *(GUS)*

Tab. 8. Trade in selected copper commodities in Poland

t Cu

Year	2008	2009	2010	2011	2012
Copper-matte, precipitated CN 7401 00					
Imports	0	0	612	–	–
Exports	2,989	1,488	956	1,566	1,302
Nonrefined copper; copper anodes for electro-refining CN 7402 00					
Imports	33,374	44,672	15,068	23,580	22,847
Exports	0	23,538	2	2	4
Copper alloys CN 7403 21–29					
Imports	3,343	2,023	2,504	2,758	3,470
Exports	4,894	3,799	2,516	1,237	2,463
Copper wastes and scrap CN 7404 00					
Imports	19,152	15,467	24,075	26,872	53,622
Exports	60,838	53,456	71,215	59,537	49,216
Transitional copper alloys CN 7405 00					
Imports	501	385	483	163	105
Exports	554	2	2	65	99
Copper powders and flakes CN 7406					
Imports	278	169	253	355	338
Exports	879	829	1,251	1,205	901
Copper wire rod CN 7408 11					
Imports	61,100	28,210	46,435	31,818	20,211
Exports	86,117	99,212	123,874	127,453	140,273

Source: ***The Central Statistical Office (GUS)***

The highest revenues among the numerous copper commodities have been brought by ***refined copper***, ***copper wire rod***, and – until 2011 – ***copper scrap*** (Tab. 8). The balance of copper scrap turned negative in 2012, as the value of their purchase surpassed the one of the sale. The financial results of the turnover of the remaining copper raw materials have been of less influence on the total trade balance. In recent years the earnings from ***refined copper*** and ***copper wire rod*** exportation has increased most spectacularly, while the deepest deficit has been observed for the trade of ***copper anodes*** and ***copper scrap*** (in 2012). That was a consequence of weakening of their sales. In the case of ***copper alloys*** the net profit has been decreasing since 2008, turning negative in 2010 (Tabs. 8, 9). Incidental growth in exportation of ***transitional copper alloys*** in 2008 resulted in positive value of trade balance. In 2009 that turned negative and further deepened in 2010 as

Tab. 9. Value of selected copper commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Copper-matte, precipitated CN 7401 00					
Exports	11,184	3,846	4,766	10,178	8,464
Imports	0	1	4,529	0	0
Balance	**+11,184**	**+3,845**	**+237**	**+10,178**	**+8,464**
Nonrefined copper; copper anodes for electro-refining CN 7402 00					
Exports	1	434,796	60	330	341
Imports	560,284	750,422	346,994	668,635	608,492
Balance	**-560,283**	**-315,626**	**-346,934**	**-668,305**	**-608,151**
Refined copper CN 7403 11–19					
Exports	4,657,127	5,111,156	7,182,763	8,539,788	8,693,482
Imports	110,542	174,306	591,063	330,674	557,881
Balance	**+4,546,585**	**+4,936,850**	**+6,591,700**	**+8,209,114**	**+8,135,601**
Copper alloys CN 7403 21–29					
Exports	69,946	35,518	28,873	25,401	27,179
Imports	50,546	28,217	48,276	63,469	53,579
Balance	**+19,400**	**+7,301**	**-19,403**	**-38,068**	**-26,400**
Copper wastes and scrap CN 7404 00					
Exports	769,139	581,502	1,163,736	1,058,354	859,306
Imports	29,362	222,083	475,920	621,823	1,203,066
Balance	**+739,777**	**+359,419**	**+687,816**	**+436,531**	**-343,760**
Transitional copper alloys CN 7405 00					
Exports	12,300	54	2	2,253	3,174
Imports	9,054	5,762	10,620	4,817	3,206
Balance	**+3,246**	**-5,708**	**-10,618**	**-2,564**	**-32**
Copper powders and flakes CN 7406					
Exports	26,587	28,199	41,561	45,712	34,526
Imports	8,845	5,813	8,812	13,946	13,050
Balance	**+17,742**	**+22,386**	**+32,749**	**+31,766**	**+21,476**
Copper wire rod CN 7408 11					
Exports	1,494,132	1,410,150	2,834,590	3,291,908	3,645,719
Imports	1,116,302	471,708	811,082	865,973	541,168
Balance	**+377,830**	**+938,442**	**+2,023,508**	**+2,425,935**	**+3,104,551**

Source: ***The Central Statistical Office (GUS)***

the sales dropped, but in the following two years the deficit diminished due to improved exportation and reduced imports. The trade balances of ***copper powder*** and ***flakes*** have improved following increased sales, especially in 2010 and 2011.

Consumption

The apparent consumption of ***refined copper***, which in 2009 decreased to merely 200 kt as a consequence of increased exportation coupled with reduced production, in the following years revived to 250-260 ktpy (Tab. 4). The principal consumer of ***refined copper*** in Poland has been the automotive industry, utilizing copper-made radiators, electronic control system and many other elements in the construction of cars. Considerable amounts of semi-products and copper alloys are utilized in the construction industry, e.g. in heating, air-conditioning and water supply systems, for facade and roofing etc. Other important copper consumers have been as follows: metallurgy, the machine industry, telecommunications, computers, transportation, foundry engineering, chemical industry, medicine, cosmetics, etc. Semi-products, utilized in cables, wires, and other electric and electrotechnical products manufacturing have been offered by **Cedynia Copper Rolling Mill** and the **Dziedzice Rolling Mill**. ***Copper wire rod*** has been consumed at numerous domestic plants for the production of ***cables*** and ***wire***.

Copper, ***copper alloy products***, and ***semi-products*** for the metallurgical, machine, and transportation industries have been supplied by **Hutmen S.A.**, Wrocław (tubes, tube couplings, flat bars, rods, rolled sections, sleeves, cast alloys, wire), **WM Dziedzice**, Czechowice-Dziedzice (rods, tubes, flat bars), the **Będzin Smelter** in liquidation, Będzin (tubes, rolled sections, rods, brass sections), and **Non-ferrous Metals Mill Łabędy**, Gliwice (sheets, flats, bands). ***Semi-products for foundry*** have been produced mainly by the **Będzin Smelter** and **Hutmen**, as well as **WM Dziedzice**, though to a lesser extent.

Companies involved in copper commodities production in Poland as of December 2012

- KGHM Polska Miedź S.A. w Lubinie (KGHM Polska Miedź Joint Stock Co.), Skłodowskiej-Curie 48, 59–301 Lubin, tel. +48 76 7478200, fax. +48 76 7478500, www.kghm.pl — *copper ore and concentrates, refined copper, copper wire rod and other semi-products*.
- Hutmen S.A. we Wrocławiu (Hutmen Joint Stock Co.), ul. Grabiszyńska 241, 53–234 Wrocław, tel. +48 71 3348300, fax. +48 71 3390346, www.hutmen.pl — *rolled, extruded and other copper products*.
- Walcownia Metali Nieżelaznych Łabędy S.A. (Łabędy Non-ferrous Metals Mill), Metalowców 6, 44–109 Gliwice, tel./fax. +48 32 2342449, www.wmn.com.pl — *copper and copper alloys rolled products*.

CORUNDUM AND EMERY

Overview

The mineral **corundum**, i.e. natural well-crystallized Al_2O_3, and **emery**, a metamorphic rock rich in corundum, were used for centuries as bulk grinding materials or shaped grinding tools. Natural deposits of corundum are rare. Synthetic **electrocorundum** is the main substitute for corundum, and predominates in abrasives and refractory applications.

The **pure crystals of corundum** are **gems**, e.g. color-less ***leukosapphire***, red ***ruby***, blue ***sapphire***, and others (see: **GEMS**). Synthetic products — ***leukosapphire***, ***ruby***, ***sapphire***, and ***other varieties of*** Al_2O_3 — are of great significance for the production of bearing stones for precise instruments and jewellery.

Sources

There are no deposits of ***corundum*** and ***emery*** in Poland.

Production

Neither ***emery*** nor ***natural corundum*** is produced in Poland. Until 2000, ***ordinary electrocorundum*** (brown fused alumina — ***BFA***, obtained from calcined bauxite) and ***high quality electrocorundum*** (white fused alumina — ***WFA***, obtained from alumina) were produced at the **Saint-Gobain Abrasives Ltd.** in **Koło** (previously: **"Korund" Grinding Materials Factory**). Recently ***electrocorundum*** is not produced in Poland, although its production was reported by the **Central Statistical Office** at the level of 3,000–4,000 tpy in the years 2008–2012 (Tab. 1). It was probably caused by imports of semi-finished products, which were crushed and screened by the **"Polmineral" Ltd.** from Aleksandrów Łódzki, and sold as electrocorundum.

Synthetic technical corundum stones and some ***synthetic corundum gems*** were occasionally produced at **Skawina** and other plants, but at a very low level.

Trade

Domestic demand for ***natural corundum*** and ***emery*** is satisfied by imports. In the recent years, the level of importation of ***natural corundum*** and ***emery*** has varied between 150 and 660 tpy (Tab. 1). The structure of imports has also been quite variable, with Turkey, United Arab Emirates, the Netherlands, China and Finland as the main suppliers. On the contrary, some re-exports of these commodities were reported in the last years.

Imports of ***artificial corundum*** (***electrocorundum***) varied over the wide range, from 16,300 to 36,500 tpy in the last five years. Supplies were primarily of Chinese origin, with a smaller share of deliveries from Germany, Hungary, Russia and Austria (Tab. 2).

Tab. 1. Natural and artificial corundum statistics in Poland

Year	2008	2009	2010	2011	2012
Corundum and emery [t] **CN 2513 20**[1]					
Imports[2]	657	156	431	463	179
Exports[3]	108	89	138	35	184
Consumption[a]	549	67	293	428	-5
Electrocorundum [‘000 t] **CN 2818 10**					
Production	4.1	3.3	3.4	3.3	3.2
Imports	36.5	16.3	29.1	27.8	30.7
Exports	3.3	3.1	3.5	2.8	3.2
Consumption[a]	37.3	16.5	29.0	28.3	30.7

[1] corundum, emery, and garnet, crude and preliminary worked

[2] amount was reduced by the probable garnets importation from India

[3] amount was reduced by the probable garnets re-exports to Russia

Source: ***The Central Statistical Office (GUS)***

Exports of ***electrocorundum*** varied between 2,800 and 3,500 tpy in recent years, being directed primarily to Germany and the Czech Republic (Tab. 3).

Tab. 2. Electrocorundum imports to Poland — CN 2818 10

‘000 t

Year	2008	2009	2010	2011	2012
Imports	**36.5**	**16.3**	**29.1**	**27.8**	**30.7**
Austria	2.4	1.7	2.2	1.8	1.5
China	19.6	5.6	14.0	13.5	17.4
Czech Republic	0.9	0.3	0.4	0.2	0.0
Germany	2.7	2.3	2.9	3.2	3.6
Hungary	2.4	1.6	2.1	2.9	2.1
Russia	2.4	1.4	2.2	1.4	1.9
Slovenia	1.9	1.1	1.4	1.1	0.9
Ukraine	1.2	0.5	1.1	0.2	0.4
Others	3.0	1.8	2.8	3.5	2.9

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***corundum*** and ***emery*** has always been negative, but a deficite was usually lower than 1 million PLN. The trade balance in ***electrocorundum*** has also been negative. The deficit ranged between 99 and 117 million PLN, with the exception of 2009 when it improved to ca. 65 million PLN as a result of significant reduction of imports (Tab. 4). The unit values of imported ***natural corundum*** and ***emery*** sharply dropped from 806 USD/t in 2008 to 443-464 USD/t in the years 2010-2011, with a recovery to 734 USD/t in 2012 (Tab. 5). The unit values of imported ***electrocorundum***

Tab. 3. Electrocorundum exports from Poland — CN 2818 10

'000 t

Year	2008	2009	2010	2011	2012
Exports	**3.3**	**3.1**	**3.5**	**2.8**	**3.2**
Czech Republic	1.9	1.4	1.3	0.8	1.1
Germany	1.2	1.4	1.5	1.6	1.3
Others	0.2	0.3	0.7	0.4	0.8

Source: ***The Central Statistical Office (GUS)***

were on the much higher level (1,189–1,404 USD/t) due to considerable share in imports structure of expensive European grades, as well as a relatively high prices of Chinese grades (due to antidumping procedure of the European Union). The average unit values of electrocorundum exports increased from 414 USD/t in 2008 to over 500 USD/t in the years 2009–2010, with the drop to the level of 450-460 USD/t in the following two years (Tab. 5).

Tab. 4. Value of corundum and emery, and electrocorundum trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Corundum and emery CN 2513 20					
Exports[1]	107	133	139	61	1,741
Imports[2]	1,269	337	580	627	430
Balance	**-1,162**	**-204**	**-441**	**-566**	**-1,311**
Electrocorundum CN 2818 10					
Exports	3,132	5,084	5,478	3,752	4,721
Imports	109,270	70,064	104,296	111,066	121,798
Balance	**-106,138**	**-64,980**	**-98,818**	**-107,314**	**-117,077**

[1] value of exports was reduced by the probable garnets re-exportation to Russia

[2] value of imports was reduced by the probable garnets importation from India

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Average unit values of natural corundum and emery, and electrocorundum trade in Poland

Year	2008	2009	2010	2011	2012
Natural corundum and emery CN 2513 20					
Average imports unit values					
— PLN/t	1,930.9	2,159.7	1,345.2	1,355.7	2,406.7
— USD/t	806.2	695.1	443.3	464.0	733.9

Electrocorundum CN 2818 10					
Average imports unit values					
— PLN/t	2,997.8	4,304.1	3,588.5	3,996.7	3,965.6
— USD/t	1,274.1	1,403.5	1,188.8	1,375.9	1,209.0
Average exports unit values					
— PLN/t	961.1	1,618.1	1,533.4	1,352.7	1,469.4
— USD/t	414.1	528.0	518.8	462.3	448.8

Source: ***The Central Statistical Office (GUS)***

Consumption

Corundum, ***emery***, and ***electrocorundum*** are used as abrasive blasting medium and also to produce ***abrasive materials*** formed into ***grinding wheels*** (10,000–30,000 tpy), primarily in **Saint-Gobain Abrasives Sp. z o.o.** in **Koło**, **Andre Abrasives Articles** in **Koło**, and **Grinding Stick Factory** in **Grodzisk Mazowiecki**. ***Electrocorundum*** is also used in the production of ***corundum refractories***, which are manufactured at the **Vesuvius Skawina** and **PCO Żarów** refractory factories (a few thousand tons per year). Small amounts of ***electrocorundum*** (***corundum***) ***molding sand*** are used in foundries.

DIATOMITE AND RELATED MATERIALS

Overview

Diatomite and **diatomaceous earth** constitute a group of sedimentary rocks which contain ***opal*** (amorphous SiO_2) as the main mineral. These comprise mainly opal skeletons of ***diatoms***, and to a lesser extent those of other micro-organisms, e.g. ***radiolaria***. **Diatomaceous earth** is a loose, soft, and very porous rock. The various types of diatomaceous earth have different trade names, e.g. ***kieselguhr***, ***tripoli***, etc. **Diatomite** is a compact rock, the product of the partial recrystalization of opal, which is why it is less porous. ***Moler*** — a variety of diatomite, containing up to 25% of clay — have also economic importance.

The applications of **diatomite** and **diatomaceous earth** are determined by their properties, including their characteristic porosity, absorbency, low thermal conductivity, heat resistance, and chemical neutrality. They are used as filtering agents and sorbents, carriers (e.g. of catalysts and crop protection products), filling agents, thermal insulators, polishing agents, etc. The raw materials are usually characterized by a volume density of 0.3–0.9 g/cm^3, a porosity of over 60%, and a SiO_2 content of over 75% (often over 85%).

Siliceous earth is relative silica mineral, being a product of chemical weathering of limestone-silica rock. It has minor importance and is used in some applications as a substitute for lower grades of diatomaceous earth and diatomite.

Other siliceous sedimentary rock is **grinding shale** (a variety of **mudstone**). The main constituent of that rock is ***quartz*** grains smaller than 0.005 mm, with admixtures of mica, hydromica, feldspar, etc. Due to the considerable quantity of alkaline compounds (K_2O+Na_2O approx. 6%) and its low melting temperature, this shale is suitable for the glass-making and ceramic industries. The excellent grinding properties of this shale make it an ideal material for whetstones and other grinding tools used to grind copper shafts, print on fabrics, polish terrazzo, and grind other artificial stones based on Portland cement, as well as to machine lithographic stone.

Sources

Poland has no deposits of ***diatomite*** or ***diatomaceous earth***. A deposit of ***diatomite rock*** has been recognized in the eastern part of the Carpathian Mountains, at **Leszczawka**. This is not typical diatomite, because of its relatively low silica content (average 72%, rarely over 75% SiO_2), high volume density (average 1.42 g/cm^3), and rather low porosity (maximum 50%, average 28.5%). The total resources of four deposits in the **Leszczawka** area currently amount to 10,019,000 t (as of 31 December 2012). Perspective resources of diatomite rock in the Leszczawka vicinity, in the **Borek Nowy** area (approx. 20 km to the west from Leszczawka), and in other areas, are estimated at ca. 100 Mt.

Deposits of ***siliceous earth*** are also known in Poland. In the Świętokrzyskie Mountains there are three abandoned deposits, while in the Lublin Plateau one abandoned and one extracted deposit. The total reserves of these five deposits are estimated at 2,223,000 t (as of 31 December 2012). The **Piotrowice** deposit has material of the best quality (87% SiO_2, 6.7% Al_2O_3+Fe_2O_3, volume density 0.29 g/cm^3), suitable for the chemical industry, while the others are of worse quality, good for insulation materials production only.

Grinding shale occurs in the ***hard coal*** deposit at the closed **Gliwice Hard Coal Mine**. Its inferred resources amounted to 123,000 t, but the attempt to output this shale was failed.

Production

The **"Górtech" Specialized Mining Enterprise** of **Cracow** is currently the only domestic producer of diatomite rock. It has been operating the **Jawornik Ruski** mine since 1992. The mineral output is processed in a small plant, with a production capacity of 6,000 tpy, into ***2–5 mm*** and ***0.2–2 mm granulates*** for sorbents, as well as ***0–0.5 mm*** and ***0–1.0 mm dusts*** for insulation materials. Due to low quality of these products, the total production volume of **"Górtech"** is marginal: 500–1,000 tpy in recent years (Tab. 1). The extraction of the second deposit — **Leszczawka — pole Kuźmina** — operated by a local firm **Alabaster Kańczuga**, was abandoned in 1998.

Tab. 1. Statistics of diatomite and related materials in Poland — CN 2512

'000 t

Year	2008	2009	2010	2011	2012
Production[1]	1.0	0.7	0.5	0.6	0.6
Imports	9.5	9.8	6.8	8.4	7.2
Exports	0.3	0.1	0.1	0.8	3.0
Consumption[a]	10.2	10.4	7.2	8.2	4.8

[1] production of diatomite rock

Source: ***The Central Statistical Office (GUS), producers' data***

Siliceous earth and ***grinding shale*** haven't been extracted in Poland recently. Exploitation of the **Piotrowice** ***siliceous earth*** deposit was abandoned in 1993, due to the poor quality of the rock and products (***insulation flour***). Moreover, in 2002 output of siliceous earth from small **Lechówka II** deposit was terminated.

Trade

The lack of high quality ***diatomite*** and ***diatomaceous earth*** results in imports, especially from Germany and Mexico, that recently became the most important suppliers. Moreover, they were traditionally imported in larger amounts from the US and Denmark (Tab. 2). The level of imports varied between 7,000 and 10,000 tpy in recent years. Exports of ***diatomite*** and ***diatomaceous earth*** in general was negligible but in 2012 increased to 3,000 tpy (Tab. 1). The balance of trade in ***diatomite*** and ***diatomaceous earth*** is consistently negative, at 10–13 million PLN (Tab. 3).

Tab. 2. Polish imports of diatomite and related materials, by country — CN 2512

'000 t

Year	2008	2009	2010	2011	2012
Imports[1]	**9.5**	**9.8**	**6.8**	**8.4**	**7.2**
Belgium	0.5	0.4	0.5	0.1	0.1
Czech Republic	0.1	0.0	0.3	0.3	0.3
Denmark	1.9	1.0	0.9	1.4	0.2
France	0.5	0.8	0.7	0.5	0.5
Germany	2.8	4.4	1.5	2.7	2.4
Mexico	2.2	2.1	1.6	0.6	1.2
Spain	0.5	0.4	0.5	0.6	0.8
USA	0.7	0.7	0.8	1.0	0.8
Others	0.3	0.0	0.0	1.2	0.9

[1] diatomaceous earth, diatomites, tripoli, moler, etc.

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of trade of diatomite and related materials in Poland — CN 2512

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	273	237	136	158	460
Imports	10,494	13,508	10,316	13,462	12,994
Balance	**-10,221**	**-13,271**	**-10,180**	**-13,304**	**-12,534**

Source: ***The Central Statistical Office (GUS)***

Unit values of imports of ***diatomite*** and ***related materials*** to Poland varied between 440 and 550 USD/t as a result of changeable share of expensive ***diatomite*** from the US and Mexico (600–700 USD/t), cheaper Danish ***moler*** (300–400 USD/t) and German ***kieselghur*** (400–500 USD/t) in the imports structure (Tab. 4).

Tab. 4. Unit values of imports of diatomite and related materials to Poland — CN 2512

Year	2008	2009	2010	2011	2012
PLN/t	1,106.4	1,372.4	1,526.6	1,603.9	1,803.5
USD/t	474.7	439.2	502.3	549.3	549.2

Source: ***The Central Statistical Office (GUS)***

Grinding shale is imported incidentally from the Czech Republic, Germany, and other Western European countries (probably a few tpy), but quantitative information is not separately recorded by the **Central Statistical Office** (**GUS**).

Consumption

The precise structure of ***diatomite*** and ***diatomaceous earth*** consumption in Poland is unknown. In all likelihood the higher quality grades are imported for filtering and purification of liquids in the chemical industry, and for the filtration of beer, wine, etc. Danish ***moler*** is used for insulation materials production.

The ***diatomite-like products*** offered by **SPG Górtech** have a wide application range: ***granulate***, for the removal of petroleum residues from water, as pesticide carriers, and (in small packages) as bedding for domestic animals; ***dusts***, for the production of thermalite brick and other heat and noise insulating materials, for polishing glass, and as a cleaning agent. The current rather low demand for diatomite products is caused by a lack of knowledge regarding possible applications. Domestic diatomite products are considered to be primarily absorbents of petroleum pollutants, used for emergency purification of surface waters in the event of cistern leaks or spillage.

Previously obtained ***siliceous earth*** was used primarily for insulation materials production.

Grinding shale is used to manufacture whetstones and other grinding tools. Detailed information is not available.

Companies involved in diatomite rock and related minerals production in Poland as of December 2012

- Specjalistyczne Przedsiębiorstwo Górnicze “Górtech” w Krakowie, Wydział Produktów Diatomitowych w Jaworniku Ruskim (“Górtech” Specialized Mining Enterprise of Cracow, Diatomite Products Unit in Jawornik Ruski), Jawornik Ruski, 37–751 Żohatyn, tel./fax +48 16 6725050, www.gortech.pl — *diatomite-like granulate and dust.*

DOLOMITE

Overview

The main constituent of **dolomite** — more correctly, **dolomite rock** — is mineral ***dolomite***, i.e. $CaMg[CO_3]_2$. Dolomites are sedimentary (**primary dolomite**) or metasomatic rocks (**secondary dolomite**). Under high pressures dolomite re-crystallizes into **dolomitic marbles**. Various transient forms are also common: **limestone dolomite** and **dolomitic limestone** (**dolostone**), which are intermediate forms between dolomite and limestone rocks, as well as **dolomitic clay** and **dolomitic marl**, intermediate forms between dolomite and clay.

Dolomite is more compact than limestone and more resistant to the influence of climatic and mechanical conditions. That is why it is used as **crushed stone**. Dolomite is also used in many other branches of industry, agriculture, and public utilities, for which reason **industrial dolomites** are distinguished from the previous types. The following grades are known: ***smelter*** (***blast furnace fluxes***), ***refractory***, ***ceramic*** and ***glass***, ***chemical***, and ***dolomites for agriculture*** (***dolomite fertilizers***), for water treatment, and as a nutrient.

Sources

Poland has a wealth of ***dolomite*** deposits, which are generally divided into two groups:

- ***Industrial dolomites for smelters***, the ***refractories*** industry, and ***ceramics***. As of 31 December, 2012, the proven reserves of 12 deposits amounted to 336.7 Mt. These deposits are located mainly in the **Silesia-Cracow** region (11 deposits, including 3 under operation), with one deposit in **Lower Silesia** (**Rędziny**, under operation). Except for one deposit of dolomite for the ceramics industry (**Rędziny**), the remaining deposits are suitable for the production of smelter and refractory grades of dolomite;
- ***Dolomites*** and ***dolomitic marbles for crushed stone production*** (counted as deposits of crushed and dimension stones). As of December 31, 2012, the total resources of 49 proven deposits of ***dolomites*** (excluding dolomitic marbles) amounted to 1,070.3 Mt. These occur primarily in the **Silesia-Cracow** region (total of 18 deposits) and the **Świętokrzyskie Mountains** region (total of 23 deposits). In **Lower Silesia**, 12 deposits of ***dolomitic marbles*** occurring south-east of **Kłodzko** are counted as deposits of crushed and dimension stones, despite a part is of sufficient quality for the production of ***ceramic*** and ***glass grades***. Their total resources are 381.1 Mt.

Another source of dolomite is the Triassic ***ore-bearing dolomite*** from ***Zn-Pb ores*** deposits in the **Silesia-Cracow** region, a by-product of ore processing.

Production

There are a lot of plants, which extract dolomite deposits, but their structure of production is very diversified. The majority of them do not produce wastes, as fine fraction is used for Ca-Mg fertilizers production. The total mining output of ***dolomite rock*** has risen to ca. 16 Mt in 2011, with reduction to 13.2 Mt in 2012 (Tab. 1). Official production of ***dolomite raw materials*** (i.e. some industrial grades of dolomite) achieved the level of ca. 2.1 Mtpy in 2007-8, with distinct reduction to under 1.8 Mtpy in the next 4 years (Tab. 1). In the structure of ***industrial dolomite*** production, the share of ***dolomite rock*** is still dominant. ***Dolomite grits*** and ***dolomite flours*** are of minor importance.

Tab. 1. Dolomite[1] statistics in Poland — CN 2518 10

'000 t

Year	2008	2009	2010	2011	2012
Mining output	**11,804**	**12,721**	**12,183**	**16,065**	**13,194**
— Dolomitic marbles	766	732	731	808	821
— Dolomite	11,038	11,989	11,452	15,257	12,373
• *Małopolskie voivodeship*	*2,206*	*2,216*	*2,389*	*3,300*	*2,753*
• *Śląskie voivodeship*	*4,063*	*5,068*	*4,122*	*4,839*	*3,837*
• *Świętokrzyskie voivodeship*	*4,769*	*4,705*	*4,941*	*7,118*	*5,783*
Production	**2,079.0**	**1,749.6**	**1,727.3**	**1,795.0**	**1,762.7**
Imports	**177.1**	**140.0**	**133.2**	**98.2**	**132.7**
Exports	**36.4**	**31.8**	**36.4**	**35.7**	**33.7**
Consumption[a]	**2,219.7**	**1,857.8**	**1,824.1**	**1,857.5**	**1,861.7**

[1] excluding dead-burned dolomite

Source: ***The Central Statistical Office (GUS), Mineral Resources Datafile, producers' data***

The ***smelter*** and ***refractory grades of dolomite*** are produced almost entirely by the only one Upper Silesian plant. i.e. the **Mining Dolomite Works** (**GZD**) in **Siewierz**, exploiting the **Brudzowice** deposit. This company produces several grades of ***raw dolomite rock***, used as a fluxing agent at smelters and for the production of refractories (50–70% of total production), as well as ***dolomite crushed aggregates*** (20–40%). ***Ca-Mg carbonate fertilizers*** are produced from mining and processing wastes (ca. 10%). GZD's total production varied between 1.3–1.8 Mtpy in recent years, with decreasing share of industrial dolomite rock. The **"Żelatowa" Dolomite Mining and Roasting Plant** in **Chrzanów** was previously the second producer of industrial dolomite. Recently, this company was providing 0.5–0.8 Mtpy of ***dolomite products***, but with only 15–25% share of ***raw dolomite rock***, offered mainly as ***metallurgical*** and ***refractory grades***, 50–70% share of ***dolomite crushed aggregates***, and 10–20% share of ***Ca-Mg carbonate fertilizers***. Its production of ***dead burned dolomite*** was ceased in 2003. Recently, ***metallurgical grade dolomite*** and ***refractory grade dolomite*** started to be delivered also by other dolomite mines of Silesia-Cracow region, extracting deposits of ***dolomite for crushed aggregates production***, e.g. **"Dolomit" Ltd. Libiąż**, **"Dolomit" S.A. Dąbrowa Górnicza**, and **"Promag" Ltd. Żelisławice**.

Suppliers of ***dead burned dolomite*** for refractories and ***calcined dolomite*** for steel industry are basing their production primarily on ***Siewierz metallurgical dolomite***. There are mainly: **ArcelorMittal Refractories** of **Cracow** (only ***dead burned dolomite***), **Lhoist Opolwap S.A. Production Unit Sabinów** in **Częstochowa**, and **"Chemokor" Dąbrowa Górnicza**. In 2012, ***dead burned dolomite*** production amounted to 63,800 t, while ***calcined dolomite*** production — only 3,500 t. The total production of ***dead burned*** and ***calcined dolomite*** varied between 125–150 ktpy in recent years, with strong drop since 2009 to under 70,000 in 2012 (Tab. 2).

Tab. 2. Dead-burned dolomite statistics in Poland — CN 2518 20

'000 t

Year	2008	2009	2010	2011	2012
Production	127.4	84.4	93.5	84.6	67.3
Imports	0.6	0.9	1.9	4.8	7.0
Exports	0.0	0.2	0.3	0.4	6.6
Consumption[a]	128.0	85.1	95.1	89.0	67.7

Source: ***The Central Statistical Office (GUS)***

The production of ***dolomite flour for the ceramic and glass-making industries***, as well as of ***dolomite flour for paints, plastics, and rubber industry***, is based on the purest rocks (***dolomitic marble***), mined at **Ołdrzychowice** and **Rędziny** (Lower Silesia). The **Rędziny** mine, operated by **Jelenia Góra Mineral Mines**, provides 190–220 ktpy of ***dolomitic marble***. In the nearby **Pisarzowice** processing plant, as well as in another **Jarnołtówek** processing plant, company produces 100–150 ktpy of ***dolomite flour*** (***grade 1***, ***1S***, ***2***), as well as significant amounts of ***Ca-Mg carbonate fertilizers***. The output of ***dolomitic marble*** from the **Ołdrzychowice-Romanowo** deposit (extracted by **"Omya" Ltd. Warszawa**, previously **"Kambud" Ltd.** of **Ołdrzychowice**), in the last years rose significantly to almost 600 ktpy. The plant delivers the highest quality ***grits***, as well as small amounts of ***dolomite flour of 2*** and ***2S grade***. In the **Jasice** processing plant near Ożarów (Świętokrzyskie voivodeship), the same company manufacture ***dolomite flour of 1*** and ***1S grade***. The remaining part of ***dolomite grits*** is sold for the production of ***terrazzo***, as well as to other processors, which produce dolomite flour for glass, ceramic and chemical industries. ***Dolomitic marble*** from the nearby **Nowy Waliszów C** deposit is extracted irregularly by **Omya**, being mainly used to produce ***dolomite flour***. The total production of ***dolomite flours*** in Poland amounts to over 400 ktpy in recent years. The majority of them is used in the glass industry (coarse grades), while minor part as filler in the other industries (very fine grades).

Dolomites for road building and ***construction*** are extracted from over 20 deposits, located only in the Silesia-Cracow and Świętokrzyskie Mountains regions. The total output is continuously increasing, achieving a level of 11-12 Mtpy, only in 2011 it exceeded 15 Mt (Tab. 1). The share of ***fertilizers*** in the production of these mines commonly amounts to 10–20%, whereas ***aggregates*** account for 80–90%. Currently, the ***dolomite aggregates*** and ***fertilizers*** manufacturers in the **Silesia-Cracow** region include: **"Tribag" Ltd.** of **Siewierz**, the **"Dolomit" S.A. Dąbrowa Górnicza**, the **Road Materials Quarries** of **Rudawa** near Cracow (**Lafarge Group**), **"Promag" Ltd.** of **Żelisławice**, **"Dolomit" Ltd.** of **Libiąż**, **"PRInż Surowce" Ltd.** of **Katowice**, **"Kopalnia Imielin" Ltd.** of **Imielin,** the **Mineral and Light Aggregates Production Plant** of

Katowice, as well as above mentioned the **Mining Dolomite Works** (**GZD**) in **Siewierz**, and the **"Żelatowa" Dolomite Mining and Roasting Plant** in **Chrzanów** (total amount 5-6 Mtpy of dolomite aggregates). Moreover, ***dolomite aggregates*** are produced on the basis of ***ore-bearing dolomite*** from ***Zn-Pb ores*** deposits in the **Silesia-Cracow** region, where ***washed dolomite*** is obtained as a by-product of ore processing. Such aggregates are currently manufactured only by **"Boloil" Co.** of **Bukowno** near Olkusz on the basis of the **"Bolesław" Mining and Smelting Plant** dolomite waste rock (0.5–0.7 Mtpy).

In the Świętokrzyskie Mountains region, ***dolomite aggregates*** and ***Ca-Mg fertilizers*** are delivered by four larger producers: the **Dolomite Quarries** of **Sandomierz**, **"Lafarge Kruszywa" Ltd.** of **Warsaw**, the **Minerals Mines** of **Kielce**, and **"Kopalnie Świętokrzyskie" Ltd.** of **Kielce**, and a few smaller mines (total amount 4-6 Mtpy of dolomite aggregates).

Trade

Both the production volume and product assortments of ***dolomite commodities*** satisfy the domestic demand, except for ***top quality flours***: coarse grades for the glass-making and ceramics, as well as fine grades used as fillers in other industries: plastics, paints, etc. These are imported mainly from Slovakia and Estonia (cheap grades), as well as from Norway, the Czech Republic, Sweden, Hungary and others (higher quality grades). A deficit of such flours on the domestic market resulted in a sharp increase in imports to almost 180,000 t in 2008, with strong drop to under 100,000 t in 2011 and recovery to 132,700 t in 2012 (Tab. 3). On the opposite, exports of dolomite flours are also reported, but they do not exceed 40,000 tpy (Tab. 1). They were directed to Ukraine and Belarus mostly.

Tab. 3. Polish imports of dolomite flour, by country — CN 2518 10

'000 t

Year	2008	2009	2010	2011	2012
Imports	**177.1**	**140.0**	**133.2**	**98.2**	**132.7**
Czech Republic	24.3	13.1	10.0	3.6	-
Estonia	33.9	16.7	4.2	3.0	-
Germany	0.4	2.9	1.5	0.5	0.3
Hungary	0.3	0.1	-	0.0	0.0
Norway	7.9	5.4	5.5	4.6	9.7
Slovakia	100.9	97.8	109.6	86.0	121.7
Sweden	8.9	3.7	1.9	0.0	0.0
Others	0.5	0.3	0.5	0.5	1.0

Source: ***The Central Statistical Office (GUS)***

Other dolomite products, mainly ***dead burned dolomite***, are imported, as well as exported, incidentally. However, in 2012 its exports rose to ca. 6,600 t, while imports to ca. 7,000 t (Tab. 2).

The ***dolomite*** trade balance was consistently negative, exceeding 10 million PLN/y in previous years. Recently, trade balance started to be positive due to lower imports of cheaper dolomite flour grades, as well as higher exports of more expensive dolomite flour grades (Tab. 4). The average unit values of ***dolomite flour*** imports rose to almost 60 USD/t in 2008, with remarkable decrease to ca. 30 USD/t in 2012 (Tab. 5), while ***dolomite flour*** exports unit values rose to almost 100 USD/t. Unit values of ***dead burned and calcined dolomite*** after reduction to ca. 90 USD/t, recently rose to over 110 USD/t (Tab. 5).

Tab. 4. Value of dolomite trade in Poland — CN 2518

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	11,444	12,429	14,395	12,225	17,519
Imports	24,909	23,440	19,649	15,306	16,119
Balance	**-13,465**	**-11,011**	**-5,254**	**-3,081**	**+1,400**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Average unit values of production and trade of dolomite commodities in Poland

Year	2008	2009	2010	2011	2012
Dolomite rock CN 2518 10					
Average production values					
— PLN/t	42.6	57.1	82.3	84.7	94.7
— USD/t	18.4	18.4	27.3	29.1	29.0
Dolomite flour CN 2518 10					
Average imports values					
— PLN/t	136.5	161.3	147.5	131.5	100.4
— USD/t	59.0	51.8	48.9	45.2	30.7
Dead-burned and calcined dolomite CN 2518 20					
Average production values					
— PLN/t	289.8	271.6	279.2	340.0[e]	363.6
— USD/t	125.8	87.3	92.6	116.7	111.2

Source: ***The Central Statistical Office (GUS)***

Consumption

One of the basic consumers of dolomite is the steelmaking industry, which uses ***raw dolomite*** as a ***fluxing agent*** for blast furnace, open-hearth furnace, and converter operations. ***Dolomite*** from the **Siewierz** and **Żelatowa** mines is mainly used for this purpose. Consumption of this sector in the last years varied between 250–500 ktpy, with maximal level reported in the years 2007-2008. The second large consumer is the refractories industry. Its importance is continuously decreasing, down to under 180 ktpy since 2009. Raw dolomite of DK, DM1, and DM2 grades is used to produce appropriate ***dead burned*** (***sintered***) ***dolomite*** grades for this industry, being used for ***dolomitic refractory mixes***,

refractory dolomite bricks, ***magnesite-dolomite bricks***, ***dolomite-tar bricks***.

The glass-making and ceramics industries consume 230-290 ktpy of ***high purity dolomite flours***, containing lesser amounts of coloring oxides, particularly Fe_2O_3 and TiO_2 (max. 0.05–0.40% Fe_2O_3, depending on the grade). These are used primarily for the production of flat float glass, as a 10–20% batch additive. In the ceramics industry, they are used as fluxing agents to produce glazes, porcelain, and faience mixes. Both the glass-making and ceramics industries utilize ***dolomite flours*** of ***grades 1***, ***1S***, ***2*** and ***2S***, produced currently from **Ołdrzychowice-Romanowo**, and **Rędziny** dolomitic marble. However, some applications require ***extra pure dolomite flour*** (<0.05% Fe_2O_3), which is imported. ***Fine dolomite flours*** are used as ***fillers*** for paints, emulsions, surface layers, plastics, etc., as well as ***agglomeration preventing agent*** for fertilizers (e.g. ammonium nitrate).

An important application of dolomite is for the production of ***Ca-Mg fertilizers*** that improve the pH balance of soils. However, as the subsidies to their purchase were abandoned in May 2004, the production was hardly reduced. Other important dolomite product is ***feed grade dolomite*** for animals. ***Dolomite tablets*** for human consumption (to compensate ***magnesium*** deficiency) are of marginal importance.

A considerable portion of dolomite is applied for the production of a wide range of ***crushed aggregates***, used for road and railway building purposes, primarily in the close vicinity of quarries, i.e. in the Upper Silesia and the Cracow region, and in the Świętokrzyskie Mountains region. ***Dolomite grits*** from dolomitic marble are also used in the construction industry for ***terazzo flooring*** and ***plates***.

The estimated structure of dolomite consumption in Poland in 2012 was as follows: ***aggregates*** and ***fertilizers*** — 92%, ***dolomite flour*** for ***glass*** and ***ceramics***, ***paints*** and ***varnishes*** — 4%, ***dolomite rock*** as ***flux for steelworks*** — 3%, ***dolomite rock*** for ***refractory dead-burned dolomite*** — 1%.

Principal companies involved in dolomite assortment production in Poland as of December 2012

- Górnicze Zakłady Dolomitowe S.A. w Siewierzu (Mining Dolomite Works Joint Stock Co. of Siewierz), ul. Bacholińska 11, 42–470 Siewierz, tel. +48 32 6744300, fax +48 32 6744305, www.gzd.com.pl — *raw dolomite for metallurgy and refractories, aggregates, fertilizers.*
- Kopalnia i Prażalnia Dolomitu "Żelatowa" S.A. w Chrzanowie ("Żelatowa" Dolomite Mining and Roasting Plant Joint Stock Co. of Chrzanów), 32–500 Chrzanów, ul. Borowcowa 125, tel. +48 32 6234275, fax +48 32 6234278, www.zelatowa.com.pl — *raw dolomite for metallurgy and refractories, aggregates, fertilizers*.
- ArcelorMittal Refractories Sp. z o.o. w Krakowie (ArcelorMittal Refractories Ltd. of Cracow), ul. Ujastek 1, 30–969 Kraków, tel. +48 12 6804800, fax +48 12 6802908, www.pmo-komex.pl — *dead burned dolomite*.
- "Lhoist Opolwap" S.A., Wydział Produkcyjny Sabinów w Częstochowie ("Lhoist Opolwap" Joint Stock Co., Production Unit Sabinów of Częstochowa), ul. Żyzna 15, 42–200 Częstochowa, tel. +48 34 3699171, fax +48 34 3699167, www.lhoist.pl — *dead burned dolomite, calcined dolomite (dolomite lime)*.
- "Chemokor" Sp. z o.o. w Dąbrowie Górniczej ("Chemokor" Ltd. of Dąbrowa Górnicza), ul. Myśliwska 9, 41–303 Dąbrowa Górnicza, tel. +48 32 2601646, fax +48 32

2602002, www.chemokor.com.pl — *dead burned dolomite, calcined dolomite (dolomite lime).*

- Jeleniogórskie Kopalnie Surowców Mineralnych — Lipiński i Mandrela Sp. jawna w Szklarskiej Porębie (Jelenia Góra Minerals Mines — Lipiński i Mandrela Open Co. of Szklarska Poręba), ul. B. Czecha 2, 58–580 Szklarska Poręba, tel. +48 75 7172001, fax +48 75 7172515, www.jksm.pl — *dolomite flour, Ca-Mg fertilizers*.
- "Omya" Sp. z o.o. w Warszawie ("Omya" Ltd. of Warszawa), ul. Krucza 16/22, 00–526 Warszawa, tel./fax +48 22 5258900, www.omya.pl — *dolomite flour, dolomite grits*.
- Przedsiębiorstwo Produkcyjno-Usługowo-Handlowe "Dolomit" S.A. w Dąbrowie Górniczej ("Dolomit" Production, Services and Trade Enterprise Joint Stock Co. of Dąbrowa Górnicza), ul. Dolomitowa 6, 42–520 Dąbrowa Górnicza, tel. +48 32 2623010, fax +48 32 2623013, www.dolomit.com.pl — *aggregates, Ca-Mg fertilizers, raw dolomite for metallurgy*.
- Kopalnie Odkrywkowe Surowców Drogowych w Rudawie S.A. (Road Materials Quarries Joint Stock Co. of Rudawa), ul. Legionów Polskich 105, 32–064 Rudawa, tel./fax +48 12 2838751, www.kosd-rudawa.pl — *aggregates, Ca-Mg fertilizers*.
- Przedsiębiorstwo Wielobranżowe "Promag" Sp z o.o. ("Promag" Multipurpose Enterprise Ltd.), ul. Podleśna, Żelisławice, 42–470 Siewierz, tel./fax +48 32 6741830, www.promagpw.pl — *aggregates, Ca-Mg fertilizers, raw dolomite for metallurgy and refractories*.
- "Tribag" Sp. z o.o. w Siewierzu ("Tribag" Ltd. of Siewierz), ul. Przemysłowa 2, 42–470 Siewierz, tel. +48 32 2676056, fax +48 32 2676057, www.tribag.pl — *aggregates, Ca-Mg fertilizers*.
- Przedsiębiorstwo Produkcyjno-Usługowe "Dolomit" Sp. z o.o. w Krakowie, Kopalnia Dolomitu w Libiążu ("Dolomit" Production and Services Enterprise Ltd. of Kraków, Dolomite Quarry Ltd. of Libiąż), ul. Kamienna 9, 32–590 Libiąż, tel./fax +48 32 6277273, www.dolomitlibiaz.pl — *aggregates, Ca-Mg fertilizers, dimension dolomite, dolomite pitcher, raw dolomite for metallurgy.*
- "Boloil" S.A. w Bukownie ("Boloil" Joint Stock Co. of Bukowno), ul. Kolejowa 37, 32–332 Bukowno, tel.+48 32 2955708, fax +48 32 2955745, www.boloil.com.pl — *aggregates.*
- "Lafarge Kruszywa i Beton" Sp. z o.o., Kopalnia Dolomitu w Radkowicach ("Lafarge Kruszywa i Beton" Ltd., Dolomite Mine in Radkowice), 26–026 Morawica, tel./fax +48 41 3117571, www.lafarge-kruszywa.pl — *aggregates, Ca-Mg fertilizers*.
- Kopalnie Dolomitu S.A. w Sandomierzu (Dolomite Quarries Joint Stock Co. of Sandomierz), ul. Błonie 8, 27–600 Sandomierz, tel./fax +48 15 8323036, www.kopalnie-dolomitu.pl — *aggregates, Ca-Mg fertilizers*.
- Kieleckie Kopalnie Surowców Mineralnych S.A. w Kielcach (Minerals Mines of Kielce Joint Stock Co.), ul. Ściegiennego 5, 25–033 Kielce, tel. +48 41 3612711, fax +48 41 3613249, www.kksm.com.pl — *aggregates, Ca-Mg fertilizers*.
- "Kamieniołomy Świętokrzyskie" Sp. z o.o. w Sandomierzu ("Kamieniołomy Świętokrzyskie" Ltd. of Sandomierz), ul. Błonie 8, 27–600 Sandomierz, tel. +48 15 8611662, fax +48 15 8320662, www.kruszywa-mineralne.pl — *aggregates, Ca-Mg fertilizers*.

FELDSPAR

Overview

The **feldspars** are the commonest of the rock forming minerals in the earth's crust (up to 60% of the igneous rocks mineral composition). There are two series: the **alkali feldspars** which have compositions between $KAlSi_3O_8$ (***orthoclase/microcline***) and $NaAlSi_3O_8$ (***albite***), and the **plagioclase feldspars** which lie between $NaAlSi_3O_8$ (***albite***) and $Ca_2Al_2Si_2O_8$ (***anorthite***). Pure ***feldspar rocks***, such as ***K-feldspar*** (which is distinguished from other feldspars by its high potash content) are very rare. As a source of alkalis are also utilized ***quartz-feldspar rocks*** that occur much more frequently. The most important of these are leucogranite, leucoporphyry, aplite, and nepheline syenite.

Feldspar raw materials consist of feldspar, along with feldspar-quartz and quartz-feldspar mixtures containing over 8% K_2O+Na_2O. They are used mainly in the ceramics and glass-making industries, and to some extent, in paint, plastics, and rubber manufacturing.

Sources

In 2012 domestic reserve base consisted of 10 deposits of ***feldspar-quartz*** and ***quartz-feldspar rock*** located in the Lower Silesia region and in the vicinity of Cracow. Their total reserves amounted to 137.5 Mt (as of 31 December 2012). There were two deposits of feldspar-quartz rock operated, i.e. the **Pagórki Wschodnie** and **Stary Łom**, both near Sobótka (***leucogranite***). An important source for feldspar recovery were also Lower Silesian deposits of granitoids, e.g. **Pagórki Zachodnie**, **Strzeblów I**, **Graniczna**, **Rogoźnica II**, **Gniewków**, **Kośmin**, and **Czernica** among others.

Production

The production of ***feldspar-quartz*** raw materials in Poland, which achieved around 640 kt in 2008, after a brisk downfall in 2009-2010, improved by more than 10% in 2011 (Tab. 1). In 2012 it declined again by 9% due to weakening of demand from principal end-users, i.e. ceramic tile producers, especially in the first couple of months. The largest domestic producer of feldspar-quartz raw materials, supplying 380-450 ktpy (65–85% of the total domestic production) is the **Strzeblowskie Mineral Mines** (**SKSM**) of **Sobótka**, with the production capacities approaching 500 ktpy. The company extracted ***feldspar-quartz rock*** from the following deposits: **Pagórki Wschodnie**, **Pagórki Zachodnie**, **Strzeblów I** (since 2007), and **Stary Łom** (since 2011). The raw material has been processed into ***feldspar-quartz grits*** (98-99% of sales) and ***powders***, which were basically utilized in the ceramic and glass-making industries.

Tab. 1. Feldspar minerals statistics in Poland — CN 2529 10, 2529 30

'000 t

Year	2008	2009	2010	2011	2012
Mining output[1]	599.1	445.5	513.7	550.0[e]	376.5
Production	643.7	478.0	485.1	538.8	487.2
incl. feldspar- quartz from granite processing	*118.9*	*69.3*	*72.3*	*83.3*	*61.7*
Imports[2]	323.7	276.7	324.1	412.4	364.3
Exports[2]	5.5	9.2	8.4	10.5	8.6
Consumption[a]	961.9	745.5	800.8	940.7	841.9

[1] the output of the Pagórki Wschodnie, Pagórki Zachodnie, Karpniki (until 2010), Strzeblów I (since 2007), and Stary Łom (since 2011) deposits

[2] feldspar and nepheline syenite

Source: ***The Central Statistical Office (GUS), producers' data***

Until 2010 another producer of feldspar raw materials was **Pol-Skal Ltd.** of **Cracow** operating **Karpniki** deposit. Its output achieved 100,000 t in 2008, but in 2009-2010 the company's sales of ceramic grades of ***feldspar-quartz grits*** (0–8, 1-8, 0-2 mm) were reduced, to 65 and 30 ktpy respectively. In the mid-2010 the Pol-Skal indefinitely suspended mining activity due to the opposition of local community.

Since the mid-1990s, fine-grained fractions generated in course of the production of crushed aggregates at Lower Silesian granite quarries have been utilized as a source of feldspar-quartz raw materials in the ceramic industry. Despite high content of Fe_2O_3, these cheap alkali-rich products have been used in the manufacturing of glazed stoneware and clinker tiles. The largest supplier of these materials (35-60 ktpy) has been the **Wrocławskie Mineral Mines – WKSM** (since 2010 **Eurovia Kruszywa S.A.** – a subsidiary of **Vinci Group**). The company has offered basically ***granite sand*** 0–2 mm which has been successfully utilized in the ceramic industry for the production of gres porcellanato tiles and biscuit, as well as for the manufacturing of clinker tiles and red ceramics goods. Fine-grained material (usually 0–5 mm size) has been also sold to the ceramic industry by other producers of crushed aggregates and building stones in the Lower Silesia, e.g.: **Gniewków Mine**, **Rogoźnica II Granite Mine**, **Kośmin Syenite (Granodiorite) Mine**, and **Czernica Granite Mine**. Total domestic consumption of these feldspar-quartz by-products in the ceramic industry (which is not recorded in the official statistics) has been estimated at 40-100 ktpy.

Relatively small amounts (5-10 ktpy) of ***feldspar powders*** have been also offered by the **Jeleniogórskie Mineral Mines Co.** of **Szklarska Poręba.** These products are appropriated basically for the glass-making industry.

Trade

In 2008-2012 the importation of feldspar commodities to Poland reached its top level of 412 kt in 2011. That was the result of record deliveries of feldspar from Turkey and the Czech Republic, and of nepheline syenite from Norway (Tab. 2). Despite the drop of ca. 12% last year, it remained higher than in 2008-2010. There were imported ***feldspar grit*** and ***powder*** of the highest quality for the porcelain industry, ***feldspar concentrate*** for high-purity glass production, and ***nepheline syenite*** for the glass and sanitaryware industries. The share of nepheline syenite in total deliveries ranged from 22 to 24% in the last couple of years. Large amounts of feldspar of relatively lower quality were also brought for the ceramic tiles industry (ca. 60% of the total) to supplement domestic supplies, which were insufficient to keep pace with expansion of this sector's demand, especially in respect to production of ***gres porcellanato*** tiles (with 40-50% of feldspar in the ceramic body composition). The principal deliveries of ***tile grades*** (usually sodium feldspars) has come from the Czech Republic and Turkey, and – until 2011 – Norway. In 2012 from the Czech Republic originated around 37% of the total importation (mainly from **Lasselsberger**'s **Halamky** deposit, and **KMK Granit — Krasno** deposit), from Turkey (basically ***sodium feldspar*** of ceramic grade made by **Kaltun**, **Esan Eczacibasi**, **Cine Akmaden**, **Kalemaden**, and **Ermad**) – also 37%, and from Norway — 22% (only ***nefeline syenite*** manufactured at **Stjernoy** island by **Sibelco Nordic**– formerly **North Cape Minerals**). Until 2011 there were also ***feldspar flotation concentrates*** imported from Norway, but in June 2011 the only facility globally to separate potassic and sodic feldspar from pegmatite via flotation in **Lillesand** was closed. The reasons were expensive processing costs and falling demand, notably in traditional cathode ray tube TV sets market. Regular deliveries of smaller quantities of feldspar commodities came also from France (**Imerys**) and Germany (**AKW Amberger Kaolinwerke/Quarzwerke Group**).

Tab. 2. Polish imports of feldspar commodities, by country

'000 t

Year	2008	2009	2010	2011	2012
Imports, total	**323.7**	**276.7**	**324.1**	**412.4**	**364.3**
Feldspar CN 2529 10	**245.2**	**194.3**	**244.9**	**316.0**	**285.0**
Czech Republic	106.3	93.7	90.0	120.5	136.2
Finland	2.9	0.4	1.0	1.8	1.5
France	9.3	9.5	6.3	6.2	6.2
Germany	2.8	2.4	4.5	3.1	3.5
Italy	1.4	6.5	3.9	0.3	–
Norway	11.4	10.6	13.8	8.8	0.0
Spain	–	–	–	1.5	4.4
Sweden	–	0.1	0.2	0.2	0.1
Turkey	110.7	71.1	125.0	173.5	133.0
Others	0.4	–	0.2	0.1	0.3
Nepheline syenite CN 2529 30	**78.5**	**82.4**	**79.2**	**96.4**	**79.3**
Norway	78.5	82.3	79.2	96.1	79.2
Others	0.0	0.1	0.0	0.3	0.1

Source: ***The Central Statistical Office (GUS)***

A small exportation of ***feldspar raw materials*** from Poland was also recorded, which ranged from 8 to 10 ktpy in recent years (Tab. 1). The most regular recipients of these sales have been Ukraine, Russia, and Hungary. Small amounts were also sold sporadically to the Czech Republic, Slovakia and other neighbouring countries. In 2012 almost 84% (in 2011 - 71%) of the exportation were made up by nepheline syenite, sold (re-exported) in large portion to Ukraine and Russia (probably to the **Cersanit's** foreign sanitaryware divisions).

The trade balance of feldspar commodities was always negative. In 2008-2010 it ranged from 64 to 67 million PLN/y, deepening to 95 and 84 million PLN/y in the last two years, respectively, as a result of increased importation (Tab. 3).

Tab. 3. Value of feldspar commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Feldspar CN 2529 10					
Exports	943	928	1,609	1,753	887
Imports	43,899	35,462	41,220	61,992	56,629
Balance	**-42,956**	**-34,534**	**-39,611**	**-60,239**	**-55,742**
Nepheline syenite CN 2529 30					
Exports	2,359	4,648	4,500	6,192	6,454
Imports	25,919	33,958	31,663	40,961	34,290
Balance	**-23,560**	**-29,310**	**-27,163**	**-34,769**	**-27,836**

Source: ***The Central Statistical Office (GUS)***

The unit values of ***feldspar*** importation to Poland varied between 55 and 77 USD/t, i.e. 168 and 199 PLN/t (Tab. 4). The unit cost of deliveries from two principal suppliers, i.e. the Czech Republic and Turkey, were much lower as compared to the unit values of importation from other countries. In 2012 the value of the Czech's feldspar amounted to 53 USD/t, i.e. 174 PLN/t, while in the case of Turkish raw materials it was 62 USD/t, i.e. 201 PLN/t. The unit cost of Norwegian ***nepheline syenite*** importation were much higher, i.e. 131-143 USD/t, influencing the overall financial results of trade in feldspar commodities. The 2012 prices of feldspar-quartz grades sold by domestic producer **Strzeblów Mineral Mines** were incomparably lower, i.e. in the range of 41–115 PLN/t for ***grits*** and of 170-328 PLN/t for ***feldspar-quartz powder***.

Tab. 4. The unit value of feldspar imports to Poland

Year	2008	2009	2010	2011	2012
Feldspar CN 2529 10					
PLN/t	179	182	168	196	199
USD/t	77	58	55	66	61
Nepheline syenite CN 2529 30					
PLN/t	330	412	400	425	433
USD/t	138	136	131	143	132

Source: ***The Central Statistical Office (GUS)***

Consumption

Consumption trends in the domestic market for ***feldspar***, ***feldspar-quartz*** and ***nepheline syenite*** are largerly defined by demand from primary end-users of ceramics and glass, i.e. the construction industry. In the ceramics, the alkalis in feldspar (basically potassium and sodium oxides) act as a flux, lowering the melting temperature of a mixture. In the glassmaking, alumina from feldspar prevent the glass crystallization, improves product hardness, durability, and resistance to chemical corrosion.

The world economic recession of 2008-2009 resulted in noticeable declines in housing starts and commercial construction projects in Poland. This led to a slump in the consumption of feldspar in tile (especially of gres porcellanato type with 40-50% of feldspar in the ceramic batch) and porcelain pottery units used in sanitaryware, as well as to drop in demand for automotive and residential flat glass. In 2009 the total domestic demand amounted to 745 kt, i.e. 23% less than in the previous year. In the following years the feldspar market recovered from the downturn of the crisis, increasing to 940 kt in 2011 (Tab. 1). This was partly a result of the introduction of antidumping duties for the importation of tiles from China to the EU in 2011 (acc. to EC regulation N^{o} 258/2011 from 26-32% imposed on suppliers listed in the regulation, up to 73% for other than those mentioned in that document), and better performance of the construction industry (new commercial buildings start-ups connected with organization of Euro 2012 football cup in Poland, increased repairs and renovation). Last year brought a slowdown in the development of the construction sector, which led to contraction in demand for feldspar to 840 kt.

The tile sector has been the largest ***feldspar*** consumer, accounting for over 80% (by tonnage) of the total domestic demand. In recent couple of years Poland has become the fourth tile producer in Europe - after Italy, Turkey, and Spain. Large-scale investments in new production facilities and technologies in that branch resulted in the expansion of its total capacities to 120-140 Mm^{2}py (including over 60 Mm^{2}py of gres porcellanato), 70% of which fell on two giants: **Cersanit** and **Ceramika Paradyż**. The remaining 20% of the total feldspar consumption has gone into the manufacture of the following products: glass, including glass containers and glass fiber — 10%, sanitaryware — 5%, tableware and electrical porcelain, semi-vitreous China-ware, faience — ca. 3%, chemicals, enamels, abrasives, refractories, etc. — ca. 2%.

Companies involved in feldspar commodities production in Poland as of December 2012

- Strzeblowskie Kopalnie Surowców Mineralnych Sp. z o.o. w Sobótce (Strzeblów Mineral Mines Ltd. of Sobótka), ul. Torowa 1, 55–051 Sobótka, tel. +48 71 3904211, fax +48 71 3904224, www.sksm.pl — *ceramic and glass grade feldspar-quartz grits and powders*.
- Jeleniogórskie Kopalnie Surowców Mineralnych S.A. (Jelenia Góra Mineral Mines Joint Stock Co.), ul. Bronka Czecha 2, 58–580 Szklarska Poręba, tel. +48 75 7172001, fax +48 75 7172515, www.jksm.pl — *glass grade feldspar powders.*
- Eurovia Kruszywa S.A. (Eurovia Aggregates Joint Stock Co.), ul. Powstańców Śląskich 5, 53–332 Wrocław, tel. +48 71 3351002, tel./fax +48 71 3351061, www.eurovia.pl — *quartz-feldspar sand and powder.*

FERROALLOYS

Overview

Ferroalloys are defined as iron alloys that contain one or more alloy metals. They are made in smelters from ores and concentrates and in specialized electrometallurgical plants affiliated with mines, e.g. nickel alloys made of siliceous and latheritic ores, known as ***nickel matte*** and ***ferronickel*** (Ni yields of 93–95% from the ore). ***Specular pig iron*** (***Spiegeleisen***) rich in manganese, ***carbon ferromanganese*** containing 6–8% C, and ***ferrosilicon*** containing 10–15% Si are melted in iron blast furnaces. Most alloys are produced by electrothermal methods in electric furnaces. These include ***ferroaluminum***; low-, medium-, and high-carbon ***ferrochromium***, containing 60% Cr (minimum 55% Cr); ***ferromanganese*** in several grades; ***ferromolybdenum***, with 50–60% Mo; ***ferronickel***; ***ferroniobium***, and ***ferrotantalum***; ***ferrophosphorus***; ***ferrosilicon*** in various grades, depending on the Si content (from 20 to 92% Si); ***ferrosilicoaluminum*** in several grades, containing 25–60% Si and 10–50% Al; ***ferrosilicochromium***; ***ferrosilicomanganese***; ***ferrosilicotitanium***; ***ferrosilicocalcium***; ***ferrosilicotungsten***; ***ferrotungsten***; ***ferrozirconium***, containing 18–55% Zr; and ***nitrided ferroalloys***, which contain purposefully introduced nitrogen.

Ferroalloys are used to produce alloyed steel, cast iron, and cast steel, as well as other alloys. They serve to introduce alloy additives into fused steel or cast iron, and also act as modifiers, and as deoxidizing and de-nitriding agents. They are used for technical reasons (easier fusing with the base metal) and also for economic reasons: the cost of obtaining a metal additive in the form of a ferroalloy, e.g. ferrotungsten, is considerably lower than the cost of producing pure metal.

Sources

Imported ores and concentrates are the main sources for ferroalloys production in Poland (see: **CHROMIUM**; **MANGANESE**). The exceptions are ***ferrosilicon*** and ***ferrosilicomanganese***, where the silicon comes partly from **Bukowa Góra** ***quartzite***, and in past years from the **Stanisław** ***quartz*** deposit as well.

Production

The higher grades of ferroalloys, such as ***ferrosilicomanganese***, ***ferrosilicon*** (mainly 75%), are produced at the **"Łaziska" Smelter** in electric furnaces, where despite the weak financial standing in comparison to the previous years, in 2008 there were produced 84,000 t of ferroalloys, and the main product was ***ferrosilicon*** (Tab. 1). Weakening condition of domestic steelmaking industry, as well as intensified financial difficulties of the Łaziska Smelter, resulted in 2009 in sudden reduction in output, which amounted to only 14,000 t. However, in the period 2010–2012 production increased again, reaching almost 80,000 t, as an effect of growing demand from steelmaking industry. Ferrosilicon remained the main product, while production of ferrosilicomanganese was significantly reduced.

Tab. 1. Ferroalloys statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Ferroalloys, total					
Production	**92.5**	**15.7**	**54.3**	**74.2**	**80.7**
Imports	**132.6**	**133.6**	**128.4**	**146.0**	**128.0**
Exports	**93.9**	**38.7**	**77.4**	**86.5**	**83.2**
Consumption[a]	**131.2**	**110.6**	**105.3**	**133.7**	**125.5**
Ferroalloys from blast furnace					
Production	8.5	1.7	0.8	0.8	0.8
• *ferromanganese* **CN 7202 11**	*8.5*	*1.7*	*0.8*	*0.8*	*0.8*
Imports	31.8	27.3	25.5	33.0	25.2
Exports	8.0	1.5	1.8	0.8	1.2
Consumption[a]	32.3	27.5	24.5	33.0	24.8
Ferroalloys from electric furnace					
Production	84.0	14.0	53.5	73.4	79.9
• *ferrosilicomanganese* **CN 7202 30**	*25.1*	*0.0*	*0.1*	*0.4*	*0.2*
• *ferrosilicon* **CN 7202 21–29**	*56.0*	*9.7*	*53.2*	*72.7*	*79.4*
• *other* **CN 7202x**	*2.9*	*4.2*	*0.2*	*0.3*	*0.3*
Imports	100.8	106.3	102.9	113.0	102.8
Exports	85.9	37.2	75.6	85.7	82.0
Consumption[a]	98.9	83.1	80.8	100.7	100.7

Source: ***The Central Statistical Office (GUS)***

"Stalmag" Ltd. in **Ruda Śląska** is the sole producer of ***blast furnace ferromanganese*** (high carbon ferromanganese) in Poland. In 2008 production amounted to 8,500 t, but in 2009 slowdown in Polish steelmaking industry, intensified in 2010 by economic problems of the sole ferromanganese producer in Poland, has caused further production decline to only 762 t in 2010. Output remained almost unchanged in next two years (Tab. 1), in spite of growing demand from steelmaking industry. The domestic FeMn production volume in the last five years is many times lower in comparison to 2004 when production amounted to nearly 47,000 t.

Trade

The domestic demand for ***ferroalloys***, especially those not produced in Poland, is satisfied by imports, in period 2008–2012 coming mainly from Ukraine, Norway, Slovakia, Russia, Germany, and Kazakhstan. In recent years imports of ***ferromanganese*** from blast furnace were dominated by deliveries from Norway, the Republic of South Africa and Germany, and former signicant supplier – France – has limited supply (Tab. 2). In the years 2008–2012 imports of FeMn from blast furnace was at the level of 25,000–33,000 tpy, but imports of ferroalloys from electric furnace were at the level of ca. three times greater in recent years. The highest imports were recorded in 2011 (Tab. 2).

Tab. 2. Polish imports of ferroalloys, by country

'000 t

Year	2008	2009	2010	2011	2012
Ferroalloys from blast furnace	**31.8**	**27.3**	**25.5**	**33.0**	**25.2**
Ferromanganese CN 7202 11	**31.8**	**27.3**	**25.5**	**33.0**	**25.2**
Austria	–	0.4	–	–	–
Belgium	–	–	–	–	0.1
Brasil	–	–	–	–	1.2
China	0.9	0.0	–	0.0	0.0
Czech Republic	0.3	1.1	0.4	0.3	0.0
France	0.1	0.3	0.2	0.0	1.8
Germany	0.3	0.8	2.1	0.9	0.8
India	1.4	0.4	0.2	0.0	0.3
Netherlands	0.5	0.3	0.9	0.3	0.1
Norway	1.0	15.1	13.6	17.7	11.4
Russia	2.0	0.2	0.5	0.8	0.9
Slovakia	13.7	1.7	1.7	0.2	0.0
South Africa, Republic of	4.2	3.2	2.4	6.8	5.1
Spain	1.4	0.1	0.0	0.1	–
Ukraine	5.2	3.3	3.3	5.6	3.1
Others	0.8	0.4	0.2	0.3	0.3
Ferroalloys from electric furnace	**100.8**	**106.3**	**102.9**	**113.0**	**102.8**
Ferromanganese CN 7202 19	**4.2**	**3.6**	**5.8**	**11.1**	**5.8**
Brazil	0.4	0.0	–	–	–
China	0.2	0.1	0.0	–	0.0
Germany	0.1	0.1	0.4	0.3	0.4
India	0.1	–	–	–	–
Norway	2.7	3.1	5.2	1.7	3.9
Slovakia	0.4	–	–	–	0.1

South Africa, Republic of	0.0	0.0	0.0	8.7	1.0
Sweden	–	0.2	–	–	0.0
Turkey	0.1	0.0	0.1	0.2	0.0
Ukraine	–	0.0	0.0	0.1	0.1
Others	0.2	0.1	0.1	0.1	0.2
Ferrosilicon CN 7202 21–29	**19.5**	**15.9**	**21.9**	**18.7**	**15.5**
Argentina	–	–	–	0.4	0.5
Belgium	0.6	0.2	0.1	0.1	–
Brazil	–	0.5	1.8	0.5	0.3
Bulgaria	–	0.3	0.1	0.0	0.0
China	1.0	0.3	0.1	0.1	0.0
Czech Republic	3.0	2.0	2.1	1.6	0.9
France	0.2	0.1	0.1	0.2	0.4
Germany	1.2	2.2	3.7	3.8	3.4
Iceland	–	0.4	0.4	0.2	–
India	0.6	1.1	1.1	1.0	0.7
Italy	0.3	0.1	0.1	0.2	0.4
Luxembourg	2.2	1.5	0.3	0.4	1.5
Macedonia	0.6	0.2	0.2	0.1	0.7
Netherlands	1.1	0.5	0.4	0.6	0.0
Norway	1.9	1.4	2.3	2.7	3.2
Russia	0.8	0.9	0.4	0.3	–
Slovakia	3.4	1.4	3.0	2.0	1.8
Slovenia	0.4	0.1	0.1	0.1	0.4
Spain	1.4	0.1	–	–	–
Ukraine	0.2	2.2	5.3	3.9	1.1
United Kingdom	0.1	0.1	0.2	0.1	–
Others	0.5	0.3	0.1	0.4	0.1
Ferrosilicomanganese CN 7202 30	**50.8**	**73.0**	**56.8**	**65.5**	**60.6**
Brazil	–	–	–	–	0.5
China	3.1	0.8	0.3	0.0	–
Czech Republic	1.9	2.6	2.4	0.1	1.1
France	0.2	0.4	0.0	–	0.0
Germany	1.1	1.4	1.6	0.0	–
India	2.2	0.8	0.1	0.2	0.1
Italy	–	–	–	–	0.1
Kazakhstan	–	0.1	2.5	2.4	2.2
Netherlands	0.1	0.1	0.8	0.6	0.6
Norway	1.4	17.4	14.6	15.6	17.6
Saudi Arabia	–	0.1	1.1	0.5	0.0

Slovakia	11.0	5.5	1.1	0.1	7.6
South Africa, Republic of	0.6	1.0	1.1	9.3	2.0
Ukraine	28.9	42.1	30.5	36.2	28.4
Others	0.3	0.7	0.7	0.4	0.4
Ferrochromium CN 7202 41–49	**14.0**	**5.7**	**7.9**	**7.7**	**9.4**
Brazil	0.1	0.0	–	0.3	0.3
China	1.0	0.2	0.3	0.1	0.1
Czech Republic	0.4	0.5	1.0	1.3	0.9
Germany	0.1	0.1	0.1	0.1	2.0
India	2.2	0.7	0.5	1.8	0.5
Kazakhstan	1.2	0.5	0.9	1.4	1.3
Luxembourg	0.2	0.0	0.0	–	–
Netherlands	1.0	0.1	0.1	0.2	0.2
Russia	3.0	1.7	2.6	1.7	3.4
Slovakia	0.9	0.1	0.4	0.1	0.0
South Africa, Republic of	2.0	1.7	0.6	0.2	0.3
Switzerland	0.2	0.0	–	–	0.1
Turkey	1.2	0.1	0.4	0.1	0.1
Zimbabwe	0.1	–	0.6	0.0	–
Others	0.4	0.0	0.3	0.3	0.2
Ferrosilicochromium CN 7202 50	**0.2**	**0.1**	**0.5**	**0.0**	**0.1**
Ferronickel CN 7202 60	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**
Ferromolybdenum CN 7202 70	**1.5**	**0.7**	**0.6**	**0.4**	**1.0**
Ferrotungsten and ferrosilicotungsten CN 7202 80	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ferrotitanium and ferrosilicotitanium CN 7202 91	**0.2**	**0.1**	**0.2**	**0.2**	**0.3**
Ferrovanadium CN 7202 92	**0.4**	**0.3**	**0.4**	**0.2**	**0.5**
Ferroniobium CN 7202 93	**0.2**	**0.2**	**0.4**	**0.2**	**0.4**
Ferrophosphorus CN 7202 99 10	**1.3**	**0.6**	**0.9**	**1.2**	**1.0**
Ferrosilicomagnesium CN 7202 99 30	**4.1**	**2.6**	**3.4**	**1.9**	**1.7**
Other ferroalloys CN 7202 99 80	**4.4**	**3.3**	**4.1**	**5.9**	**6.3**

Source: ***The Central Statistical Office (GUS)***

Exports levels of ferroalloys in recent years were very unstable, reflecting economic condition of domestic steelmaking industry. As usual, ***ferrosilicon***, ***ferrosilicomanganese***, and ***ferromanganese*** from blast furnace had the main share in exports volume, and the main purchasers were Germany and other European Union countries (Tab. 3).

Tab. 3. Polish exports of ferroalloys, by country

'000 t

Year	2008	2009	2010	2011	2012
Ferroalloys from blast furnace	**8.0**	**1.5**	**1.8**	**0.8**	**1.2**
Ferromanganese CN 7202 11	**8.0**	**1.5**	**1.8**	**0.8**	**1.2**
Czech Republic	0.5	0.6	0.7	0.3	0.6
Germany	7.1	–	0.6	0.1	0.1
Romania	–	–	–	–	0.1
Slovakia	0.2	0.7	0.2	0.1	0.0
Slovenia	0.1	0.1	0.1	–	–
Ukraine	–	–	–	0.2	0.2
Others	0.0	0.1	0.2	0.1	0.1
Ferroalloys from electric furnace	**85.9**	**37.2**	**75.6**	**85.7**	**82.0**
Ferromanganese CN 7202 19	**1.0**	**0.9**	**0.8**	**0.8**	**0.8**
Bulgaria	0.0	0.0	0.0	0.1	0.1
Hungary	0.5	0.4	0.4	0.4	0.4
Indonesia	0.2	0.2	0.3	0.2	0.2
Italy	0.2	0.1	–	–	–
Russia	–	0.1	0.1	0.1	–
Others	0.1	0.1	0.0	0.0	0.1
Ferrosilicon CN 7202 21–29	**53.4**	**16.2**	**63.4**	**76.0**	**72.1**
Austria	1.9	0.9	3.1	4.1	6.4
Belarus	0.0	0.0	0.0	0.1	0.1
Belgium	–	–	9.3	18.9	1.4
Czech Republic	8.5	5.1	11.1	17.1	16.8
Finland	0.6	1.5	0.8	1.2	0.2
France	–	–	1.2	0.1	0.8
Germany	23.2	4.2	25.0	22.5	26.8
Greece	–	–	–	–	0.3
Hungary	0.5	0.1	0.4	0.6	1.5
Indonesia	0.1	0.0	0.1	0.0	0.1
Italy	2.7	0.8	1.9	1.6	8.1
Netherlands	0.0	0.0	1.3	0.0	–
Romania	–	0.2	1.4	0.7	1.1

Russia	0.2	0.1	0.2	0.1	–
Slovakia	8.4	0.9	1.8	1.8	2.2
Slovenia	3.6	0.9	2.5	3.1	2.9
Spain	–	–	–	0.7	0.2
Sweden	3.2	1.4	2.9	3.1	2.2
United Kingdom	–	–	0.1	0.0	0.4
Others	0.5	0.1	0.3	0.3	0.6
Ferrosilicomanganese CN 7202 30	**28.7**	**18.3**	**7.4**	**1.7**	**3.7**
Belgium	0.1	–	0.2	–	–
Czech Republic	3.8	6.7	2.8	0.5	1.7
France	–	1.4	–	–	–
Germany	16.5	8.3	2.3	0.6	1.6
Hungary	–	0.1	0.1	0.0	0.1
Italy	0.4	–	–	–	–
Luxembourg	–	0.3	1.2	–	–
Netherlands	5.6	0.1	0.1	–	–
Romania	–	0.0	–	0.2	0.0
Slovakia	2.1	1.1	0.4	0.0	–
Slovenia	–	0.2	0.2	0.3	0.1
Others	0.2	0.1	0.1	0.1	0.1
Ferrochromium CN 7202 41–49	**1.8**	**0.4**	**0.7**	**0.3**	**0.5**
Bosnia and Herzegovina	0.1	0.1	0.0	0.0	–
Czech Republic	0.1	0.1	0.0	0.0	0.0
Hungary	0.1	–	0.0	–	0.0
Netherlands	0.4	–	–	–	–
Slovakia	0.8	0.1	0.4	0.0	0.0
Romania	0.0	0.0	0.1	0.0	0.1
Ukraine	0.1	0.0	0.2	0.1	0.4
Others	0.2	0.1	0.0	0.1	0.0
Other ferroalloys[1]	**1.0**	**1.4**	**3.3**	**6.9**	**4.9**

[1] in 2008, ***FeMo***, ***FeW*** and ***FeSiW***, ***FeTi*** and ***FeSiTi***, ***FeV***, ***FeNb***, ***FeP***, ***FeSiMg***, and others,
in 2009, ***FeNi***, ***FeMo***, ***FeTi*** and ***FeSiTi***, ***FeV***, ***FeNb***, ***FeP***, ***FeSiMg***, and others,
in 2010, ***FeSiCr***, ***FeNi, FeMo***, ***FeW*** and ***FeSiW***, ***FeTi*** and ***FeSiTi***, ***FeV***, ***FeNb***, ***FeP***, ***FeSiMg*** and others,
in 2011, ***FeMo***, ***FeW*** and ***FeSiW***, ***FeTi*** and ***FeSiTi***, ***FeV***, ***FeNb***, ***FeP***, ***FeSiMg***, and others,
in 2012, ***FeNi, FeMo***, ***FeW*** and ***FeSiW***, ***FeTi*** and ***FeSiTi***, ***FeV***, ***FeNb***, ***FeP***, ***FeSiMg***, and others,

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***ferroalloys***, except for 2011, was traditionally negative and had increasing tendency in the years 2008–2009 up to the record of 477 million PLN, while in period 2010–2012 significant increase in exports has caused improvement in negative value of ferroalloys trade, which in 2011 turned even to positive value and amounted to almost 12 million PLN (Tabs. 1, 4).

Tab. 4. Value of ferroalloys trade in Poland — CN 7202

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	470,854	177,218	513,125	725,721	631,587
Imports	933,695	564,549	683,640	713,821	681,244
Balance	**-462,841**	**-477,331**	**-170,515**	**+11,900**	**-49,657**

Source: ***The Central Statistical Office (GUS)***

Consumption

Ferroalloys produced in Poland, as well as those imported, are almost entirely consumed by the domestic steelmaking industry. The demand should rise significantly, because of the anticipated increase in alloyed steel production in Poland.

Companies involved in ferroalloys production in Poland, as of December 2012

- Huta "Łaziska" S.A. w Łaziskach Górnych ("Łaziska" Smelter Joint Stock Co. of Łaziska Górne), ul. Cieszyńska 23, 43–170 Łaziska Górne, tel. +48 32 2241500, fax +48 32 2241523, www.hlsili.pl — *ferrosilicon and ferrosilicomanganese from electric furnace.*
- "STALMAG" Sp. z o.o. w Rudzie Śląskiej ("STALMAG" Ltd. of Ruda Śląska) ul. Hutnicza 2, 41–709 Ruda Śląska, tel. +48 32 7712801, fax +48 32 7712800, www.stalmag.pl — *ferromanganese from blast furnace.*

FLINT

Overview

Flints are silica concretion balls of spherical or oval shape, sometimes occurring as banks (up to 30 cm thick), usually among carbonate rocks of the Jurassic or Cretaceous ages. Due to their high resistance to erosion, they remain in coarse-grained deposits. The main constituents are minerals containing SiO_2: ***chalcedony***, ***autogenous quartz***, rarely ***opal***, with admixtures of carbonates, iron hydroxides, pyrite, etc. Flint stones of commercial significance contain over 96% SiO_2. Well-rounded flint stone balls, called **"shots,"** are used as **millstones** in rolling mills. Flint stone is also comminuted and classified to obtain **flint abrasives** for the production of abrasive cloth and papers, known under the English name **flint**. **Striped flint stone** is commonly used to make some jewellery and stone fancy products.

Sources

Flint stone was one of the first rock types used by Man for the production of tools, beginning in the Paleolithic period. In the Neolithic age, flint stone was extracted in the vicinity of Tomaszów Mazowiecki, Inowłódz, Radom, Iłża, and Kraśnik, and on the largest scale in an underground mine, **Krzemionki Opatowskie**, close to **Ostrowiec Świętokrzyski**, dated 3,500–1,600 BC, currently a tourist attraction (the **Krzemionki Opatowskie Museum**).

The most important raw materials are ***flint stone balls*** occurring in Cretaceous limestones (e.g. **Karsy**, **Mielnik**, and **Kornica**), ***bank type flint*** near **Inowłódz**, and the so-called ***"horn flint,"*** e.g. **Leszczawa Górna**, **Krzeszowice**, and **Radom**. There are proven deposits in **Bocheniec** and **Tokarnia** (***striped flint stone***) with total resources of 28,000 t (as of 31 December 2012).

Production

Currently, the ***flint stone*** deposits in Poland are not being extracted. However, some amounts of ***flint stone*** (a dozen tpy or so) are irregularly recovered by the **"Bełchatów" Lignite Mine**. They are used as millstones in the mills of some processing plants.

Collectors pick up ***striped flints*** in the **Świętokrzyskie Mountains** region (a few hundred kilograms per year), recently mainly from **Śródborze** limestone quarry near Ożarów. Since May 2011 ***striped flints*** are legally extracted from limestone deposit in Śródborze. Flint content in the output of mine is estimated at 0.1%, and the average weight of lumps is about 20 kilograms.

Trade

Flint millstones are mainly imported, but exact data are not available. Some amounts of ***flint abrasives*** are also imported by small manufacturers of abrasive paper. Currently, the **"Franspol"** company of Warszawa is the largest importer — ca. 1,000 tpy of the ***flint pebbles*** (grain size from 1 to 15 cm) and ***granulated flints*** (0.5–12mm). ***Granulated flints***, useful as fillers, are also offered by **"Mercury" Ltd.** of Żary.

Striped flints from Ożarów area are exported to Germany and Austria, where they are used in the production of jewellery.

Consumption

Flint millstones are used mainly as grinding media and mill-linings in mills for the comminution of ceramic materials, cosmetics and drugs, in order to avoid contamination with coloring metal oxides, particularly Fe_2O_3 and TiO_2. The ***granulates flints*** are used as fillers for paints and plasters production. There is no information on the consumption of ***flint abrasives*** in Poland.

The ***striped flint stone*** that collectors pick up is used to make fancy goods, e.g. ash trays. For over 30 years, striped flint stone from Ożarów area in the Świętokrzyskie Mountains has been used for production of jewellery. Recently, it started to be very attractive jewellery stone, being introduced e.g. in the jewellery collection of the **"W. Kruk"** company.

FLUORITE

Overview

The most commonly used forms of **fluorine** (**F**) are **fluorite CaF_2** (**fluorspar**) and **hydrofluoric acid**, as well as its derivatives (fluorides, fluosilicates, etc.). In practice, the only primary source material is **fluorite**, which occurs in various types of individual deposits, or as an accompanying mineral in deposits of ***barite***, ***Zn-Pb***, ***Pb***, and ***Ag ores***. To a limited extent, some fluorine compounds (e.g. **fluosilic acid**, **sodium fluosilicate**) are recovered in ***phosphate*** and ***apatite*** processing. **Synthetic cryolite** is also produced by recycling in aluminum smelters.

Sources

There are no ***fluorite*** deposits of economic significance in Poland. In the deeper parts of the **Stanisławów** ***barite*** deposit there are recognized resources of ***fluorite***, which have been evaluated at 542,000 t (as of 31 December 2012).

Production

There is no domestic production of ***fluorite***. Small amounts of ***synthetic cryolite***, ca. 1,000–2,000 tpy, are produced by processing of ***phosphates*** into ***phosphoric acid*** at **"Siarkopol" Tarnobrzeg Chemical Plants Ltd.** of **Tarnobrzeg**. Some ***fluorine compounds*** are produced by domestic chemical plants.

Trade

The demand for ***fluorite*** is entirely satisfied by imports, exceeding 11,000 tpy in the years 2011–2012 (Tab. 1). The materials were bought mainly from Mexico (entirely ***metallurgical grade***), Germany (mainly ***chemical grade***), and the Czech Republic (***chemical*** and ***ceramic grade***). Share of ***chemical grade fluorite*** imports is about 31%. Many fluorine compounds are also imported, e.g. ***aluminum fluoride***, ***synthetic cryolite***, and ***hydrofluoric acid***. Due to liquidation of ***primary aluminum*** production in the **"Konin" Aluminum Smelter** of Konin (see: **ALUMINUM**) imports of ***aluminum fluoride*** decreased by over 2,000 tpy since 2009. Simultaneously, small amounts of ***synthetic cryolite*** were exported (Tab. 2).

The total trade balance in ***fluorite*** and ***fluorine commodities*** has been consistently negative (Tab. 3), while its value correlates with imports volumes and unit values of imported commodities (Tab. 2 and 4).

Tab. 1. Polish imports of fluorite, by country — CN 2529 21,22

'000 t

Year	2008	2009	2010	2011	2012
Imports = Consumption[a]	**9.1**	**9.5**	**9.2**	**11.2**	**11.4**
Czech Republic	0.3	0.3	0.8	0.4	0.6
Germany	4.2	4.2	3.4	3.5	4.3
Mexico	4.6	4.1	4.7	6.6	6.1
United Kingdom	–	0.9	0.2	0.5	0.0
Others	0.0	0.0	0.1	0.2	0.4

*Source: **The Central Statistical Office (GUS)***

Tab. 2. The trade of fluorine commodities in Poland

t

Year	2008	2009	2010	2011	2012
Hydrofluoric acid CN 2811 11					
Imports	364	555	682	826	534
Exports	0	26	6	1	20
Aluminum fluoride CN 2826 12					
Imports	2,473	182	234	313	331
Exports	20	10	22	32	45
Synthetic cryolite CN 2826 30					
Imports	900	758	1,368	1,397	1,524
Exports	242	175	300	208	115

*Source: **The Central Statistical Office (GUS)***

Tab. 3. Value of fluorine commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Fluorite CN 2529 21,22					
Imports = **Balance**	**-6,525**	**-8,723**	**-8,109**	**-10,660**	**-12,445**
Hydrofluoric acid CN 2811 11					
Exports	3	40	51	11	132
Imports	1,042	2,358	3,564	4,009	2,746
Balance	**-1,039**	**-2,318**	**-3,513**	**-3,998**	**-2,614**
Aluminum fluoride CN 2826 12					
Exports	94	52	90	158	220
Imports	9,061	669	669	1,021	1,079

Balance	**-8,967**	**-617**	**-579**	**-863**	**-859**
Synthetic cryolite CN 2826 30					
Exports	674	589	969	704	514
Imports	2,671	2,411	2,911	3,272	3,822
Balance	**-1,997**	**-1,822**	**-1,942**	**-2,568**	**-3,308**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of fluorine commodities trade in Poland

Year	2008	2009	2010	2011	2012
Fluorite CN 2529 21,22					
Imports unit values					
— PLN/t	724.3	919.1	877.1	950.9	1,088.3
— USD/t	313.3	296.2	291.8	324.4	332.5
Hydrofluoric acid CN 2811 11					
Imports unit values					
— PLN/t	2,864.9	4,246.5	5,225.4	4,855.4	5,141.5
— USD/t	1,201.0	1,371.8	1,742.5	1,642.6	1,576.0
Aluminum fluoride CN 2826 12					
Imports unit values					
— PLN/t	2,864.9	3,680.5	2,863.5	3,266.9	3,256.4
— USD/t	1,201.0	1,185.3	967.0	1,094.6	1,003.3
Synthetic cryolite CN 2826 30					
Exports unit values					
— PLN/t	2,780.1	3,370.8	3,235.9	3,384.2	4,452.2
— USD/t	1,161.0	1,091.7	1,058.3	1,173.5	1,361.6
Imports unit values					
— PLN/t	2,967.2	3,181.2	2,128.5	2,341.6	2,508.6
— USD/t	1,272.7	1,039.7	706.0	798.2	765.7

Source: ***The Central Statistical Office (GUS)***

Consumption

The main consumers of ***fluorspar*** and ***fluorine compounds*** in Poland are: the steel-making, chemical, and glass-making industries, and glaze manufacturers. Until early 2009, also the **"Konin" Aluminum Smelter** was their important consumer. The detailed consumption structure of fluorite consumption in Poland is not known.

It would be still possible that if domestic sources of fluorine were to be developed, imports could be considerably reduced. After closure of electrolysis unit in the **"Konin" Aluminum Smelter**, imported phosphates and apatites processed into phosphoric acid are the only source of the possible recovery of ***fluorine compounds***.

Companies involved in fluorine compounds production in Poland as of December 2012

- Zakłady Chemiczne “Siarkopol” Tarnobrzeg Sp. z o.o. w Tarnobrzegu (“Siarkopol” Tarnobrzeg Chemical Plants Ltd. of Tarnobrzeg), ul. Zakładowa 50, 39–402 Tarnobrzeg 4, tel. +48 15 8555710, fax. +48 15 8229797, +48 15 8227208, www.zchsiarkopol.pl — *synthetic cryolite*.

GALLIUM

Overview

Over 90% of **gallium** (**Ga**) is recovered as **primary gallium** during the complex electrolysis of so-called ***red slime*** — waste material from ***bauxite*** processed into ***alumina***. The remainder is obtained by the chemical method from ***zinc*** smelter ***dust***.

Gallium has been in wider use since the end of the 1950s, when digital watches and calculators were developed and popularized (**gallium arsenide GaAs** is used in LEDs). The growth of the gallium market is directly related to the extent of utilization of its arsenide, a substitute for silica in the semi-conductors and integrated circuits used in wireless and satellite communication.

Sources

The potentially resources of ***gallium*** in the as-yet-unmined **Silesia-Cracow *Zn-Pb ore*** deposits are estimated at 120 t Ga (as of 31 December 2008). In the years of 2009–2012 this data were not reported in the Polish Mineral Resources Datafile.

Production

Gallium is not presently recovered in Poland.

Trade

The entire demand is satisfied by imports, mainly in ***gallium-bearing*** electronic products. Imports of ***gallium*** in unprocessed form (**CN 8112 92 89**) until 2007 was rare, while in 2008 rose to 57 kg, in period 2009–2011 decreased to 25–35 kgpy and in 2012 increased to 61 kg (Tab. 1). The main suppliers were Slovakia, the US, Germany, France and Sweden. Similarly, exports (re-exports) in the years 2008–2011 were at the level of 4–8 kg, and the sole purchaser was Belarus, but in 2012 there were no re-exports of gallium from Poland (Tab. 1).

Tab. 1. Gallium statistics in Poland — CN 8112 92 89

kg

Year	2008	2009	2010	2011	2012
Imports	57	25	35	34	61
Exports	4	8	4	7	–
Consumption[a]	53	17	31	27	61

Source: ***The Central Statistical Office (GUS)***

Moreover, there were recorded imports of ***gallium***, ***indium*** and ***vanadium products*** (**CN 8112 99 70**) to Poland. In the years 2008–2009, their imports increased to 115 kg, Japan and the US mainly from, but in 2010 they decreased to 86 kg and main imports sources were Japan, the US, Russia and Germany. In 2011 imports soared up to 2,115 kg, with Germany and China as the main deliverers, but in 2012 they dropped to 1,847 kg, mainly from Germany. Exports of ***gallium***, ***indium*** and ***vanadium products*** in 2009 amounted to 526 kg, with Japan as the main receiver, and in 2010 dropped to only 6 kg practically to the US only. In the years 2011–2012 they soared even more than imports, and amounted to 2,475 kg, with Belgium and Germany as the main recipients, but in 2012 increased up to the record of 4,786 kg and were directed to China, Laos and Germany. Moreover, in 2012 the unit value of exports was five times lower than imports, but in 2011 both unit values were comparable.

Consumption

There are no reliable data available on the structure of ***gallium*** consumption in Poland.

GARNET

Overview

Garnets occur in magmatic and metamorphic rocks, and form concentrations in deposits of ***beach*** and ***alluvial sand***, ***glass sand***, ***foundry sand***, and ***natural aggregates***, from which they are separated. **Concentrates of garnets** (mainly of ***almandite*** and ***andradite***) are produced with various grain sizes; they are characterized by high hardness and density, and are resistant to chemical and physical erosion.

For centuries the broad group of **garnets** has been used as ***gemstones*** (see: **GEMS**). Since the mid-nineteenth century, they have been used mainly in the tools and abrasives industries. The demand from these industries is continuously growing.

Sources

There are no deposits of ***garnets*** in Poland. Nevertheless, occurrences have been noted in many regions, e.g. in ***mica schists*** with ***garnets*** near **Gierczyn** in the **Izerskie Foothills**, containing 20–40% of ***almandite*** and ***andradite***, with grain sizes from 3 to 5 mm, locally even to 10 mm. The heavy fractions separated from **Słupsk Bank** ***aggregates*** contain fine grains of garnets, as do some ***beach sands*** (in the vicinity of Hel, Władysławowo, Łeba, and Darłowo). Garnets also occur in heavy fractions removed from deposits of ***glass sand*** and ***molding sands***. These may serve as sources for ***fine-grained garnets***, which are much less valuable.

Production

Due to a lack of deposits, there is no production of ***garnets*** in Poland. They are also not recovered from heavy fractions obtained during processing of other minerals.

Trade

Domestic demand is covered exclusively by imports of both garnet grains (used as abrasive blasting medium and water-jet medium) and garnet abrasive tools. The imports of ***garnets*** increased from ca. 4,000–6,000 tpy in the years 2008–2010 to 8,000–10,000 tpy in the years 2011–2012. They were reported together with ***corundum*** and ***emery*** in one CN item (see: **CORUNDUM AND EMERY**). The supplies were coming from India and were utilized e.g. by **"JetSystem"** and **"Garnet Polska"** companies from Elbląg. The growth of the imports of garnet is connected with substitution of silica sand in some blast cleaning applications. In May 2004, according to EU regulations, a ban for quartz sand use for blast cleaning was introduced in Poland, due to health risk. The unit values of imported garnets range from 218 to 272 USD/t. Some amounts of ***garnets*** are re-exported to Russia. These re-exports rose from 357 t in 2008 to 1,739 t in 2011, with the slight reduction to 1,146 t in 2012. The prices of the exported garnet have consistently decreasing tendency and dropped from 425 USD/t in 2008 to 157 USD/ t in 2012.

Consumption

Poland, together with Russia and Czech Republic, is one of the European fastest growing market for ***industrial garnet***. The ***almandites*** imported by **"JetSystem" Co.** are used mainly for sandblasting (blast cleaning) of steel constructions, production of abrasive tools and to cut many different materials (waterjet cutting). Small amounts of garnets are utilized as a filtration medium.

GAS, NATURAL

Overview

Natural gas is the most important gaseous fuel in the world economy. It consists mainly of ***methane*** CH_4, accompanied by higher gaseous and liquid carbohydrate compounds (***ethane***, ***propane***, ***butane***) and other gas components, especially ***carbon monoxide*** and ***carbon dioxide***, ***hydrogen sulfide***, ***nitrogen***, ***hydrogen***, ***helium***, and ***argon***. **Dry natural gas** is obtained from individual deposits, whereas **wet natural gas** — rich in higher liquid hydrocarbons — comes from ***gas/petroleum*** deposits, as well as from ***condensate*** deposits. **Methane gas**, similar to natural gas, occurs in ***hard coal*** deposits. Among the natural gas substitutes used in many countries for commercial and public utility purposes are **coke-oven gas**, obtained in coking plants, and the **town gas** produced in municipal gas works.

Before it is delivered to the users, **raw natural gas** must be treated to remove small particles of solid minerals, carbohydrates other than methane, and excess nitrogen and helium; it must also be desulfurized (see: **NITROGEN**; **HELIUM**; **SULFUR**) and dried. ***Helium***, ***sulfur***, ***butane*** and ***propane***, ***liquid nitrogen***, and ***liquid***, easily evaporating ***gasoline*** are obtained as co-products. Gas is delivered by systems of pipelines connecting suppliers and consumers. **Liquefied natural gas** is also transported by ship, in special gas tankers, or by road in tank trucks, and then re-gasified.

Natural gas is a valuable and eco-friendly fuel directly consumed in many branches of industry and in households, and also used for the production of electrical power, for fueling automobile engines, and for many chemicals.

Sources

In Poland ***natural gas*** terrestrial deposits occur in the **Polish Lowland** (71.3% of terrestrial resources), in the **Carpathian Foredeep** (27.7%), and in the **Carpathian Mountains** (1.0%). The gas from the Lowland deposits is generally of poor quality (from under 20% to 85% methane), has high nitrogen and sulfur contents, and requires purification before use. Some of the deposits contain ***helium*** (see: **HELIUM**). The gas from the Carpathian Mountains and the Carpathian Foredeep is much better (70–99% methane). The recoverable terrestrial resources of natural gas amount to 132.0 Bm^3, with 61.4 Bm^3 of economic reserves occurring in 281 deposits (as of 31 December 2012). At the present extraction volume, these reserves will be sufficient for the next 24 years.

On the **Baltic Sea Shelf**, up till now two crude oil and natural gas deposits **B3** and **B8** were recognized (see: **OIL, CRUDE**), as well as two natural gas and condensate deposits **B4** and **B6**. The natural gas from the Baltic Sea Shelf commonly contain 70–95%

methane. The recoverable resources of natural gas amount to 5.8 Bm^3, with 5.1 Bm^3 of economic reserves (as of 31 December 2012).

In the end of 2009, some international oil companies announced their interest in potential deposits of ***shale gas*** and ***tight gas*** in Poland. Up to the end of 2012, the Ministry of the Environment granted 115 prospecting licences for such unconventional gas. In 2012, Polish Geological Institute reported estimated resources of ***shale gas*** in Lower Paleozoic shales in Bałtyk-Podlasie-Lublin Basin at max. ca. 1,920 Bm^3, but most probably between 348-768 Bm^3. Moreover, prognostic resources of natural gas in conventional deposits were recently estimated at ca. 1,727 Bm^3 as of 31 December 2009.

The ***methane*** reserves associated with ***hard coal*** deposits complement the total natural gas reserves. Currently, the recoverable resources of very high quality methane gas in hard coal deposits in the **Upper Silesia Coal Basin** amount to 87.6 Bm^3, including 6.1 Bm^3 of economic reserves, occurring in 51 deposits (as of 31 December 2012), while the perspective recoverable resources in this coal basin are evaluated at approx. 107 Bm^3 (as of 31 December 2009).

In 1998 ***nitrogen gas*** deposits were recognized separately in the Polish Lowland. They contain from 91.0% to 97.6% of ***nitrogen*** and from 1.6% to 5.2% of ***methane***. Two deposits were evaluated: **Cychry** and **Sulęcin**. The recoverable resources amounted to 14.8 Bm^3, and economic reserves to 1.0 Bm^3 (as of 31 December 2012). Only the Cychry deposit is extracted (production of natural gas), but there are plans for the Sulęcin deposit to be extracted and liquid nitrogen to be produced.

Production

In the years 2008–2012, the mining production of ***natural gas*** has been between 5,450 and 5,920 Mm^3py, including 1,630–1,730 Mm^3py of high-methane gas, 3,330–3,900 Mm^3py of nitrified gas from oil and gas deposits, and 380–390 Mm^3py of coal-bed methane (Tab. 1). Traditionally, over 99.5% of production comes from terrestrial output. In 2012, commercial extraction and use of natural gas accompanying crude oil in B3 deposit (in the Polish part of Baltic Sea shelf), amounted to 20.9 Mm^3. In the end of 2008, the largest domestic producer the **Polish Oil and Gas Company Joint Stock Co.** (**POGC**) announced new POGC Strategy till 2015. It assumes gradual increase of domestic natural gas output to ca. 4.5 Bm^3py (on high-methane basis). In 2012, this output amounted to ca. 4.4 Bm^3, including ca. 4.3 Bm^3 coming from POGC (on high-methane basis). There are also some possibilities of growth of natural gas off-shore output from Baltic Sea Shelf deposits.

Nitrified natural gas is extracted from the nitrogen-rich deposits of the Polish Lowlands, the largest of which are **Brońsko**, **Kościan S**, **BMB**, **Żuchlów**, and **Radlin**. Gas is extracted from the Polish Lowlands deposits by the **POGC — Zielona Góra Unit**. In 2012, ca. 56% of raw nitrified gas output was directed to the **POGC — Odolanów Unit** (formerly Natural Gas Denitriding Plant "KRIO" in Odolanów) and new denitriding plant in **Grodzisk Wielkopolski** (part of the **POGC — Zielona Góra Unit**) for ***nitrogen*** removal. As a result, 1.5 Mm^3 of high-methane gas was obtained there in 2012 (Tab. 1).

High-methane gas from oil and gas deposits comes mainly from the Carpathian Foredeep (dominated by the **Przemyśl** and **Pruchnik-Pantalowice** deposits), and marginally from the Carpathian Mountains and the Baltic Sea Shelf. In 2012, ca. 3% of its

Tab. 1. Natural gas and others fuel gas statistics in Poland

million m^3

Year	2008	2009	2010	2011	2012
High-methane natural gas CN 2711 21					
Production	2,116	2,047	2,010	2,025	2,016
• *gas from oil and gas deposits*	*1,729*	*1,669*[e]	*1,634*	*1,632*	*1,631*
• *coal-bed methane*	*387*	*378*[e]	*376*	*393*	*385*
Imports	10,619	9,436	10,328	11,177	11,611
Exports	37	39	44	28	3
Stocks change	315	-308	-330	689	269
Consumption	12,383	11,752	12,624	12,486	13,355
• gas from denitrification plants	886	1,018	1,386	1,484	1,464
Consumption, total	13,269	12,770	14,010	13,970	14,819
Nitrified natural gas					
Production[1]	3,335	3,511	3,753	3,896	3,855
Stocks change	-	9	50	105	38
Consumption	3,335	3,502	3,703	3,791	3,817
• gas from blending plants	73	67	67	61	53
Consumption, total	3,408	3,569	3,770	3,852	3,870
Coke-oven gas CN 2705					
Production = Consumption[a]	4,207	3,076	4,239	4,055	3,878

[1] from oil and gas deposits

Source: ***The Central Statistical Office (GUS)***

mining output was directed to blending plants, where 61 Mm^3 of ***nitrified natural gas*** was obtained (Tab. 1). Gas is extracted from the Carpathian Foredeep and Carpathian Mountains deposits by the **POGC — Sanok Unit**, and the Baltic Sea Shelf deposit by the **LOTOS Petrobaltic Joint Stock Co.** (**LOTOS Capital Group**).

The recovery of ***methane*** from ***hard coal*** deposits is currently carried on at 21 deposits in the Upper Silesia Coal Basin. Their total production (recovery) volume amounted to 383 Mm^3 in 2012 (Tab. 1). Exploration and extraction activities initiated by several Polish and foreign enterprises, which would rise coal-bed methane recovery, were practically abandoned in recent years due to technical and commercial problems.

Trade[1]

In 2010 – 2012, imports of ***natural gas*** to Poland increased by 23%. Imports satisfied ca. 78% of the Polish demand for high-methane gas in 2012. Share of deliveries from Russia and Middle Asia countries (since 2010 also from Azerbaijan) decreased from ca. 90% to ca. 80% (Tab. 2).

[1] Data on geographic structure and value of natural gas trade in Poland collected by the **Central Statistical Office** were totally secret due to so-called statistical secret.

Tab. 2. Polish imports of natural gas, by country — CN 2711 21

million m³

Year	2008	2009	2010	2011	2012
Imports	**10,619**	**9,436**	**10,328**	**11,177**	**11,611**
Czech Republic	0	0	0	0	556
Germany	859	1,028	1,077	1,628	1,794
Russia, The Middle Asia countries, Azerbaijan[1,2]	9,755	8,402	9,245	9,549	9,261
Ukraine	5	5	6	–	–

[1] source POGC [2] including ***Yamal contract***

Source: ***Ministry of the Economy, The Central Statistical Office (GUS), POGC***

Long-term "Yamal" contract, signed with Russia in 1996 and valid until 2022 (on the basis of *take-or-pay* rule, without possibilities of re-export in case of lower domestic consumption, but with possibility of reception in the next years) remains the main import source of natural gas in Poland. In 2003, contract was renegiotiated and imports volume was reduced. In 2009, there were significant disturbances in natural gas supplies from Russia to Poland. Due to gas conflict between Russia and Ukraine, gas deliveries from Middle Asia countries realized by RosUkrEnergo AG company, were blocked in Ukraine. As a result, new short-term contracts were signed with Russian Gazprom. There were talks on renegotiation of long-term Yamal contract, finished in October 2010. Re-exports of "Yamal" gas started to be possible. Increase of gas deliveries is also assumed: in 2010 – 9.03 Bm^3, in 2011 – 9.78 Bm^3, in 2012-2022 – 10.25 Bm^{3}py, so 131.56 Bm^3 in total (2010-2022). On the basis of smaller contracts, some amounts of natural gas coming from European countries are delivered by pipelines from Germany and the Czech Republic (new connection in Cieszyn area). Idea of construction of pipeline from the North Sea to Poland (Scanled and Baltic Pipe pipelines) was resumed until the end of 2011. In December 2007 **POGC** decided on location and construction of LNG terminal in **Świnoujście**; it will have initial capacity of ca. 2.5 Bm^{3}py of LNG. In 2009, POGC signed long-term contract for LNG deliveries form Qatar - 1 million tpy of LNG (1.4 Bm^{3}py) in the years 2014-2033.

The trade balance in ***natural gas*** has been consistently negative. Since 2002, trade deficit has been rising, according to quickly increasing world gas prices, but exact data are not available due to so-called statistical secret. Probably trade deficit currently amounts to 15-20 billion PLN/y.

Consumption, distribution, and storage

In the years 2010–2012, consumption of ***high-methane gas*** increased by 16% to 14.82 billion m^3, while consumption of ***nitrified gas*** increased by 8.4% to 3.87 billion m^3 (Tab. 3). Total domestic ***natural gas*** consumption in the years 2008–2012 increased by 12.1%. In the domestic structure of natural gas consumption in 2012, industry dominates (63.7%), with 21.4% share of households. Agriculture, transportation and construction consume together 2.6% of natural gas, while other users (trade, services, etc.) — 10.1%. In 2012, share of natural gas in the Poland's consumption of primary energy decreased to ca. 12%, whereas in the world this percentage is 23% and is still increasing.

Tab. 3. Structure of natural gas consumption in Poland — CN 2711 21

million m^3

Year	2008	2009	2010	2011	2012
High-methane gas					
Consumption, total	**13,269**	**12,770**	**14,010**	**13,970**	**14,819**
• direct consumption in households	3,347	3,510	3,926	3,590	3,704
• other direct consumption	7,747	7,556	8,301	8,694	8,987
• energy transformation	1,942	1,446	1,453	1,582	1,842
• balance losses and differences	233	258	330	104	286
Nitrified gas					
Consumption, total	**3,408**	**3,569**	**3,770**	**3,852**	**3,870**
• direct consumption in households	432	354	303	259	292
• other direct consumption	1,004	1,101	818	824	721
• energy transformation	1,950	2,121	2,730	2,874	2,856
• balance losses and differences	22	-7	-81	-105	1

Source: ***The Central Statistical Office (GUS)***

The main consumer of natural gas is traditionally the industry. The main users have been manufacturers of nitrogen fertilizers, steel works, glass works and other metals processing industries, building ceramics plants, as well as food and drinks industry — all of them consume the natural gas directly in the production process as the fuel (60.6%), but in power plants and heating plants, natural gas denitrification and blending plants, refineries, gas is consumed in energy transformation processes (39.4%).

The second group of consumers consists of individuals using natural gas for household and home heating purposes. In 2012, household consumption increased again (Tab. 3).

Currently, direct consumption accounts for 73.3% of the total volume of gas used. The remainder is transformed into other energy carriers, and covers various losses and differences in the balance (Tab. 3). In November 2009, the Polish government accepted "Energy Policy of Poland until 2030", which assumed that demand for natural gas should reach 14.1 billion m^{3}py in 2010 (calculated as high-methane gas), 15.4 billion m^{3}py in 2015, 17.1 billion m^{3}py in 2020, 19.0 billion m^{3}py in 2025, and 20.2 billion m^{3}py in 2030. Taking into account domestic mining output of natural gas (ca. 4.3 billion m^3 in 2009, calculated as high-methane gas) and POGC assumptions, it is expected that domestic natural gas production in the years 2010-2015 will amount to 4.3–4.8 billion m^{3}py (if ***shale gas*** production will not be commenced), while the rest of demand will be met by imports.

Other types of gas are also used as fuel in Poland. These include primarily ***coke-oven gas*** (calorific value of approx. 4,500 kcal/m^3), a by-product of the coking of coal (Tab. 1). ***Coke-oven gas*** still plays an important role in Lower and Upper Silesia, but since 1996 it has been utilized locally, in plants located close to cokeries.

Seasonal variations in the demand for gas (approx. 20 Mm^3 per day in summer versus 48 Mm^3 per day in winter) necessitate the buffering storage of gas during the spring and summer. **POGC** controls six storages in the exhausted natural gas deposits: **Wierzchowice** — being currently enlarged, **Husów**, **Strachocina** (in 2011 enlarged), **Swarzów**, **Brzeźnica**, **Daszewo** and **Bonikowo** (since 2010, storage of nitrified gas); as well as cavern storage at the **Mogilno II** ***salt*** deposit. Their total capacity at the end of 2012 amounted to ca. 2.05 Bm^3, but works for their enlargement are still going on. In 2007, **DPV SERVICE Ltd.** (subsidiary of EMFESZ NG Polska Ltd.) started to construct commercial storage in the exhausted natural gas deposit — **Antonin**, with planned capacity ca. 200 Mm^3. Moreover, POGC currently constructs the new **Kosakowo** storage (cavern storage at the salt deposit). According to the new POGC strategy, total storage capacity should amount to 3.8 billion m^3 in 2015.

Companies involved in natural gas production in Poland as of December 2012

- Polskie Górnictwo Naftowe i Gazownictwo S.A. (Polish Oil and Gas Company Joint Stock Co.) — ul. Kasprzaka 25, 01–224 Warszawa, tel. +48 22 5835000, fax +48 22 6918273; www.pgnig.pl — *natural gas.*
- LOTOS Petrobaltic S.A. (LOTOS Petrobaltic Joint Stock Co.) — ul. Stary Dwór 9, 80–958 Gdańsk, tel. +48 58 3013061–5, fax +48 58 3014311, www.lotos.pl — *natural gas.*
- FX Energy Poland Sp. z o.o. (FX Energy Poland Ltd.) — ul. Chałubińskiego 8, 00-613 Warszawa, tel. +48 22 8300074, fax +48 22 6306632; www.fxenergy.pl — *natural gas.*
- ZOK Sp. z o.o. (ZOK Ltd.) — ul. Boczna 24, 44-335 Jastrzębie Zdrój, tel. +48 32 4760602-08, fax +48 32 4760601; www.zok.pl — *natural gas.*
- DPV Service Sp. z o.o. (DPV Service Ltd.) — Al. Ujazdowskie 41, 00-540 Warszawa, tel. +48 22 3195720, fax +48 22 3195721; www.dpvservice.pl — *natural gas.*

GASES, COMMERCIAL

Overview

Commercial gases are natural gases (air and its constituents) and synthetic gases used for commercial purposes. They are produced by the commercial gas industry, which is also involved in producing **medical gases**, **reference standard gases**, etc. The most important commercial gases are produced from atmospheric air, primarily **nitrogen** (see: **NITROGEN**), **oxygen**, **argon**, **neon**, **krypton**, **xenon** and **ammonia** NH_3, a nitrogen derivative. Other gases, e.g. **acetylene**, **carbon dioxide**, **helium** (see: **HELIUM**), and **hydrogen**, are obtained from sources other than air. One of the most important commercial gases is **chlorine**, a principal raw material in the chemical industry.

Sources

The majority of ***commercial gases*** are obtained from ***atmospheric air***. The exceptions are: ***chlorine***, produced by the electrolysis of ***sodium chloride*** water solution; ***carbon dioxide*** CO_2, coming from gas purification process in ammonia plants, and ***elementary hydrogen*** obtained by the reaction of methane and water steam under high pressure (the first stage of ammonia synthesis). The recovery of ***helium*** from atmospheric air is insignificant, as compared to its production from natural gas (see: **HELIUM**).

Production

Natural and ***synthetic commercial gases*** are produced in Poland for many branches of industry, including medicine and the aircraft industry, by more than twenty commercial gas plants. All of them have changed their ownership structure through privatization, now being subsidiaries of large international commercial gases companies: **Air Products**, **Linde Gaz Polska**, and **Messer Polska**. The domestic commercial gases plants together supply approx. 30% of the demand, mainly for ***oxygen***, ***argon***, ***carbon dioxide***, ***acetylene***, and ***nitrogen***. Other large producers of commercial gases are steel works (***commercial oxygen*** for steel-making purposes) and large chemical plants (***carbon dioxide*** in **Puławy** and **Tarnów**, ***chlorine*** in **Włocławek**, and **Brzeg**). A certain amount of ***carbon dioxide*** is supplied by health resorts.

Information on the domestic market for commercial gases is incomplete. ***Oxygen*** in compressed and liquid form is the main product in terms of production volume. The level of its production varied between 1.9-2.3 Mtpy in recent years, being dependent on demand of steel works (Tab. 1). The most common grade is ***technical grade oxygen*** (over 95% O), manufactured and used by steel works. Higher grades of ***technical grade oxygen***, as well as ***medical*** and ***aircraft*** (fuel component) grades, are produced by commercial gas plants.

Tab. 1. Commercial gases statistics in Poland

'000 t

Year		2008	2009	2010	2011	2012
Gases recovered from the air						
Oxygen CN 2804 40						
Production		2,089.6	1,939.0	1,978.6	2,263.7	2,340.2
Imports		54.5	30.7	15.8	6.1	6.0
Exports		3.7	13.7	29.1	50.5	73.6
Consumption[a]		2,140.4	1,956.0	1,965.3	2,219.3	2,272.6
Argon CN 2804 21						
Production	[Mm^3]	20.2	15.8	29.9	186.9	44.0
Imports		28.6	21.8	18.7	18.1	17.2
Exports		3.5	1.0	2.7	4.8	7.8
Gases recovered from other sources						
Chlorine CN 2801 10						
Production		354.0	333.2	279.0	282.5	298.6
Imports		3.0	2.4	33.0	18.3	16.1
Exports		14.3	12.0	14.7	13.7	12.9
Consumption[a]		342.7	323.6	297.3	287.1	301.8
Carbon dioxide CN 2811 21						
Production		449.8	458.6	568.0	464.8	609.8
Imports		7.4	8.3	0.7	3.8	2.1
Exports		37.4	33.8	39.1	34.1	33.0
Consumption[a]		419.8	433.1	529.6	434.5	578.9
Hydrogen CN 2804 10						
Production	[Mm^3]	1,168.5	1,111.1	1,181.4	1,189.3	1,220.9
Imports		0.3	0.1	0.2	0.2	0.2
Exports		0.5	0.0	0.0	0.2	0.1

Source: ***The Central Statistical Office (GUS)***

Among the noble gases obtained from the air, the most important is ***argon***. Domestic commercial gas plants supply ***pure liquid argon*** (99.9998% Ar), ***commercial liquid argon*** (99.995% Ar), ***pure gaseous argon*** (99.995% Ar), ***compressed argon for welding*** (99.98% Ar), and mixtures of ***argon*** with nitrogen, oxygen, and carbonic acid (***Coxogen***), ***carbon dioxide***, ***oxygen***, ***silicon hydride***, ***methane***, and ***neon***. Production data on ***argon*** previously varied between 15–30 Mm^3py, with sharp increase to ca. 187 1 Mm^3 in 2011 and decline to 44 Mm^3 in 2012 (Tab. 1). Besides argon, ***krypton***, ***xenon***, and a mixture of both (used to fill light bulbs, for example) are produced, but in much smaller amounts, along with ***neon***, ***helium***, and a mixture of both.

Chlorine is produced at the chemical plants in **Włocławek** and **Brzeg**. Production volume varied between 0.28–0.35 Mtpy, including up to 50% of chlorine on gaseous form (Tab. 1).

Domestic production of ***carbon dioxide*** rose to the level of ca. 0.61 Mtpy in 2012 (Tab. 1). Currently, most of the carbon dioxide is supplied by the **Puławy** and **Tarnów** nitrogen plants. Some health resorts deliver some quantities of liquid CO_2 (e.g. Duszniki a few hundred tons per year).

Domestic production of ***elementary hydrogen*** oscillates between 1,110–1,220 Mm^3py (Tab. 1). The majority of the hydrogen is produced by nitrogen plants, as well as by caustic soda manufacturers and in commercial gas plants, delivering gaseous hydrogen.

Trade

The most important items in Polish commercial gases trade have been for years the higher grades of imported ***oxygen***. Exports amount to under 15,000 tpy with sharp increase to 73,600 t in 2011, while imports dropped to only 6,000 tpy (Tab. 1).

Exports of ***argon*** were commonly under 5,000 tpy in recent years, while their imports rose to almost 20,000 tpy (Tab. 1). The level of ***other noble gases*** (***excluding argon*** and ***helium***) trade currently does not exceed 100 tpy.

Chlorine is subject to a very variable turnover, typically a few thousand tpy of imports (in 2010 it rose incidentally to 33,000 t) and 12,000–23,000 tpy in exports in recent years (Tab. 1).

Carbon dioxide is traded in the form of compressed gas, liquid gas, and the so-called ***dry ice*** (***solidified carbon dioxide***, ***carbon dioxide snow***). In recent years, imports were under 10,000 tpy, while exports — coming from the **Puławy Nitrogen Plant** — rose to 30,000-40,000 tpy (Tab. 1). ***Hydrogen*** turnover is marginal.

The only group of commercial gases having a traditionally positive balance of trade is ***chlorine*** (6–10 million PLN/y), but since 2010 its balance has become negative. The ***oxygen*** and ***argon*** trade balances are commonly negative, though since 2010 oxygen trade balance has started to be distinctly positive. The ***carbon dioxide*** trade balance since 2005 has been distinctly positive (Tab. 2).

The average unit values of commercial gases trade are variable. The highest values are reported in case of noble gases, e.g. ***argon***, the lowest ones — for ***oxygen*** (Tab. 3).

Consumption

It is difficult to assess the consumption level in Poland, due to the lack of complete data on production. ***Oxygen*** is used mainly in steelworks to intensify blast furnace process. It is also an important raw material in the organic chemical industry. Smaller amounts of oxygen are used as rocket fuel, in medicine, etc.

Argon is used mainly as inert gas in welding and other processes. It is also used for glow-discharge tubes. ***Neon*** is also applied for glow-discharge tubes, lamps, and starters.

Chlorine is utilized for the production of ***hydrogen chloride***, ***hydrochloric acid***, ***plastics*** (e.g. PVC), and other chemical compounds, as well as in the pulp and paper industry, for the chlorination of potable water, etc.

The compressed and liquid forms of ***carbon dioxide*** are used mainly in the food industry, for the production of carbonated beverages, and in medicine. ***Dry ice*** is used mainly as a cooling agent.

Tab. 2. Value of commercial gases trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Oxygen CN 2804 40					
Exports	1,146	4,880	10,960	17,862	24,566
Imports	17,998	11,099	4,996	2,465	2,471
Balance	**-16,852**	**-6,219**	**+5,964**	**+15,397**	**+22,095**
Argon CN 2804 21					
Exports	3,514	1,175	2,684	5,225	8,836
Imports	26,281	21,815	14,706	14,682	14,713
Balance	**-22,767**	**-20,640**	**-12,022**	**-9,457**	**-5,877**
Chlorine CN 2801 10					
Exports	8,217	8,692	11,037	9,813	9,491
Imports	1,954	1,331	25,195	14,245	12,760
Balance	**+6,263**	**+7,361**	**-14,158**	**-4,432**	**-3,269**
Carbon dioxide CN 2811 21					
Exports	12,577	12,064	14,759	11,446	10,530
Imports	5,052	6,540	2,680	2,802	3,989
Balance	**+7,525**	**+5,524**	**+12,079**	**+8,644**	**+6,541**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Average unit values of commercial gases trade in Poland

Year	2008	2009	2010	2011	2012
Oxygen CN 2804 40					
Exports unit values					
— PLN/t	312.6	355.0	376.2	353.7	333.9
— USD/t	134.3	120.0	124.8	119.6	102.2
Imports unit values					
— PLN/t	330.4	361.6	316.6	406.8	413.8
— USD/t	141.7	116.4	107.1	139.0	126.5
Argon CN 2804 21					
Exports unit values					
— PLN/t	1,015.1	1,207.0	997.7	1,090.4	1,126.2
— USD/t	418.3	373.6	332.6	371.9	344.5
Imports unit values					
— PLN/t	918.5	1,000.7	785.1	811.8	855.0

— USD/t	389.5	320.0	261.2	277.2	261.5
Chlorine CN 2801 10					
Exports unit values					
— PLN/t	573.5	725.1	753.2	714.7	734.0
— USD/t	245.3	235.7	250.1	241.1	223.9
Imports unit values					
— PLN/t	661.5	546.0	764.2	779.0	792.5
— USD/t	295.1	179.9	253.8	268.1	243.0
Carbon dioxide CN 2811 21					
Exports unit values					
— PLN/t	336.5	356.8	377.9	335.8	318.7
— USD/t	139.3	114.8	120.5	116.2	96.9
Imports unit values					
— PLN/t	687.4	790.9	3,618.8	732.7	1,864.5
— USD/t	288.8	254.3	1,189.9	257.5	565.1

Source: ***The Central Statistical Office (GUS)***

Elementary hydrogen is used in the fat industry for hydrogenating fats and oils, in metallurgy with high-melting-point metals, e.g. platinum, cobalt, tungsten, germanium (the temperature of hydrogen/oxygen flame is 2,700°C), in the synthesis of petrol, alcohols, etc.

The principal companies involved in commercial gases production in Poland as of December 2012

- Anwil S.A. we Włocławku (Anwil Joint Stock Co. of Włocławek), ul. Toruńska 222, 87–805 Włocławek, tel. +48 54 2363091, fax +48 24 3677634, www.anwil.pl — *chlorine (liquid).*
- PCC Rokita S.A. w Brzegu Dolnym (PCC Rokita Joint Stock Co. of Brzeg Dolny), ul. Sienkiewicza 4, 56–120 Brzeg Dolny, tel. +48 71 7942000, fax +48 71 7942197, www.pcc.rokita.pl — *chlorine (liquid and gaseous).*
- Grupa Azoty S.A. Zakłady Azotowe w Tarnowie (Grupa Azoty Joint Stock Co. Nitrogen Plants in Tarnów), ul. Kwiatkowskiego 8, 33–101 Tarnów, tel. +48 14 6330781, fax +48 14 6330718, www.grupaazoty.com — *carbon dioxide (liquid).*
- Grupa Azoty Zakłady Azotowe Puławy S.A. w Puławach (Grupa Azoty Puławy Nitrogen Plants Joint Stock Co. of Puławy), Al. Tysiąclecia Państwa Polskiego 13, 24–110 Puławy, tel. +48 81 5652833, fax +48 81 5652856, www.zapulawy.pl — *carbon dioxide (liquid, solidified).*
- Air Products Sp. z o.o. w Warszawie (Air Products Ltd. of Warsaw), ul. Pory 59, 02–757 Warszawa, tel. +48 22 4403200, fax +48 22 4403205, www.airproducts.com.pl — *oxygen, argon, noble gases, carbon dioxide, hydrogen.*
- Linde Gaz Polska Sp. z o.o. w Krakowie (Linde Gaz Polska Ltd. of Cracow), al. Jana Pawła II 41a, 31–864 Kraków, tel. +48 12 6439200, fax +48 12 6439300, www.linde-gaz.pl — *oxygen, argon, noble gases, carbon dioxide, hydrogen.*

- Messer Polska Sp. z o.o. w Chorzowie (Messer Polska Ltd. of Chorzów), ul. Maciejkowicka 30, 41–503 Chorzów, tel. +48 32 7726000, fax +48 32 7726115, www.messer.pl — *oxygen, hydrogen, argon, noble gases, carbon dioxide, hydrogen*.

Nitrogen and ammonia producers — see: **NITROGEN**. Other helium producers — see: **HELIUM**.

GEMS

Overview

Gems are minerals, less often rocks, suitable for direct use in jewellery, in their natural form or ground and polished. The German classification standard **RAL560A5** divides gems into ***precious stones***, ***decorative jewellery***, ***decorative***, ***reconstructed*** and ***synthetic stones***, ***doublets*** and ***triplets***, ***natural pearls***, ***precious corals***, and ***amber***, as well as ***counterfeits*** and ***imitations***.

Precious stones are characterized by their considerable hardness, beautiful colours, bright glance, excellent transparency, high refractory index, and resistance to chemicals, e.g. ***diamonds***, ***rubies***, ***sapphires*** (varieties of corundum) and ***emeralds*** (variety of beryllium). The most precious is **diamond**, one of eight allotropic forms of ***elemental carbon***. Diamond is the hardest mineral, colourless or slightly coloured (the most precious is blue shaded). Strong sheen and high index of refraction characterize it. Two classes of **natural diamonds** are distinguished: ***jewellery*** and ***industrial***. ***Jewellery diamonds*** are ideally transparent, with no cracks, intrusions, or defects, and are therefore suitable for precise grinding into ***brilliants***. ***Industrial diamonds*** are used in the grinding industry in the form of powders and micro-powders; in the tool-making industry, in medicine, in optics and in electronics.

As the substitutes of diamond can be used synthetic abrasives of similar hardness, e.g. **boron nitride — BN** (of the same structure but as distinct from diamond resistant to oxidation) and manufactured in Poland **boron suboxide B_2O**.

Decorative jewellery consists of those minerals, which due to their beautiful colours or play of colours are used in jewellery, e.g. ***opal***, ***topaz***, and ***turquoise***. **Decorative stones** — e.g. ***quartz***, ***chalcedony***, ***jade***, ***gagate*** — are various rocks, sometimes minerals and solid organic substances, characterized by permanent decorative properties, and often occurring in nature in considerable amounts. It is assessed that among 2,700 minerals, approximately 100 can be qualified to this category. **Amber** is a solid substance of organic origin, occurring in the form of petrified resins of ancient conifers.

Synthetic stones are crystals or amorphous solids obtained by synthesis. Their chemical and physical properties are similar to those of natural stones, e.g. ***corundum***, which may have the colour of ***ruby***, ***emerald***, or ***quartz***. Since 1955 **synthetic diamonds** have been produced. Presently, the world production capacity exceeded the supply of natural diamonds over threefold.

Sources

In Poland, the most familiar and common ***gem*** is ***amber***, which for centuries has been collected along the Baltic seaside. Total economic reserves of four recognized ***amber*** deposits amounted to 1,118 t (as of 31 December 2012). Three of them, including recently recognized **Przeróbka–SL** deposit (with reserves of 17 t), as well as **Możdżanowo** (containing ca. 10 t of amber at a depth of 11 m), and **Wiślinka I** deposits (with 2.7 t of amber at a depth of 6 m) occur in the Baltic seaside area. Moreover, there are some uneconomic resources of amber documented primarily in large **Chłapowo** deposit (resources of approx. 640 t), located near Władysławowo at a depth of 95–130 m. The exploration of amber deposits in the marine areas was so far unsuccessful.

On the other hand, some occurrences of amber are recognized near Lublin, in the Carpathian Foredeep. The total resources in this area are estimated at 6,900 t, but presently only **Górka Lubartowska** deposit near Parczewo is recognised. The resources of the deposit are estimated at 1,088 t. The amber occurs at a depth below 20-30 m and its average content in the deposit is about 377 g/m^2. Moreover, small occurrences of amber are found in the Pleistocene sediments in Tuchola, Konin and Bełchatów areas as well as in the Tertiary sediments of Lower Silesia.

There are no deposits of ***precious stones*** including ***natural diamond***, while there were recognized 41 kinds of ***decorative jewellery*** and ***stones***, which can be used in jewellery and gold decoration manufacturing. Most of them have not high quality, but many of them can be inserted in silver.

Quartz, one of the most common minerals, forms the veins of ***milky*** and ***white quartz*** in **Taczalin**, the reserves of which amount to 500,000 t. The ***rock crystal*** from **Jegłowa**, characterized by exceptional clarity, is also an excellent jewellery material. Its resources are considerable, particularly in the deeper part of the deposit. ***White*** and ***yellowish quartz*** also occurs there. ***Morion*** (opaque) and ***smoky quartz*** (transparent) are known in the old granite quarry at **Czernica**. ***Amethyst*** in various shades of violet, even purple, occurs in the vicinity of **Szklarska Poręba** and **Nowy Świętów**.

The most significant member of the ***chalcedony*** group is ***chrysoprase***: green or bluish, glassy, transparent, or matte, which occurs in the old mine of ***nickel ore*** **"Marta"** in **Szklary**, and in the **"Wiry"** ***magnesite*** mine in **Wiry**. ***Agate***, with its characteristic colour band structure, occurs around **Płóczki Górne** and **Nowy Kościół**. Due to their small sizes, numerous cracks, and low transparency, these agates are of limited value. ***Jasper***, red-gray or (rarely) green, forms concentrations in **Świerki** near Nowa Ruda and in **Niedźwiedzia Góra** near Krzeszowice.

The only one precious variety of ***opal*** recognized in Poland is ***hialite***. It may be found in the serpentine quarry in **Nasławice**. However, the quality of the mineral is very changeable, and the reserves have not been determined. As for ***tourmaline*** minerals, there are noteworthy concentrations of ***scorile*** occurring in the **Izera Foothills**, ranging in size up to 10 cm. These minerals are utilised for the production of stone fancy goods. On the other hand, ***tourmalines*** from the **Sowie Mountains**, particularly those of 30–40 cm diameter, are highly prized by collectors.

Nephrite, known as ***Polish decorative stone*** (due to its excellent properties for sculpturing and decoration), is extracted to a very small extent. The occurrence of ***nephrite*** in **Jordanów** near Sobótka is ranked second in Europe in respect to its quality.

Flint stone, containing ***opal*** or ***chalcedony***, and characterized by its colourful bands, is attractive for jewellery and decorative purposes. Concentrations are known in the **Cracow-Częstochowa Jurassic Range**, along the northeast edges of the **Świętokrzyskie**

Mountains, in the **Lublin Upland**, and in other parts of Poland. They are used in various branches of industry and in jewellery. ***Petrified tree-stems***, formed primarily from ***chalcedony*** or ***fine-grained quartz***, are characterized by compact texture, considerable hardness, and mechanical strength. They occur in the vicinity of **Krzeszowice** near Cracow, in the region of Kielce, and near Wałbrzych. However, the main concentrations occur in **Siedliska** near Bełżec.

Gagate (jet coal) is characterized by pitch-black colour and shade. The only concentrations are the so-called ***"zagajskie" seams*** near **Odrowąż**.

Production

For all practical purposes, only ***amber*** is collected in Poland, mainly along the Baltic Sea coast in the so-called Gdańsk region. Moreover the extraction of amber is carried out illegally on the small scale in this area (Sobieszewo Island, Stogów and Wiślinka region), with use of hydraulic boreholes method. In the structure of gathered assortments small agglomerates — 1–10 g and coarser — 10–40 g, are dominating. Since 2008, data about amber production and trade have not been available. It is estimated that the total amounts of collected on the beaches and illegally mined amber in Poland currently do not exceed 5–6 tpy (in 2000 it was ca. 20 t). Moreover, during the exploration of deposits in the marine areas some amounts of amber were obtained.

The prices of ***amber*** in Poland has been increasing in recent years. The price of the ***amber*** sold by private collectors varied depending on the weight of amber, e.g.: for 2,5–5 g — 960 PLN/kg; 5–10 g — 2,200 PLN;/kg 10–20 g — 3,900 PLN/kg; 20–50 g — 5,900 PLN/kg.

Data on ***gems*** output in Poland, other than amber, are not available. Among the ***synthetic gemstones — artificial ruby***, ***zircon***, and ***corundum monocrystal*** were produced in Poland by the **Cemkor Ltd.** in Skawina until early 2000s. Until 1998 **Diamsil Ltd.** in **Osieczany** near Cracow manufactured only ***synthetic diamonds*** — total production capacity was 1.2 million carats yearly. In the face of increasing competition, mainly from Russian and Ukrainian deliveries, the operation was halted in 1999.

Trade

There is no official data about the imports of ***amber,*** however it is estimated that the level of deliveries varied between 40 and 65 tpy in the years 2008–2012. The main supplier of ***amber*** to Poland was Russia, where quantity of amber production from Primorskaja mine (Sambia Peninsula) increased to ca. 340 tpy in recent years. Second important supplier remains Ukraine, where after closing the Pugacz mine in 2011 amber is obtained only illegally. On the other hand, the recipients of Polish jewellery with amber (ca. 40% of production is exported) are the EU countries, the US, Canada, China and Russia. The trade balance in amber is estimated at ca. 800 million PLN/y.

The imports volume of ***rough precious*** and ***decorative stones*** (excluding diamonds) decreased from 50,000–60,000 tpy in the period 2008–2010 to ca. 20,000 tpy in the years 2011–2012, but it was still exceeding exports (Tab. 1). Deliveries came primarily from China, Congo, Brazil, and the South Africa, while the main recipients of re-exported from Poland ***precious*** and ***decorative stones*** were China, Hong Kong, Switzerland, Ukraine, and the US. Despite of quite high level of imports, the value of exports was considerably higher than value of imports in the years 2008–2011. In 2012 trade balance of precious and decorative stones started to be negative and amounted to ca. 2 million PLN (Tab. 2).

Tab. 1. Precious and synthetic stones trade in Poland

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Year	2008	2009	2010	2011	2012
Precious and decorative stones CN 7103					
Exports	7.5	8.8	7.9	5.1	3.4
Imports	52.5	56.5	49.4	23.8	22.7
Synthetic stones CN 7104					
Exports	1.1	2.0	6.3	7.7	7.5
Imports	51.3	53.4	61.2	42.3	22.0

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of precious and synthetic stones trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Precious and decorative stones CN 7103					
Exports	35,882	47,834	11,433	10,109	5,941
Imports	8,475	9,971	10,307	5,479	7,562
Balance	**+27,407**	**+37,863**	**+1,126**	**+4,630**	**-1,621**
Synthetic stones CN 7104					
Exports	872	1,364	11,195	13,151	7,483
Imports	10,872	13,135	14,149	12,442	11,445
Balance	**-10,000**	**-11,771**	**-2,954**	**-709**	**-3,962**

Source: ***The Central Statistical Office (GUS)***

Imports of ***synthetic stones*** firstly increased from 51.3 t in 2008 to 61.2 t in 2010, but afterwards it dropped to 22.0 t in 2012. The exports level rose from 1.1 t in 2008 to 7.7 t in 2011, with slight reduction to 7.5 t in 2012 (Tab. 1). The trade balance in ***synthetic stones*** has always been negative. After a growth to ca. -12 million PLN in 2009, the deficit was rapidly reduced to ca. -0.7 million PLN in 2011, while in 2012 it deepened again to ca. -4.0 in million PLN (Tab. 2). In the years 2008–2012 the unit values of ***synthetic stones*** imports to Poland ranged from 76 to 156 USD/t and they were considerably higher than the unit values of ***precious*** and ***decorative stones*** imports (Tab. 3).

Domestic demand for ***diamonds*** is satisfied by imports (Tabs. 4, 5, 6). Deliveries of ***natural non-industrial diamonds*** came mainly from Belgium, Italy, Germany, as well as the Netherlands in 2012 (Tab. 4). Suppliers of ***natural industrial diamond*** were Germany, China, Austria, the UK, and the Republic of South Africa, and in 2008 a large majority of imports (over 90%) came from Sweden (Tab. 5). Imports of majority of ***syn-***

thetic diamonds were coming from China, Belgium, Ireland, Japan, Germany, Ukraine, the US, the UK, and Russia (Tab. 6). In spite of incidental exports of ***diamonds*** reported in recent years, the trade balance has always been negative (Tab. 7). The unit values of diamond imports to Poland depend on the volume of imports (Tab. 8).

Tab. 3. The unit value of gems imports to Poland

Year	2008	2009	2010	2011	2012
Precious and decorative stones CN 7103					
PLN/kg	163	176	208	230	333
USD/kg	67	56	69	79	102
Synthetic stones CN 7104					
PLN/kg	212	246	231	294	521
USD/kg	89	76	77	101	159

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Polish imports of natural non-industrial diamonds, by country — CN 7102 31–39

kg

Year	2008	2009	2010	2011	2012
Imports	**72**	**5**	**11**	**5**	**5**
Belgium	47	1	2	0	0
Germany	2	0	0	0	0
India	0	0	1	0	0
Italy	16	–	5	0	0
Netherlands	–	0	0	0	3
Thailand	4	0	1	3	1
Others	3	4	2	2	1

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Polish imports of natural industrial diamonds, by country — CN 7102 21–29

kg

Year	2008	2009	2010	2011	2012
Imports	**1,088**	**161**	**160**	**9**	**2**
Austria	32	128	11	–	–
China	14	4	–	2	–
Germany	5	2	53	3	1
Netherlands	–	0	1	0	–
South Africa, Republic of	17	2	0	0	0
Sweden	1,000	–	–	–	–

United Kingdom	14	25	80	3	1
Others	6	0	15	1	0

Source: ***The Central Statistical Office (GUS)***

Tab. 6. Synthetic diamonds statistics in Poland — CN 7105 10

kg

Year	2008	2009	2010	2011	2012
Imports	**686**	**52,428**	**396**	**42,519**	**649**
Belgium	46	18	3	4	62
China	202	52,263	249	42,292	317
France	0	2	–	1	–
Germany	21	11	17	41	39
Ireland	146	38	2	7	49
Italy	0	–	5	14	46
Japan	18	10	40	34	41
Russia	25	16	14	21	7
Switzerland	4	0	3	1	0
Ukraine	14	12	–	–	23
United Kingdom	6	27	20	8	8
USA	204	30	41	54	9
Others	0	1	2	42	48
Exports	**2**	**102**	**10**	**12**	**7**

Source: ***The Central Statistical Office (GUS)***

Tab. 7. Value of diamonds trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Natural non-industrial diamonds CN 7102 31–39					
Exports	361	695	366	302	879
Imports	20,135	12,396	9,979	17,839	14,423
Balance	**-19,774**	**-11,701**	**-9,613**	**-17,537**	**-13,544**
Natural industrial diamonds CN 7102 21–29					
Exports	4	43	234	432	142
Imports	3,683	1,400	3,429	1,809	1,710
Balance	**-3,679**	**-1,357**	**-3,195**	**-1,377**	**-1,568**
Synthetic diamonds CN 7105 10					
Exports	5	65	43	21	94
Imports	1,464	933	849	1,283	1,963
Balance	**-1,459**	**-868**	**-806**	**-1,262**	**-1,869**

Source: ***The Central Statistical Office (GUS)***

Tab. 8. Unit values of diamond imports to Poland

Year	2008	2009	2010	2011	2012
Natural non-industrial diamond CN 7102 31–39					
PLN/kg	279,659	2,479,298	907,217	3,567,778	2,884,697
USD/kg	120,131	785,791	298,958	1,220,701	886,178
Natural industrial diamond CN 7102 21–29					
PLN/kg	3,385	8,695	21,430	586,261	855,065
USD/kg	1,418	2,887	7,061	200,955	259,894
Synthetic diamonds CN 7105 10					
PLN/kg	2,134	18	2,144	30	3,025
USD/kg	901	6	700	10	924

Source: ***The Central Statistical Office (GUS)***

Consumption

Amber is used in artistic handicraft, which is expected to develop constantly in the near future. The official data about volume of consumption are not available, however it is estimated that 60–70 tpy of amber was utilized in Poland in the years 2008–2012. A large majority of plants has started production of silver jewellery where amber takes part in only 8–15% by weight, though visual amber is still dominating, as a result of much lower density in comparison with silver. ***Decorative stones*** are consumed in large amounts too, e.g. ***flint***, which is used, as well as in different industries and in jewellery (see: **FLINT**).

The ***corundum*** monocrystals (***leucoshapphires***) were used for the production of elements for analytical scales, surgical blade, nozzles, other goods against individual order, etc.

Consumption of ***synthetic*** and ***natural industrial diamonds*** was very changeable. Apparent consumption of ***synthetic diamonds*** varied between 0.4 and 52.3 tpy. Consumption of ***natural industrial diamonds*** ranged from kilograms to thousands of ton per year. Because of high unit values of ***natural non-industrial diamonds*** their consumption did not exceeded a hundred kilograms per year (Tab. 8). Both ***synthetic*** and ***industrial diamonds*** are used in production of abrasive diamond paste and diamond suspensions. ***Synthetic diamonds*** are used also in the production of surgical and abrasive tools, in food making industry (nozzles) and in laboratory devices industry.

GERMANIUM

Overview

Germanium (**Ge**) is obtained as a by-product from the roasting of ***zinc sulfide concentrates***, and also in the course of ***zinc*** smelting, mainly as **germanium tetrachloride** (**$GeCl_4$**), the raw material for the production of **germanium dioxide GeO_2** and **germanium metal**. To a lesser extent it is produced in ***lead*** and ***copper ore*** smelting operations. Considerable amounts of germanium are obtained from secondary sources (***electronic scrap*** and ***optoelectronic waste*** materials), as well as the US strategic reserves. The ***fly ash*** produced by the combustion of thermal coal is a rich potential source of germanium.

Germanium appeared in the commercial metals market in 1948, after germanium transistors began to be manufactured. Now, due to competition from cheaper silicon, germanium is used mainly for IR night vision systems and fiber optics.

Sources

Trace amounts of ***germanium*** occur in ***Zn-Pb ore*** deposits in the **Silesia-Cracow** region. The resources amounted to 40 t of Ge (as of 31 December 2008). In the years of 2009–2012 these reserves were not reported in the Polish Mineral Resources Datafile.

Production

Germanium is not recovered at Polish ***lead*** and ***zinc*** smelters.

Trade

Domestic demand is satisfied by imports of irregular small amounts of ***germanium commodities*** (raw germanium, germanium scrap, waste, and powders) — up to 22 kgpy, and continuous imports of ***germanium oxides*** (Tab. 1). They came mainly from China, France, the UK, the Netherlands, Germany, as well as from Canada, Japan and the US. In the last five years variable imports of ***germanium products*** were reported.

The trade balance of all ***germanium commodities*** and ***products*** has been consistently negative, mainly due to increased imports of ***germanium oxides*** (Tab. 2). In recent years the unit values of germanium oxides imports to Poland has been reflected the changes of producer prices, but in comparison to them were surprisingly low (Tab. 3).

Consumption

The structure of ***germanium*** and ***germanium compounds*** consumption in Poland is not known. ***Germanium oxide*** is probably used mainly in IR systems, fiber optics, and electronics.

Tab. 1. Germanium statistics in Poland

kg

Year	2008	2009	2010	2011	2012
Germanium[1] commodities CN 8112 92 95					
Imports = Consumption[a]	–	15	4	22	32
Germanium products CN 8112 99 20					
Imports = Consumption[a]	41	130	12	44	26
Germanium oxides CN 2825 60 [t]					
Imports	28	23	15	77	60
Exports	–	20	–	0	3
Consumption[a]	28	3	15	77	57

[1] raw germanium, germanium scrap, waste, and powders

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of germanium trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Germanium[1] commodities CN 8112 92 95					
Exports	–	–	–	–	–
Imports	–	28	3	115	332
Balance	**–**	**-28**	**-3**	**-115**	**-332**
Germanium products CN 8112 99 20					
Exports	–	–	–	–	–
Imports	103	118	108	121	75
Balance	**-103**	**-118**	**-108**	**-121**	**-75**
Germanium oxides CN 2825 60					
Exports	–	270	–	329	852
Imports	863	1,037	745	1,956	2,424
Balance	**-863**	**-767**	**-745**	**-1,627**	**-1,572**

[1] raw germanium, germanium scrap, waste, and powders

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of germanium oxides imports to Poland — CN 2825 60

Year	2008	2009	2010	2011	2012
PLN/t	31,382	45,087	49,903	25,312	40,383
USD/t	13,099	14,427	16,527	8,562	12,323

Source: ***The Central Statistical Office (GUS)***

GOLD

Overview

Gold (**Au**) is known and used since ancient times. It was used in jewellery and as instrument of payment (golden coins). In the last centuries, governments and banks collected gold reserves, and after introduction of banknotes in the 19th century, convertibility of banknotes into gold was established (gold standard). Gold standard was removed after the Second World War, in the US in 1970 at the latest. Government reserves of gold are continuously reduced in many countries, what sometimes influence negatively on the world market of gold. Jewellery is still the main consumer of gold, but industrial applications are dynamically developing. In electronics, telecommunications, aviation and astronautics, gold is used in pure form or in the form of alloys with silver, copper, platinum and zinc.

The majority of world **gold** supply comes from mine production (60–65%), while 21–30% comes from scraps, and 8–16% from government and central banks sales together with private persons disinvestment. About 80–85% of gold mine production origin from its primary deposits, while 15–20% is recovered as a by-product of silver and base metals ore treatment.

Sources

Gold occurs in Poland almost entirely in the Lower Silesia, but economic concentrations have marginal importance. There are four basic forms of gold occurrence: ***gold-bearing alluvias*** in the **Kaczawa** river valley (**Złotoryja** and **Legnica** area) and the **Bóbr** river valley (**Bolesławiec** area), ***gold-bearing veins*** in the **Kaczawa Mountains** (**Stara Góra**, **Czarnów**, etc.), ***arsenopyrite ore*** in **Złoty Stok**, impurities of ***gold*** in ***copper ore*** deposits of the **Fore-Sudetic Monocline**.

In the **Złoty Stok** deposit of ***arsenopyrite ores***, which was abandoned in 1960, the average gold content in the ore is about 2.8 ppm, with total remaining gold resources being estimated at ca. 1,500 kg. Prospecting licence was issued there to **KGHM "Polska Miedź" S.A.**, but prospecting was finished without success.

So, impurities of ***gold*** in ***copper ore*** deposits of the **Fore-Sudetic Monocline** are currently the only recoverable primary source of gold in Poland. It is concentrated mainly in copper-bearing shale, with content ranged from 0.01 to 0.3 ppm, but locally it approaches over 1,000 ppm (0.1%). Gold forms its own minerals and is present as a natural alloy with silver and other metals (e.g. ***bornite***). Its reserves in the **Fore-Sudetic Monocline** deposits are estimated at ca. 50 t.

Production

KGHM Polska Miedź S.A. is currently the only domestic ***primary gold*** producer. The ***copper ore*** extracted from deposits in the **Fore-Sudetic Monocline** contains an average of less than 0.1 g/t of Au, while copper concentrates — under 1 g/t. In the **Precious Metals Plant** at the **Głogów Smelter** of the **KGHM Polska Miedź S.A.**, gold is recovered after silver electrolysis of anode slimes in two-stadial process of leaching and precipitation. The so-called ***"gold sand"*** is obtained, which is then melted and cast into ***gold ingots*** (99.99–99.995% Au). Gold yield in this process amounts to 99.8%. The annual production depends on gold content in extracted ores. In recent years, it varied between 700–900 kgpy (Tab. 1).

Tab. 1. Gold[1] statistics in Poland — CN 7108 11–12

kg Au

Year	2008	2009	2010	2011	2012
Production[2]	902	814	776	704	916
Imports	1,088	352	342	714	178
Exports	435	103	199	2,288	9,689
Consumption[a]	1,555	1,063	919	-870	-8,595

[1] together with gold powder [2] primary gold production in the **KGHM "Polska Miedź" S.A.**

Source: ***The Central Statistical Office (GUS), producer's data***

Trade

Gold trade mainly in bar, powder and coin form, as well as in the form of semiproducts (rods, wires, foils, etc.), is very variable. It is partly influenced by "unofficial trade" of these forms of gold (smuggling). However, this aspect is much more important in case of golden jewellery.

Raw gold exports from Poland — according to official data — amounted commonly to 100–400 kgpy (Tab. 2). Germany and numerous other European countries were the main buyers of Polish gold (Tab. 2). However, in 2011 and 2012 extraordinary gold exports were reported, mainly to Italy, reaching almost 10 t in 2012. This maybe related to some sales of gold stocks by central bank, but it is not confirmed. In recent years some ***gold semiproducts*** were also exported.

Official ***raw gold*** imports to Poland are also variable (100-1,100 kgpy, Tab. 3). It comes mainly from Germany, Austria, the UK and other Western European countries, but recently Slovakia was also important supplier (Tab. 3). Commonly, 300–800 kgpy of ***gold semiproducts*** were also imported.

Until 2005, the trade balance in ***raw gold*** has had a positive value in general, but since 2005 it changed entirely and trade balance was negative, down to –26.9 million PLN in 2008, with improvement in 2009. In 2010, it started to be positive again, while in 2012 it achieved record value of 1,666 million PLN (Tab. 4). The average unit values of ***raw gold*** trade are very variable (Tab. 5), being a result of a fact that trade of gold alloys is sometimes also reported under this CN item (e.g. gold alloys, high-purity gold).

Tab. 2. Polish exports of gold[1], by country — CN 7108 11–12

kg Au

Year	2008	2009	2010	2011	2012
Exports	**435**	**103**	**199**	**2,288**	**9,689**
Austria	–	–	53	–	120
Belgium	–	–	–	–	17
Czech Republic	–	16	39	23	29
Germany	431	83	96	473	600
Italy	4	3	1	1,773	8,922
Lithuania	–	–	–	7	–
Slovakia	–	–	–	6	–
Turkey	–	1	10	3	1
Others	–	–	1	3	–

[1] together with gold powder

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Polish imports of gold[1], by country — CN 7108 11–12

kg Au

Year	2008	2009	2010	2011	2012
Imports	**1,088**	**352**	**342**	**714**	**178**
Australia	–	–	–	6	–
Austria	7	–	63	129	36
Canada	–	–	–	5	–
China	–	–	–	8	0
Czech Republic	39	9	5	3	2
Ghana	26	–	1	–	10
Germany	184	207	204	435	44
Hungary	24	42	24	16	4
Italy	227	5	4	1	0
Latvia	–	5	3	6	0
Lithuania	–	8	10	8	5
Slovakia	579	67	12	–	14
Sweden	1	2	–	1	0
United Kingdom	–	–	–	87	63
USA	0	1	9	2	0
Others	1	6	7	7	0

[1] together with gold powder

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Value of gold[1] trade in Poland — CN 7108 11–12

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	29,518	10,834	23,011	364,443	1,690,632
Imports	56,429	22,991	19,634	55,562	24,403
Balance	**-26,911**	**-12,157**	**+3,377**	**+308,881**	**+1,666,229**

[1] together with gold powder

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Average unit values of raw gold[1] trade in Poland — CN 7108 11–12

Year	2008	2009	2010	2011	2012
Exports unit values					
PLN/kg	67,856	105,189	115,635	159,284	174,490
USD/kg	28,163	31,927	38,623	52,013	53,296
Imports unit values					
PLN/kg	51,865	65,315	57,408	77,818	137,096
USD/kg	21,570	20,167	19,172	27,289	42,776

[1] together with gold powder

Source: ***The Central Statistical Office (GUS)***

Consumption

Gold produced by the **KGHM "Polska Miedź" S.A.**, as well as imported to Poland in the form of raw gold and gold semiproducts, find primarily industrial applications (electronics, precise instruments, special alloys, photography, etc.). It is also used by the **State Mint** of **Warsaw** (under 100 kgpy), as well as in golden and gold-plated jewellery. It is also collected in bars as a treasury. Total consumption of gold from official sources (domestic production, official trade) is estimated at 900–1,800 kgpy. Level of real consumption of gold is very difficult to establish due to a lack of data on gold scrap recovery and stocks changes in Poland. It is also a result of large dispersion of gold use in jewellery. Recovery of scrap of jewellery gold alloys (583, 750 and 875 fineness) by jewelers may achieve a level of even 10–20 tpy. Use of gold in industry (mainly electronics) and for coinage may amount to 300–600 kgpy.

Companies involved in gold recovery in Poland as of December 2012

- KGHM Polska Miedź S.A. w Lubinie (KGHM Polska Miedź Joint Stock Co. of Lubin), ul. Marii Skłodowskiej-Curie 48, 59–301 Lubin, tel. +48 76 8478200, fax +48 76 8478500, www.kghm.pl — *refined gold.*

GRAPHITE

Overview

Graphite is one of two polymer varieties of ***elementary carbon*** (the other being ***diamond***). The basic varieties of the mineral are ***large crystalline***, ***flake crystalline***, and the so-called ***"amorphous" graphite***. It is a good thermal and electrical conductor, resistant to chemicals and high temperatures, and thus particularly suitable for the manufacture of refractory materials, as well as for foundry work, brake friction linings, and greases.

Natural graphite is often replaced by **synthetic graphite**, obtained by the ***graphitization*** of ***petroleum coke*** and other petroleum and coal derivatives. Synthetic graphite is mainly used for the production of electrodes and anodes, in foundry work, and for the production of graphite crucibles. However, such substitution of natural graphite by synthetic one is not always used due to high cost of production of appropriate synthetic variety.

Sources

There are no ***graphite*** deposits in Poland, nor any prospects for their discovery.

Production

There is no ***natural graphite*** production in Poland. However, production of its synthetic substitutes — ***refined coal products***, ***graphitized products***, and ***synthetic graphite*** — is carried out primarily by the **SGL Carbon Polska S.A.**, in two large plants in **Nowy Sącz** and **Racibórz**. Plant in Racibórz specializes in ***graphite linings*** for blast furnace, electric arc furnace and Al electrolyzers, as well as in ***graphite cathode blocks***, while plant in Nowy Sącz — in the production of ***graphite electrodes***. Recently, both plants were refurbished, so they now provide higher quality products than before. Moreover, company is planning to build two production lines in Nowy Sącz plant. First of them, where the ***slabs of the exfoliated graphite*** for air-conditioning systems of building will be manufactured, will be completed by end of the 2016. Second line, where the graphite will be processed into ***anode materials*** for lithium-ion baterries, will be opened by the end of 2017.

The total production of ***synthetic graphite***, together with ***colloidal graphite*** and ***similar products*** decreased significantly from 66,300 tpy in 2008 to 33,200 t in 2012 (Tab. 1). The total production of ***coal and graphite electrodes*** and ***similar products for electrical***

use declined from 80,000 tpy in 2008 to 40,000–50,000 tpy in the years 2009-2012 due to drop in demand for graphite electrodes in steel industry.

Tab. 1. Synthetic graphite and related products[1] statistics in Poland — CN 3801

'000 t

Year	2008	2009	2010	2011	2012
Production[1]	66.3	52.6	39.6	48.6	33.2
Imports	81.4	29.3	36.0	48.4	37.3
Exports	38.8	25.6	28.2	34.5	27.7
Consumption[a]	108.9	56.3	47.4	62.5	42.8

[1] together with colloidal graphite, graphite blocks etc.

Source: ***The Central Statistical Office (GUS)***

Trade

The demand for ***natural graphite*** is satisfied entirely by imports which ranged between 2,800 and 10,300 tpy in the last years (Tab. 2). The main suppliers were China and Germany. Moreover, considerable volumes of graphite have been imported from Zavalievsky Graphite Complex in Ukraine since 2010. Increasing amounts of the ***"amorphous" graphite*** were purchased from France. Deliveries from specific suppliers are variable, depending on the price/quality ratio (Tab. 3).

Tab. 2. Natural graphite statistics in Poland — CN 2504

t

Year	2008	2009	2010	2011	2012
Imports	4,204	2,875	7,208	10,359	6,817
Exports	82	66	232	589	111
Consumption[a]	4,122	2,809	6,976	9,770	6,706

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Imports of natural graphite to Poland, by country — CN 2504

t

Year	2008	2009	2010	2011	2012
Imports	**4,204**	**2,875**	**7,208**	**10,359**	**6,817**
Austria	114	12	–	12	1
China	2,522	2,376	4,016	6,815	3,508
Czech Republic	191	72	87	139	77
France	4	4	65	130	130
Germany	943	260	1,390	910	1,113
Ukraine	40	20	1,420	1,997	1,583
United Kingdom	77	59	80	164	152
Others	313	72	150	192	253

Source: ***The Central Statistical Office (GUS)***

Synthetic graphite and ***related products*** are traditionally exported, usually at the level of 25,000–39,000 tpy (Tab. 1). Substantial imports of these commodities are also recorded, mainly of grades and types which are not manufactured in Polish plants. Volume of their imports was higher than exports, despite the drop from 81,000 tpy in 2008 to 30,000–50,000 tpy in the years 2009–2012 (Tab. 1). The sales data for ***coal and graphite electrodes*** and similar products for electrical use (**CN 8545**) have been not available since 2005. However, reported decrease of the trade value[1] in the years 2008–2011 could have been the indication of possible drop of quantity of the sales.

The trade balance in ***natural graphite*** has consistently been negative, varying between 7 and 10 million PLN/y in the years 2008–2009. In the next years deficit deepened to 18–35 million PLN/y, mainly due to a significant growth of imports volume (Tab. 4). The trade balance of ***synthetic graphite*** and ***related products*** was very changeable. Firstly, the deficit reached nearly 64 million PLN in 2008, but afterwards trade balance started to be positive as a result of substantial decline in imports volume and value (Tab. 4). Great surplus was reported in case of trade of coal and graphite electrodes and similar products for electrical use (drop from 399 million PLN in 2008 to 229 million PLN in 2011).

Tab. 4. Value of natural and synthetic graphite trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Natural graphite CN 2504					
Exports	405	449	232	3,260	5,980
Imports	9,945	8,062	17,959	38,138	26,325
Balance	**-9,540**	**-7,613**	**-17,727**	**-34,878**	**-20,345**
Synthetic graphite and related products CN 3801					
Exports	153,513	140,848	146,281	198, 247	222,805
Imports	217,029	115,369	102,014	174, 949	147,118
Balance	**-63,516**	**+25,479**	**+44,267**	**+23,298**	**+75,687**

Source: ***The Central Statistical Office (GUS)***

Unit values of ***natural graphite*** imports to Poland amounted to 820–1880 USD/t in the last years (Tab. 5). Unit values of different varieties of graphite ranged from 60-70 USD/t (***graphite*** from Ukraine), 800–1,700 USD/t (***graphite*** from China), 1000–1600 USD/t (***graphite*** from the Czech Republic), and 100–3,600 USD/t (***graphite*** from the other suppliers).

Tab. 5. Unit values of natural graphite imports to Poland

Year	2008	2009	2010	2011	2012
PLN/t	2,365.4	2,804.2	2,491.5	3,681.6	6,125.5
USD/t	978.6	915.0	821.1	1,240.4	1,879.3

Source: ***The Central Statistical Office (GUS)***

[1] According to the ***Yearbook of foreign trade statistics*** value of exports of coal and graphite electrodes decreased from 599 million PLN in 2008 to 431 million PLN in 2011, while imports value slightly increased from 200 million PLN in 2008 to 202 million PLN in 2011.

Consumption

There are no exact data available on the structure of ***natural graphite*** consumption in Poland. However, it is estimated that consumption of ***flake graphite,*** coming primarily from China, in the refractories industry (***magnesia-carbon*** and ***alumina-carbon refractories***), rose to ca. 3,000 tpy in recent years, with the exception of temporary reduction to ca. 2,000 t in 2009. The smaller amounts of the imported graphite are used for ***brake friction linings*** and ***lubricant*** (***"amorphous"*** grade), ***seal*** and recently also in electrolytic machining (e.g. parts of machines made from hardened steel).

Domestic, as well as imported ***synthetic graphite*** and ***related products***, are used for production of electrodes, linings for blast furnace, electric arc furnace, and Al electrolyzers, cathode blocks, crucibles, in foundries, etc. ***"Amorphous" natural graphite***, but especially ***synthetic graphite*** (also ***granulated graphite*** produced by **"Pegas" Co.** from Olkusz on the basis of ***synthetic graphite***) are used in cast iron carburizing and cast steel carbon restoration.

Principal companies involved in synthetic graphite production in Poland as of December 2012

- "SGL Carbon Polska" S.A. ("SGL Carbon Polska" Joint Stock Co.), ul. Piastowska 29, 47–400 Racibórz, tel. +48 32 4154501, fax +48 32 4595520, www.sglcarbon.com — *graphite linings, graphite cathode blocks, graphite electrodes.*

GYPSUM AND ANHYDRITE

Overview

Gypsum (**$CaSO_4$•$2H_2O$**) is a widely known construction binding mineral. It forms individual evaporate-type deposits, which are very common all over the world. It is also obtained as a by-product of certain chemical processes, e.g. desulfurization of off-gases in power plants (**synthetic gypsum**), or in the course of processing phosphorus minerals into fertilizers (**phospho-gypsum**). Raw gypsum is an important cement additive. After partial dehydration of raw gypsum to **calcined gypsum $CaSO_4$•$0.5H_2O$**, it is utilized for the commercial production of ***gypsum binders***, as well as ***gypsum prefabricated construction materials***, such as ***hollow bricks***, ***gypsum plasterboard***, ***dry plasters***.

Anhydrite (**$CaSO_4$**) is also a common mineral, but of much less economic significance. It is now used mainly for the production of cement (as an additive) and self-leveling floor layers, though in the past it was also used for the production of sulphuric acid.

Sources

Gypsum forms primarily Miocene evaporate-type deposits, occurring along the north edge of the **Carpathian Foredeep**. The resources of these shallow deposits are estimated at billions of tons, including eight deposits recognized in the Nida river valley, with 173.0 Mt (as of 31 December 2012). Only two of them are currently mined, i.e. the **Leszcze** and the **Borków-Chwałowice** deposits. Gypsum is also recognized in the roof part of several ***anhydrite*** deposits in Lower Silesia. ***Alabaster*** (the decorative variety of gypsum) is occasionally extracted from the **Łopuszka Wielka** deposit near Przeworsk. The total resources of gypsum are 177.2 Mt, including 55.2 Mt in developed deposits (as of 31 December 2012). The prognostic resources are many times larger.

Deposits of ***anhydrite*** accompanying ***copper ore*** in Lower Silesia form outcrops along the edge of the **North Sudetic Syncline**. Near the surface anhydrite is usually transformed into anhydrite-gypsum rock or gypsum rock. Four anhydrite deposits are currently recognized there: three in Niwnice near Lwówek Śląski (**Nowy Ląd**, **Nowy Ląd-Pole Radłówka**, and **Nawojów Śląski**) and one in Iwiny near Bolesławiec (**Lubichów**). Their total resources are 72.3 Mt, including 70.1 Mt in three operated deposits: **Nowy Ląd**, **Nowy Ląd-Pole Radłówka**, and **Lubichów** (as of 31 December 2012). The large deposits of anhydrite available from the headings of the **Lubin-Głogów Copper District** have not been recognized.

A huge secondary source of gypsum is ***phospho-gypsum***, a waste material stored at the **Police**, **Gdańsk** and **Wizów** chemical plants. It is derived from the production of fertilizers made of ***phosphates*** and ***apatites*** (these plants deliver ca. 2 Mtpy of phospho-gypsum).

There is also enormous potential for ***secondary gypsum*** (***synthetic gypsum***) production in the process of removing ***sulphur*** from ***off-gases*** in coal-fired power plants. However, only a part of power plants constructed desulphurisation installations with the use of wet lime method and synthetic gypsum as a product. Up till now, such installations were commissioned at the **"Bełchatów," "Pątnów," "Opole," "Jaworzno III," "Konin," "Połaniec," "Łaziska," "Dolna Odra," "Kozienice," "Ostrołęka"**, **"Rybnik"** and **"Siekierki"** power plants.

Production

Gypsum rock mines were traditional and — till 2000 — main sources of gypsum raw materials in Poland. The leading Polish producer of ***gypsum rock*** is the **"Dolina Nidy" Gypsum Plant** of **Leszcze**, which delivered usually ca. 570,000–720,000 tpy from the **Leszcze** deposit. Ca. 80% of its production is consumed internally for the production of ***gypsum binders*** and ***plasters*** (on site), as well as of ***gypsum plasterboards*** (in separate plant). The remaining 20% of production (mainly 0–30 mm fraction) is sold to cement plants and abroad. **"Dolina Nidy" Gypsum Plant** is managed by the consortium of Polish company **"Atlas" Łódź** and French company **"Lafarge"**. Currently, **"Atlas"** manages ***gypsum binders***, ***plasters***, and ***blocks*** production unit through its subsidiary **"Nowa Dolina Nidy,"** whereas **"Lafarge"** through its subsidiary **"Lafarge Gips Polska"**, which in October 2012 changed name to **"SINIAT"**, manages ***gypsum plasterboard*** production[1].

"Rigips Polska Stawiany" Ltd. of **Szarbków**, since 1995 a subsidiary of **British Plaster Board Gypsum Ltd.**, the world's leading gypsum manufacturer, is the second domestic producer of ***gypsum rock***. Its production from the **Borków-Chwałowice** deposit has recently varied between 414,000–541,000 tpy. Until 1999, the plant produced only gypsum rock, which was sold mainly to cement plants. However, after a new gypsum plasterboard plant commissioning (see: **Consumption**), close to the mine site in 1999, sales of gypsum rock from this plant were sharply reduced.

Smaller amounts of ***gypsum rock*** — less than 35,000 tpy — are supplied by the **"Nowy Ląd" Gypsum and Anhydrite Mine Ltd.** of **Niwnice**, which extracts the **Nowy Ląd** deposit. However, it delivers ***white gypsum*** of the best quality, entirely processed on site. Due to expected exhaustion of gypsum reserves in the **Nowy Ląd** deposit, the company started in 2005 to extract satellite deposit — **Nowy Ląd-Radłówka**, in which white gypsum of the highest quality occurs. It is wholly processed at the site into the different grades of white gypsum binders and special gypsum (i.e. dental, surgical, etc.).

The total production of ***gypsum rock*** in Poland in 2008 amounted to almost 1.3 Mt but in period 2009–2012 economic slowdown in domestic construction industry, as well as the increasing share of synthetic gypsum in Polish gypsum market has caused significant production decrease to only 1.0 Mt (Tab. 1).

Domestic production of ***anhydrite***, in the recent five years has been ranging between 150,000 and almost 200,000 tpy (Tab. 1). Both mines — **"Niwnice"** in Niwnice and **"Lubichów"** in Iwiny — are currently operated by one company: **"Nowy Ląd" Gypsum and Anhydrite Mine Ltd.** of **Niwnice**. This company is owned by the leading domestic producer of construction dry mixes and binders: **"Atlas" Łódź**. To date, **Niwnice** plant has supplied 40,000–60,000 tpy of ***anhydrite lumps*** (<100 mm), while the rest of output

[1] It manages **"SINIAT"**, while its products have a brand name **"Nida"**.

Tab. 1. Gypsum and anhydrite statistics in Poland — CN 2520 10

'000 t

Year	2008	2009	2010	2011	2012
Production	3,076.8	3,353.1	3,567.9	3,811.8	4,017.5
— gypsum rock	*1,283.0*	*1,124.9*	*1,012.2*	*1,067.3*	*1,077.6*
— anhydrite	*198.0*	*151.9*	*167.1*	*158.3*	*150.3*
— synthetic gypsum	*1,595.8*	*2,076.3*	*2,388.6*	*2,586.2*	*2,789.6*
Imports	170.6	158.0	129.3	131.5	123.2
Exports	0.4	0.2	0.3	49.2	44.7
Consumption[a]	3,247.0	3,510.9[r]	3,696.9	3,894.1	4,096.0

Source: ***The Central Statistical Office (GUS)***

processed into ***anhydrite powder*** (<0.1 mm). The **Lubichów** plant has produced entirely ***anhydrite powder***. However, after modernization of Niwnice plant (construction of modern gypsum binders mixing plant, anhydrite milling plant, and — in the years 2006–2007 — modern gypsum calciner), anhydrite lumps deliveries were limited. It results from the new strategy of the owner — to develop the wide range of products under the trade name ***"Gipsar"*** such as ***anhydrite binders***, ***gypsum binders***, ***gypsum-anhydrite binders***, and ***white gypsum coats*** and ***self-levelling floors***.

Synthetic gypsum, obtained from flue gas desulphurisation in power plants, is a very important substitute for gypsum rock, with similar applications. Its production in Poland began in 1994 with the commissioning of the first installation at the **"Bełchatów"** power plant. Currently, such installations operate in ten power plants: **"Bełchatów"** (since 1994, capacity 1,200,000 tpy), **"Jaworzno III"** (since 1996, ca. 240,000 tpy), **"Opole"** (since 1997, ca. 190,000 tpy), **"Konin"** (since 1997, ca. 60,000 tpy), **"Połaniec"** (since 1999, ca. 140,000 tpy), **"Łaziska"** (since 2000, ca. 140,000 tpy), **"Dolna Odra"** (since 2000, ca. 100,000 tpy), **"Kozienice"** (since 2001, ca. 160,000 tpy), **"Ostrołęka"** (since 2008, ca. 80,000 tpy), **"Rybnik"** (since 2008, ca. 100,000 tpy), **"Pątnów I", "Pątnów II",** (since 2008, ca. 430,000 tpy), and **"Siekierki"** (since 2011, ca. 60,000 tpy). As a consequence, production of synthetic gypsum rose from about 30,000 t in 1994 to 1,140,000 t in 2000, with some stagnation in the next few years, but in the years 2008–2012 it increased again, up to record amount of almost 2,800,000 t in 2012 (Tab. 1).

Total domestic production of ***gypsum*** and ***anhydrite*** amounted to 3.1 Mt in 2008 and was continuously increasing to over 4.0 Mt in 2012 (Tab. 1). Share of natural gypsum and anhydrite in the total supply decreased from 100% in 1993 to only 30% in 2012.

Trade

Exports of ***gypsum*** in the years 2008–2010 were almost stopped (Tab. 1). This was mainly ***gypsum rock***. In the last two years exports increased and amounted 49,200 t and 44,700 t, respectively. The ***synthetic gypsum*** was the most important exported gypsum commodity. The traditional recipients of gypsum rock were the Czech Republic, Hungary, Germany and Russia, but exports of synthetic gypsum were directed to Germany.

For years, 4,000–8,000 tpy of gypsum were usually imported. This was mainly high quality ***white gypsum*** from Germany. However, due to a deficit of gypsum for gypsum plasterboard and cement production on the domestic market, imports of ***gypsum*** to Poland in the years of 2008–2012 exceeded 130,000 tpy, with stabilization at this level in the last three years (Tab. 1). It was mainly synthetic gypsum from flue gas desulphurisation installations in Germany, and in 2008 - also synthetic gypsum from the Czech Republic (Tab. 2).

Tab. 2. Polish imports of gypsum, by country — CN 2520 10

‘000 t

Year	2008	2009	2010	2011	2012
Imports	**170.6**	**158.0**	**129.3**	**131.5**	**123.2**
Czech Republic	24.4	0.7	–	–	–
France	–	–	3.2	4.3	2.1
Germany	146.1	157.2	126.1	126.3	120.9
Ukraine	–	–	0.0	–	–
Others	0.1	0.1	0.0	0.9	0.2

Source: ***The Central Statistical Office (GUS)***

Anhydrite has probably not been traded in recent years.

The ***gypsum*** trade balance is very unstable, due to variable volume of exports and imports, as well as the high unit value of the best quality gypsum assortments that are imported (Tab. 3). However, since 2006 it was negative, though variable.

Tab. 3. Value of gypsum trade in Poland — CN 2520 10

‘000 PLN

Year	2008	2009	2010	2011	2012
Exports	143	71	212	227	294
Imports	11,252	9,026	11,857	12,430	11,695
Balance	**-11,109**	**-8,955**	**-11,645**	**-12,203**	**-11,401**

Source: ***The Central Statistical Office (GUS)***

Average unit values of ***gypsum rock*** sold production in Poland in the years 2008–2009, in PLN/t terms, has been systematically decreasing to 32.4 PLN/t, but in USD/t terms due to appreciation of Polish currency, decreased to only 10.4 USD/t (Tab. 4). In 2010 there was recorded significant sold production value increase, by 27% in PLN/t terms, and 30% in USD/terms (Tab. 4). In the years 2011–2012 the sold production value increased again, by 4% in PLN/t terms and amounted to 42.8 PLN/t, but in USD/t, after the slight increase in 2011, in 2012 decreased by 6% and amounted to 13.1 USD/t (Tab. 4).

Average unit values of ***gypsum rock*** exports in the years 2008–2009 stayed at stable level of 326–344 PLN/t, but in 2010 they have risen by almost 200% (Tab. 4), probably due to growing share of high quality white gypsum. Large amounts of synthetic gypsum exported in period 2011–2012 to Germany, were worth only 1 PLN/t in 2011 and 1.5 PLN/t in 2012, causing sharp decrease in the average unit value of exports, which amounted to only 4.6 and 6.6 PLN/t, respectively (Tab. 4).

Average unit values of ***gypsum rock*** imports have increasing tendency in the years 2008–2012, with some decrease in 2009. Moreover, in period 2008–2010 they were ten times lower than unit exports values. It is correlated with increased share of cheap synthetic gypsum in imports structure (Tab. 4).

Tab. 4. Average unit values of gypsum production and trade in Poland — CN 2520 10

Year	2008	2009	2010	2011	2012
Production average unit values					
PLN/t	35.1	32.4	41.1	41.3	42.8
USD/t	15.3	10.4	13.5	13.9	13.1
Exports average unit values					
PLN/t	326.5	344.0	681.2	4.6	6.6
USD/t	139.7	107.0	227.3	1.6	2.0
Imports average unit values					
PLN/t	65.9	57.1	83.0	94.5	95.0
USD/t	28.0	18.5	27.4	32.2	29.1

Source: ***The Central Statistical Office (GUS)***

Consumption

Gypsum and ***anhydrite*** are the basic raw materials for the production of numerous construction materials. Calcined gypsum is used in the majority of uses, while raw gypsum or anhydrite find use in the cement industry. The main gypsum and anhydrite applications are: cement production (gypsum or anhydrite as a few percent additive), binders and plasters, plasterboards, wall elements and other construction products (gypsum), self-levelling floor layers (anhydrite).

Cement plants were the main consumers of gypsum and anhydrite for years. In the years 2008–2012 gypsum and anhydrite consumption in cement plants fluctuated between 600,000–800,000 tpy due to variable level of cement production. These facts, as well as rising demand for them in other applications, resulted in the declining share of this sector in total gypsum raw materials consumption — from over 60% in the beginning of the 1990s to 21–25% in recent years. Cement plants use ***natural gypsum rock***, ***anhydrite lump***, and — in recent years — also ***synthetic gypsum*** from power plants (**"Bełchatów", "Konin", "Połaniec", "Łaziska"**). Share of ***synthetic gypsum*** in consumption of cement industry achieved almost 60% recently. These materials are added there as corrective constituents of ***Portland cement*** (4–6% of a batch for its production), and — minor quantities — for the production of ***anhydrite cement*** and other high quality cement grades. It is probable that in the coming years gypsum raw materials consumption in this sector will even decrease, if ashes from fluidised bed combustion will start to be used in significant quantities. They can be used simultaneously as pozzolanic admixture and as material for setting time regulation (instead of gypsum raw materials).

The most typical use of gypsum is the production of ***gypsum binders*** and ***mortars***. In 2008 production amounted to 1,578,800 t, with decrease to 1,300,000–1,350,000 tpy in the next two years. In 2011 production raised to the record value of 1,625,900 t, but in 2012 decreased again, down to 1,509,600 t (Tab. 5). **"Dolina Nidy"** is the main producer, but more than 20 other domestic and international companies have also entered to the market (e.g. **Knauf**, **Henkel**, **Siniat**, **BPB**, **Kreisel**, **Arel–Gips**, **Alpol Gips**, **Megaron**, **Franspol**). In addition to natural gypsum rock, traditionally used in Poland for the production of gypsum binders, synthetic gypsum has also been introduced for this purpose (e.g. by **Knauf-Jaworzno III** in **Jaworzno**, **Arel-Gips** in **Bełchatów**, **Megaron** in **Szczecin**, **Piotrowice III** in **Rybnik**, **Franspol** in **Konin** and **Połaniec**, **Atlas** in **Konin**, **Kreisel** in **Bełchatów** and recently in **Ostrołęka**). A part of produced gypsum binders is used for the production of ***gypsum plasterboards*** and ***stuccowork***, which is supplied by more than 20 domestic companies. In spite of the sharp increase in the production of gypsum binders in Poland, there is a noticeable deficit on the domestic market, especially of ***white gypsum binders***, though **"Nowy Ląd" Gypsum and Anhydrite Mine Ltd.** of **Niwnice** has developed their production (***Gipsar*** trade name). Such a deficit has resulted in growing imports level until 2008, when achieved the record volume of 215,500 t, but in the following years production development reduced imports to the level of less than 40,000 t in 2012 (Tab. 5). In the next years, further increase of gypsum binders and mortars supply is expected, mainly as a result of further development of ***normal gypsum binders*** and ***mortars*** production in **"Dolina Nidy" Gypsum Plant**, ***Gipsar extra white gypsum binder*** in **"Nowy Ląd" Ltd.** plant, and ***gypsum binders*** and ***mortars*** on the basis of ***synthetic gypsum*** by **"Knauf-Jaworzno III"** plant in Jaworzno, **"Atlas"** plant in Konin, **"Franspol"** plants in Konin and Połaniec and **"Kreisel"** plants in Rogowiec (Belchatów) and Ostrołęka.

Tab. 5. Gypsum binders statistics in Poland — CN 2520 20

'000 t

Year	2008	2009	2010	2011	2012
Production	1,578.8	1,317.4	1,346.8	1,625.9	1,509.6
Exports	57.8	40.3	30.0	50.8	60.8
Imports	215.5	82.6	53.6	46.3	39.3
Consumption[a]	1,736.5	1,359.7	1,370.4	1,621.4	1,488.1

Source: ***The Central Statistical Office (GUS)***

Until 1997, gypsum was used to produce ***gypsum plasterboards*** in only one plant: **"Nida-Gips" Ltd.** of **Gacki** (subsidiary of **"Dolina Nidy" Gypsum Plant**), delivering up to ca. 10 Mm^2 of plasterboard per year. In the years 1997–1998, German company **"Knauf"** opened a plant with total capacity of 24 Mm^2py near the **"Bełchatów"** power plant. In 1998, the **"Norgips"** company of Norway constructed another plant based on synthetic gypsum near the **"Opole"** power plant (capacity 40–50 Mm^2py), which currently is operated by **"Knauf Bełchatów Ltd."**. Yet another plant, based on gypsum rock from the **Stawiany** mine in **Szarbków**, with a capacity of 26 Mm^2py, was commissioned by **"Rigips Polska Stawiany,"** a subsidiary of **British Plaster Board** in 1999. The last new plant was commenced in 2002 by **"Lafarge Nida Gips" Ltd.** in **Gacki**, currently **"SINIAT"** in **Leszcze** (initial capacity 25 Mm^2py, possible further development to 35–45 Mm^2py). Although ***gypsum plasterboard*** production in Poland has grown very dynamically in recent years — from less than 10 Mm^2py to the record of 138.5 Mm^2 in 2008. In period 2009–2012 the domestic market condition worsened and production decreased to under 109 Mm^2/y, what — together with restricted imports volume — was correlated with the domestic consumption (Tab. 6). Since 1999 Poland has started to be a very significant supplier of these products to Eastern and Central Europe markets. As a result of growing plasterboards production in Poland, its share in total consumption of gypsum raw materials increased from only 4% in the beginning of the 1990s to ca. 40% in 2008, but in period 2009–2012 decreased by 6% to ca. 34%. Development of production will depend — however — on the conditions of domestic construction sector, as well as on possibilities of plasterboard exports development.

Tab. 6. Statistics of gypsum plasterboards and relative gypsum products in Poland — CN 6809

million m²

Year	2008	2009	2010	2011	2012
Production[e]	138.5	117.5	116.7	112.8	108.7
Exports	58.2[e]	47.0[e]	39.0[e]	40.4[e]	41,1[e]
[‘000 t]	*541.5*	*437.7*	*363.7*	*377.0*	*383.7*
Imports	8.7[e]	3.2[e]	3.5[e]	3.9[e]	3.5[e]
[‘000 t]	*81.4*	*30.1*	*32.5*	*36.8*	*33.2*
Consumption[a,e]	89.0	73.7	81.2	76.3	71.1

Source: ***The Central Statistical Office (GUS)***

Increasing imports of ***gypsum binders*** and ***plasterboards*** have resulted in a growing trade balance deficit up to 1998. This was changed in 1999, when Poland became a net exporter of ***gypsum plasterboards***. Since 2008, a negative trade balance of gypsum binders increased up to the level of 7.2–7.8 million PLN/y in the years 2009–2010, but in next two years became positive, mainly due to reduced imports and increasing exports (Tab. 7 and 6).

Tab. 7. Value of gypsum binders and plasterboards trade in Poland

‘000 PLN

Year	2008	2009	2010	2011	2012
Gypsum binders CN 2520 20					
Exports	40,236	29,038	18,721	29,016	35,212
Imports	44,480	36,854	25,984	26,433	24,668
Balance	**-4,244**	**-7,816**	**-7,263**	**+2,853**	**+10,544**
Gypsum plasterboards CN 6809					
Exports	240,785	240,934	178,006	204,179	211,910
Imports	53,961	26,518	29,945	33,788	36,721
Balance	**+186,824**	**+214,416**	**+148,061**	**+170,391**	**+175,189**

Source: ***The Central Statistical Office (GUS)***

Other uses of gypsum have minor importance. The “Nowy Ląd” Gypsum and Anhydrite Mine Ltd. of Niwnice is virtually the only Polish producer of ***specialized grades of***

gypsum: ***ceramic***, ***plaster of Paris***, ***dental***, and ***surgical gypsum***. **"Dolina Nidy" Gypsum Plant** is the main producer of ***gypsum wall elements*** and ***gypsum stuccowork***, but there are also more than 20 domestic producers of such products (e.g. **"Orth-Gipse"** in **Jaworzno**, **"Baumit"** in **Bełchatów**).

The three main areas of ***anhydrite*** use in Poland are currently as ***additives in cement production*** (in the form of ***anhydrite lump***), ***self-levelling floor layers***, and ***anhydrite binders*** in the form of ***anhydrite powder***. Other uses of anhydrite powder — such as the production of furniture glue, PVC floor tiles, or fire dams in underground coal mines — are currently of marginal importance. The growth of the construction industry produces a prospect for the further development of demand for anhydrite powder, both in the area of ***self-levelling floor layers*** and ***anhydrite binders***. Growth of production of ***Gipsar white anhydrite binder*** in **"Nowy Ląd"** plant is a good example.

The structure of ***gypsum*** and ***anhydrite*** consumption has changed significantly in recent years. It is estimated that in 2012 ca. 23% of the total tonnage was used in the cement industry as a ***cement additive*** (ca. 48% in 1995), ca. 34% for ***gypsum plasterboard*** production (only ca. 9% in 1995), ca. 38% for ***binding materials*** (ca. 38% in 1995), and ca. 5% for other uses (ca. 6% in 1995).

Companies involved in gypsum and anhydrite production in Poland as of December 2012

- "Dolina Nidy" Sp. z o.o. w Leszczach ("Dolina Nidy" Ltd. of Leszcze), Leszcze 15, 28–400 Pińczów, tel. +48 41 3578100, fax +48 41 3578700, www.dolinanidy.com.pl — *gypsum rock, gypsum products*.
- "Rigips Polska Stawiany" Sp. z o.o. w Szarbkowie ("Rigips Polska Stawiany" Ltd. of Szarbków), 28–400 Pińczów, +48 41 3569208, fax +48 41 3569298, www.rigips.com.pl — *gypsum rock, gypsum plasterboards.*
- Kopalnia Gipsu i Anhydrytu "Nowy Ląd" Sp. z o.o. w Niwnicach ("Nowy Ląd" Gypsum and Anhydrite Mine Ltd. of Niwnice), 59–600 Lwówek Śląski, tel. +48 75 7824356, fax +48 75 7823557, www.nowylad.com.pl — *specialized gypsum grades, anhydrite lumps, anhydrite powder, gypsum and anhydrite binders*.
- PGE Elektrownia "Bełchatów" S.A. w Rogowcu ("Bełchatów" Power Plant Joint Stock Co. of Rogowiec), 97–406 Bełchatów 5, Rogowiec, +48 44 6325132, fax +48 44 7352211, www.elbelchatow.pgegiek.pl — *synthetic gypsum*.
- PGE Elektrownia "Opole" S.A. w Brzeziu ("Opole" Power Plant Joint Stock Co. of Brzezie), 46–021 Brzezie k. Opola, tel. +48 77 4235050, fax +48 77 4235012, www.elopole.pgegiek.pl — *synthetic gypsum*.
- PKE S.A. Elektrownia "Jaworzno III" w Jaworznie (The Southern Power Company Joint Stock Co. "Jaworzno III" Power Plant of Jaworzno), ul. Promienna 51, 43–603 Jaworzno, tel. +48 32 6155071, fax +48 32 7153088, www.pl.ej3.pkesa.com — *synthetic gypsum*.
- PKE S.A. Elektrownia "Łaziska" w Łaziskach Górnych (The Southern Power Company Joint Stock Co. "Łaziska" Power Plant of Łaziska Górne), ul. Wyzwolenia 30, 43–174 Łaziska Górne, tel. +48 32 2241100, fax +48 32 2247416, www.tauron-wytwarzanie.pl/oddzialy/laziska/Strony/informacje.aspx — *synthetic gypsum*.

- Zespół Elektrowni “Pątnów-Adamów-Konin” S.A. (“Pątnów-Adamów-Konin” Power Plants Complex Joint Stock Co.), ul. Kazimierska 45, 62–510 Konin, tel. +48 63 2473000, fax +48 63 2473030, www.zepak.com.pl — *synthetic gypsum*.
- Elektrownia im. Tadeusza Kościuszki S.A. w Połańcu (Tadeusz Kościuszko Power Plant Joint Stock Co. of Połaniec), Zawada 26, 28–230 Połaniec, tel. +48 15 8656565, fax +48 15 8656688, www.gdfsuez-energia.pl — *synthetic gypsum*.
- Zespół Elektrowni “Dolna Odra” S.A. (“Dolna Odra” Power Plants Complex Joint Stock Co.), 74–105 Nowe Czarnowo 76 k. Gryfina, tel. +48 91 3165100, fax +48 91 4162000, www.zedolnaodra.pgegiek.pl — *synthetic gypsum*.
- Elektrownia “Kozienice” S.A. (“Kozienice” Power Plant Joint Stock Co.), Świerże Górne, 26–900 Kozienice 1, tel. +48 48 6142414, fax +48 48 6143516, www.elko.com.pl — *synthetic gypsum*.
- “ENERGA Elektrownie Ostrołęka S.A.” w Ostrołęce (“ENERGA Ostrołęka Power Plants Joint Stock Co.”), ul. Elektryczna 5, 07–401 Ostrołęka, tel. +48 29 7692000, fax +48 29 7691145, www.energa-elektrownie-ostroleka.zeo.pl — *synthetic gypsum*.
- Elektrownia “Rybnik” S.A. (“Rybnik” Power Plant Joint Stock Co.), ul. Podmiejska 28, 44–207 Rybnik, tel. +48 32 7391000, fax +48 32 4227894, www.edfrybnik.pl — *synthetic gypsum*.
- PGNiG TERMIKA S.A. w Warszawie, Elektrociepłownia “Siekierki” (PGNiG TERMIKA Joint Stock Co. of Warsaw, “Siekierki” Heat and Power Plant), ul. Augustówka 30, 02–981 Warszawa, tel. +48 22 8422041, fax +48 8423842, www.termika.pgnig.pl/o-firmie/nasze-zaklady/elektrocieplownia-siekierki — *synthetic gypsum*.
- “SINIAT”, Zakład Produkcyjny Płyt Gipsowo-Kartonowych w Leszczach (“SINIAT”, The Gypsum Plasterboard Factory of Leszcze), Leszcze 15, 28–400 Pińczów, tel. +48 41 3578200, fax +48 41 3578161, www.siniat.pl — *gypsum plasterboards*.
- “Knauf Bełchatów” Sp. z o.o. w Rogowcu (“Knauf Bełchatów” Ltd. of Rogowiec), 97–427 Rogowiec, tel. +48 44 7315500, fax +48 44 7315502, www.knauf.pl — *gypsum plasterboards*.
- “Knauf Bełchatów” Sp. z o.o. w Rogowcu, Zakład Produkcyjny w Brzeziu k. Opola (“Knauf Bełchatów” Ltd. of Rogowiec, Production Plant in Brzezie near Opole), ul. Norweska 1, 46–081 Brzezie, tel./fax +48 77 4516115 — *gypsum plasterboards*.
- “Knauf Jaworzno III” Sp. z o.o. w Jaworznie (“Knauf Jaworzno III” Ltd. of Jaworzno), ul. Promienna 51, 43–603 Jaworzno, tel. +48 32 7549900, fax +48 32 7549902, www.knauf.pl — *gypsum binders*.
- “Megaron” S.A. (“Megaron” Joint Stock Co.), ul. Pyrzycka 3 e,f, 70–892 Szczecin, tel. +48 91 4664540, fax +48 91 4664541, www.megaron.com.pl — *gypsum binders*.
- “Piotrowice III” Sp. z o.o. (“Piotrowice” Ltd.), ul. Golejowska 71, 44–207 Rybnik, tel. +48 32 7396280, fax +32 7396281, piotrowice.com.pl — *gypsum products*.
- “Franspol” Sp. z o.o. w Koninie (“Franspol” Ltd. of Konin), ul. Fabryczna 10, 62–510 Konin, tel. +48 63 2408553, fax +48 63 2408517, www.franspol.com.pl — *gypsum products*.
- “Kreisel – Technika Budowlana” Sp. z o.o. Poznań (“Kreisel – Technika Budowlana” Ltd. of Poznań), ul. Szarych Szeregów 23, 60–462 Poznań, tel. +48 61 8467900, fax +48 61 8467909, www.kreisel.pl — *gypsum binders*.

- “Alpol Gips” Sp. z o.o. w Fidorze (“Alpol Gips” Ltd. of Fidor), Fidor, 26–200 Końskie, tel. +48 41 3721100, fax +48 41 3721284, www.alpol.pl — *gypsum binders*.
- “Arel–Gips Bełchatów” S.A. w Rogowcu (“Arel–Gips Bełchatów” Joint Stock Co.), Rogowiec, 97–427 Rogowiec, tel. +48 44 7353637, www.arel-gips.com.pl — *gypsum binders*

HAFNIUM

Overview

Hafnium (**Hf**) occurs as an isomorphous admixture in ***zircon*** $ZrSiO_4$ (the sole source of hafnium), from which it is recovered during the production of ***metallic zirconium***. There are known rare minerals of hafnium, but no deposits have ever been found. ***Zircon concentrates*** usually contain 65–66% ZrO_2+HfO_2, including 1–7% HfO_2. Zirconium and hafnium exhibit nearly identical properties and are not treated separately for most applications (except for certain nuclear uses). The basic commercial hafnium products are **hafnium sponge** and **metallic hafnium**, containing 97–99% Hf, as well as chemical compounds, mainly **hafnium oxide**.

The main areas of **hafnium** applications are nuclear power engineering (where it is used in reactor control rods to regulate the fission process through neutron absorption) and super-alloys production. Therefore it is considered a strategic element. However, in recent years the demand for nuclear grade zirconium metal, the production of which necessitates the removal of hafnium, produces more hafnium than can be consumed. Surpluses are stockpiled in the form of **hafnium oxide**.

Sources

There are no sources of ***hafnium*** minerals occurring in Poland.

Production

No data on ***hafnium commodities*** production in Poland is available.

Trade

Polish demand for ***hafnium commodities*** is covered by imports of small quantities of ***raw hafnium***. In 2008 it imports amounted to 1 kg and came from the US, in 2009 imports increased to 16 kg with the United Kingdom, the US and Switzerland as suppliers, in period 2010–2011 imports came from Switzerland and amounted to 3 kg and 6 kg, respectively, but in 2012 dropped to 1 kg with Switzerland and the US as suppliers.

Consumption

The domestic demand for ***hafnium commodities*** is satisfied by imports, though in fact there are no reliable statistics available.

HARD COAL AND ANTHRACITE

Overview

Hard coal is one of the most important fuels in the world economy, although recently demand has declined, mainly due to reduced consumption in the steel making industry, in transport, and also in households (the last one primarily in developed European countries). It forms huge coal basins or small individual deposits, mainly of late Paleozoic (Upper Carboniferous and Permian age) and Mesozoic age, rarely of Cenozoic age, all around the world.

There are several hard coal classifications in use — e.g. international, American, Australian, Polish — which distinguish numerous classes, types, and grades, depending on the calorific value, sulfur and ash content, moisture, sinterability, etc. The most important distinction is between **coking** (**metallurgical**) **coal** and **steam** (**thermal**) **coal**. The borderline between **hard coal** and **brown coal** is not always very sharp, e.g. in Western Europe hard coal has a calorific value above 5,700 kcal/kg (23,865 kJ/kg) on an ash-free but moist basis, while coal of calorific value below 5,700 kcal/kg is considered as brown. In Poland, the border is drawn at 3,000 kcal/kg (12,560 kJ/kg). Brown coals are usually divided into **subbituminous coals** (the hard form, with a calorific value between 4,165 kcal/kg and 5,700 kcal/kg) and **lignite** (the soft form, with a calorific value below 4,165 kcal/kg — 17,438 kJ/kg). In some countries, however, such as the US, Australia, Belgium, Finland, France, Japan, New Zealand, Portugal, China, Poland, and Russia, subbituminous coals are included in the category of hard coal.

Sources

Hard coal deposits in Poland occur in three coal basins, all of Upper Carboniferous age: **Upper Silesian** (**GZW**), **Lower Silesian** (**DZW**), and **Lublin** (**LZW**). The total recognized resources of the 146 deposits are 48,226 Mt of coal, including 19,131 Mt in 51 developed deposits (48 extracted deposits and 3 deposits being developed, as of 31 December 2012). The available reserves in exploited deposits are estimated at 4,211 Mt. The difficult geological conditions, the growing ecological pressure, and the low quality of the coal, especially from the LZW and the eastern part of the GZW, render the future enlargement of available reserves unlikely. There is no reason to expect that new deposits will be recognized in other regions.

The **Upper Silesian Coal Basin** (**GZW**), where there are 128 deposits with total resources of 38,606 Mt, is the largest. In 2011–2012 resources increased by over 2,700 Mt, primarily due to change of some previously uneconomic resources in abandoned deposits, as well as recognition of some new deposits: Barbara Chorzów 1 deposit with resources of ca. 21 Mt, Jan Kanty 1 deposit (50 Mt), Kazimierz-Juliusz 1 deposit (61 Mt), Żory-Warszowice deposit (152 Mt), Imielin-Południe (197 Mt), and Morcinek 1 deposit (591 Mt). There are 31 underground mines currently in operation, and their total resources are 16,999 Mt, including 3,587 Mt of available reserves. These deposits contain different types of coal, mainly ***steam coal*** (bituminous and subbituminous), but also ***coking coal***, and ***anthracite***. Due to the low quality of the coal from the eastern part of the GZW, specifically its low calorific value and its high sulfur and ash content (more than 2%), it could be classified as brown coal (the so-called ***lignite polonaise***). The difficulties encountered in selling this type of coal have caused some deposits in this area to be abandoned. On the other hand, coal from the western and northern parts of the Upper Silesian Coal Basin has good quality parameters: high calorific value (ave. 26.4 MJ/kg), low ash content (ca. 13%), and low sulfur content (ave. 0.8%).

The **Lublin Coal Basin** (**LZW**), located in the eastern part of Poland, consists of 11 recognized deposits, out of them only one, **Bogdanka**, is being developed. The total resources of this basin (as of 31 December 2012) amounted to 9,260 Mt, mostly ***steam coal***. Because of the difficult geological and mining conditions, only 314 Mt of coal are classified as available reserves in the **Bogdanka** deposit. The coal from the Lublin Basin is characterized by average calorific values of 25.9 MJ/kg, 1.36% sulfur, and 14.6% ash.

The reserves of the deposits in the **Lower Silesian Coal Basin** (**DZW**) are practically exhausted, and the remaining coal resources were reclassified as uneconomic. At the end of 1998 the only one ***anthracite*** deposit was removed from **Resources Data File** due to final closure of the mine. In 2000, extraction of the last deposit was abandoned there. These deposits have very difficult geological and mining conditions, in spite of the presence of ***coking coal*** and ***anthracite***, which are scarce commodities in the domestic market. In 2011 some previously uneconomic resources in 7 abandoned deposits were qualified as economic ones at the total amount of 360 Mt (as of 31 December 2012).

Production

In the period of 2008–2011, ***hard coal*** production was significantly reduced by 7.9 Mtpy, with visible recovery by 3.4 Mt in 2012 (Tab. 1). Poland still remains important world producer of hard coal. The share of hard coal as a source of primary energy in Poland slowly decreases, down to 62%.

Tab. 1. Hard coal statistics in Poland — CN 2701

'000 t

Year	2008	2009	2010	2011	2012
Total production	84,345	78,064	76,728	76,448	79,855
— *steam coal*	*72,321*	*69,524*	*65,070*	*65,012*	*68,117*
— *coking coal*	*12,024*	*8,540*	*11,658*	*11,436*	*11,738*
Imports	10,331	10,793	14,107[r]	14,955	10,166
Exports	8,461	8,396	10,547[r]	7,007	7,070
Consumption[a]	86,215	80,461	80,288[r]	84,396	82,951
Stocks change	3,547	4,731	-4,500[r]	869	6,839
Consumption	82,667	75,730	84,788	83,527	76,112

Source: ***The Central Statistical Office (GUS)***

The main type of hard coal produced is ***steam coal***, whose share in total production is ca. 85% (Tab. 1). Due to the introduction of new air protection requirements in 1990, some improvement in coal quality parameters has been recorded in recent years, i.e. the calorific value, ash and sulfur contents. However, Polish power plants still use inferior types of steam coal (calorific value below 22.0 MJ/kg), while the better types are exported. The other type of hard coal produced is ***coking coal***. Its production depends on the availability of reserves in Upper Silesian mines, and on the domestic and foreign demand (Tab. 1).

At the end of 2012, hard coal was extracted in 31 mines, including: 15 mines of **Kompania Węglowa S.A.** (**KW**, Coal Company Joint Stock Co.); 5 mines of **Jastrzębska Spółka Węglowa S.A.** (**JSW**, Jastrzębie Coal Company Joint Stock Co.); 4 mines of **Katowicki Holding Węglowy S.A.** (**KHW**, Katowice Coal Holding Joint Stock Co.); 2 mines of **Południowy Koncern Węglowy S.A.** (**PKW**, Southern Coal Company Joint Stock Co. owned by Tauron Polska Energia Joint Stock Co.); **LW Bogdanka S.A.** (“Bogdanka” Lublin Coal Joint Stock Co.); **Kazimierz-Juliusz Sp. z o.o.** (Kazimierz-Juliusz Ltd. owned by KHW); **Siltech Sp. z o.o.** (Siltech Ltd. — private mine), **PG Silesia Sp**. **z o.o**. (PG Silesia Ltd. owned by Energeticky a Prumyslovy Holding a.s. from the Czech Republic) and **EKO-PLUS Sp. z o.o.** (EKO-PLUS Ltd. — private mine). KW (Coal Company) is currently the largest mining company in the European Union, with total capacities ca. 40 Mtpy.

In the middle of 2009, **LW Bogdanka S.A.** started to be listed on the Warsaw Stock Exchange. In 2010 the State Treasury sold the majority of the remaining shares, decreasing its share to under 5%. In December 2010, **Silesia** mine was sold by **KW** to **Energeticky a Prumyslovy Holding a.s. (EPH)**, and in January 2011 **PG Silesia Ltd.** was established. In 2011, **EKO-PLUS Ltd**. started to extract **Bytom I-1** deposit on the basis of infrastructure of the former **Powstańców Śląskich** mine (later: **ZG Bytom I**). In the middle of 2011, **JSW** started to be listed on the Warsaw Stock Exchange. At the end of 2012, the State Treasury had ca. 55% shares of this company. In the beginning of 2010 **Murcki** and **Staszic** mines were merged into one mine by **KHW**, **Knurów** and **Szczygłowice** mines were merged by **KW**, while in the beginning of 2011 **Borynia** and **Zofiówka** mines were merged by **JSW**.

Trade

In the years 2008–2012 Polish ***coal*** exports decreased by 16% to ca. 7.1 Mt. The only exception was 2010, when exports rose to 10.6 Mt (Tab. 2). Level of exports is strictly correlated with purchases of European countries, as they are the main customers (ca. 98% of Polish hard coal exports in 2012). Among the importers, the leading positions are held by EU countries: Germany, the Czech Republic, Austria, Slovakia, France, Finland, and others. ***Steam coal*** predominated in exports — ca. 76%. The rest consists mostly of ***coking coal*** and marginal quantities of ***other hard coal products***.

Only high-quality coal grades that comply with the requirements of international markets are exported. There are several companies involved in foreign trade. The most important is **Węglokoks**, whose primary line of business is the marketing and export of hard coal and coke.

In 2008, for the first time in the history, Poland started to be net importer of ***hard coal***. In 2009–2011 total hard coal imports rose again by 45% to 15.0 Mt, being 8.0 Mt

Tab. 2. Polish exports of hard coal, by country — CN 2701

'000 t

Year	2008	2009	2010	2011	2012
Exports	**8,462**	**8,396**	**10,551**	**7,021**	**7,072**
• ***steam coal***	***6,778***	***6,671***	***8,523***	***5,237***	***5,289***
• ***coking coal***	***1,683***	***1,725***	***2,024***	***1,770***	***1,780***
• ***other hard coal products***	***1***	***0***	***4***	***13***	***2***
Austria	1,383	1,212	818	432	786
Belgium	1	79	229	1	80
Bosnia and Herzegovina	2	40	46	7	267
Czech Republic	1,875	1,452	1,551	1,865	1,547
Denmark	151	91	455	59	60
Finland	88	224	185	37	148
France	0	390	603	1	212
Germany	3,655	2,661	4,290	2,669	2,762
Hungary	212	76	188	135	95
Ireland	266	240	247	206	134
Lithuania	4	0	1	1	0
Netherlands	2	165	73	0	0
Norway	124	66	73	76	117
Portugal	–	2	–	–	–
Romania	0	0	0	0	26
Serbia	22	1	1	0	6
Slovakia	355	487	639	578	335
Spain	26	73	23	60	17
Sweden	59	59	132	105	103
Turkey	–	478	292	–	147
Ukraine	32	20	66	150	139
United Kingdom	197	577	639	634	89
Others	8	3	0	5	2

Source: ***The Central Statistical Office (GUS)***

higher than exports. In 2012 this tendency was stopped and imports decreased to 10.2 Mt, but they still were 3.1 Mt higher than exports (Tab. 1). High imports of ***steam coal*** were reported (rise to 12.7 Mt in 2011), while imports of ***coking coal*** were significantly reduced (Tab. 3). Moreover, some imports of ***anthracite*** were reported. ***Steam coal*** and ***anthracite*** were imported mainly from Russia, the Czech Republic, Ukraine (***anthracite***), and Kazakhstan, while ***coking coal*** from the US, the Czech Republic, Australia and Colombia.

Hard coal trade balance until 2008 was positive. Due to changes on the domestic hard coal market — decrease of production and demand, lower demand for Polish hard coal on the European market — in 2008 hard coal trade balance started to be negative,

Tab. 3. Polish imports of hard coal, by country — CN 2701

'000 t

Year	2008	2009	2010	2011	2012
Imports	**10,340**	**10,820**	**14,150**	**14,991**	**10,193**
• ***steam coal***	***6,831***	***8,534***	***10,831***[e]	***12,691***[e]	***8,367***[e]
• ***coking coal***	***3,500***	***2,259***	***3,276***[e]	***2,263***[e]	***1,798***[e]
• ***other hard coal products***	***9***	***27***	***43***	***36***	***27***
Australia	63	64	283	137	356
Belgium	–	0	69	0	0
Canada	–	–	–	0	65
China	9	5	5	6	4
Colombia	505	255	344	323	87
Czech Republic	1,803	1,751	2,618	2,928	1,572
Germany	13	30	55	38	28
France	–	12	11	0	–
Kazakhstan	387	298	267	341	283
Netherlands	207	0	41	0	0
Norway	104	–	36	0	–
Russia	5,039	7,075	8,155	9,310	6,568
South Africa, Republic of	167	3	–	–	0
Ukraine	329	352	402	568	396
USA	1,703	963	1,852	1,319	796
Venezuela	–	–	–	–	32
Others	11	12	12	21	6

Source: ***The Central Statistical Office (GUS)***

for the first time in history. In 2009 it was slightly reduced to 340 million PLN (Tab. 4), but in 2010 and 2011 it rapidly jumped to 2,905 million PLN, with significant improvement in 2012. It was a result of increasing imports volume, but also of higher import unit values in comparison to export unit values, especially in case of ***coking coal*** (Tab. 5).

Tab. 4. Value of hard coal trade in Poland — CN 2701

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	3,359,428	2,965,037	3,596,160	3,407,531	3,154,751
Imports	3,776,351	3,305,137	5,209,265	6,312,725	4,062,864
Balance	**-416,923**	**-340,100**	**-1,613,105**	**-2,905,194**	**-908,113**

Source: ***The Central Statistical Office (GUS)***

Consumption

Domestic ***hard coal*** consumption in the years 2008–2012 varied between 75.7–84.8 Mtpy (Tab. 6), with stable declining tendency up to 2009, with remarkable 12%

Tab. 5. Average unit values of hard coal trade in Poland

Year	2008	2009	2010	2011	2012
Hard coal CN 2701					
Exports unit values					
— PLN/t	397.0	353.2	340.8	485.3	446.1
— USD/t	167.8	113.8	112.9	165.7	136.7
Imports unit values					
— PLN/t	365.2	305.5	368.1	421.1	398.6
— USD/t	150.5	98.3	121.8	143.0	121.9
Steam coal CN 2701 19					
Exports unit values					
— PLN/t	366.7	339.9[e]	290.5	396.4	390.7
— USD/t	154.7	109.2[e]	96.3	134.9	119.7
Imports unit values					
— PLN/t	278.3	258.9[e]	273.8[e,r]	342.5[e]	329.2[e]
— USD/t	110.4	83.5[e]	90.9[e,r]	116.3[e]	100.7[e]
Coking coal CN 2701 12					
Exports unit values					
— PLN/t	513.9	402.9[e]	552.0	740.4	603.3
— USD/t	218.5	131.2[e]	182.6	253.9	184.4
Imports unit values					
— PLN/t	527.4	481.3[e]	660.5[e]	818.3[e]	678.9[e]
— USD/t	225.2	153.9[e]	217.7[e]	277.5[e]	207.4[e]

Source: ***The Central Statistical Office*** *(**GUS**)*

increase in 2010 and significant reduction in 2012. The share of ***hard coal*** in the structure of primary energy demand in Poland decreased from 46% to 44% in 2009, returned to 46% since 2010, and decreased to only 40% in 2012 .

Tab. 6. Structure of hard coal consumption in Poland

'000 t

Year	2008	2009	2010	2011	2012
Total consumption	**82,667**	**75,730**	**84,788**	**83,527**	**76,112**
• Energy transformation	62,194	56,444	63,501	61,831	58,122
— *power stations*[1]	*48,793*	*47,009*	*50,393*	*49,216*	*45,899*
— *coke plants*	*13,401*	*9,435*	*13,108*	*12,615*	*12,223*
• Direct consumption	18,322	17,554	18,661	17,521	17,383
• Balance losses and differences	2,151	1,732	2,626	4,175	607

[1] coal-fired power plants and central heating plants

Source: ***The Central Statistical Office*** *(**GUS**)*

The main consumer of ***steam coal*** is the energy sector — for generation of electricity and heat. In the years 2004–2007 total consumption of this sector stabilized at 51–53 Mtpy, with strong decrease in the years 2008-2009 down to 47 Mt in 2009, recovery to 50 Mt in 2010, and further strong reduction in the years 2011-2012 down to 46 Mt in 2012 (Tab. 6). The share of power plants and district heating stations in total consumption amounted to ca. 60%. Significant amounts of steam coal are also directly consumed in heavy industry, construction, and transport, and in households. Recently, some amounts of imported ***anthracite***, instead of expensive ***coke***, started to be used e.g. in soda plants.

Coking coal is transformed by thermal processing in cokeries into ***coke***, ***semi-coke***, ***crude coal pitch***, ***crude benzole***, and their derivatives. It is also utilized in non-ferrous metals smelters, as a fuel and reduction agent.

Another application of coal, anthracite, and coke is the manufacture of coal products, such as graphitized, metallo-graphite, and coal-ceramic products, etc.

Companies involved in hard coal production in Poland as of December 2012

- Kompania Węglowa S.A. (Coal Company Joint Stock Co.), controlling 15 mines — ul. Powstańców 30, 40–039 Katowice, tel. +48 32 2553353, fax +48 32 2555453; www.kwsa.pl — *steam* and *coking coal*.
- Jastrzębska Spółka Węglowa S.A. (Jastrzębie Coal Company Joint Stock Co.), controlling 5 mines — ul. Armii Krajowej 56, 44–330 Jastrzębie Zdrój, tel. +48 32 7564113, fax +48 32 4762671; www.jsw.pl — *coking* and *steam coal*.
- Katowicki Holding Węglowy S.A. (Katowice Coal Holding Joint Stock Co.), controlling 4 mines — ul. Damrota 16–18, 40–022 Katowice, tel. +48 32 7573069, fax +48 32 7573150; www.khw.pl — *steam coal* only.
- Lubelski Węgiel Bogdanka S.A. (Bogdanka Lublin Coal Joint Stock Co.) — 21–013 Puchaczów, tel. +48 81 4625100, fax +48 81 4625191; www.lw.com.pl — *steam coal*.
- Południowy Koncern Węglowy S.A. (Southern Coal Company Joint Stock Co.), controlling 2 mines — ul. Grunwaldzka 37, 43–600 Jaworzno, tel. +48 32 6185000, fax +48 32 6164476, www.pkwsa.pl — *steam coal*.
- KWK Kazimierz-Juliusz Sp. z o.o. (KWK Kazimierz-Juliusz Ltd.) — ul. Ogrodowa 1, 41–215 Sosnowiec, tel. +48 32 3685000, fax +48 32 2968474 — *steam coal*.
- SILTECH Sp. z o.o. (SILTECH Ltd.) — ul. Szybowa 2, 41–808 Zabrze, tel. +48 32 2744546, fax. +48 32 2753429 — *steam coal*.
- PG Silesia Sp. z o.o. (PG Silesia Ltd.) — ul. Górnicza 60, 43-502 Czechowice-Dziedzice, tel. +48 32 2152451, fax. +48 32 2152230, www.pgsilesia.pl — *steam coal*.
- ZG EKO-PLUS Sp. z o.o. (ZG EKO-PLUS Ltd.) — ul. Strzelców Bytomskich 127d, 41-933 Bytom, tel. +48 32 787 80 31, www.ekoplus-kopalnia.pl — *steam coal*.

HELIUM

Overview

Helium (**He**) belongs to the noble gases, i.e. chemically inert, not forming chemical compounds. Like other noble gases, it occurs in atmospheric air (obtained in relatively small amounts). The main sources of **helium** are certain deposits of ***nitrogen-rich natural gas***, where helium occurs as an accompanying element.

Due to its cryogenic properties (with the lowest liquefaction temperature, minus 269°C), **helium** has no substitutes in low temperature and superconductor applications.

Sources

Helium is present in the deposits of ***natural gas*** in the **Polish Lowland** area. Between Nowa Sól and Ostrów Wielkopolski there are 16 proven deposits of gas containing economic concentrations of ***helium*** (min. 0.08% He). Their total reserves amount to 28.33 Mm^3, including 13.19 Mm^3 in the largest one, **Bogdaj-Uciechów** (as of 31 December 2012).

Production

Helium is recovered from ***nitrified natural gas*** at the **Polish Oil and Gas Company** (**POGC**) — **Odolanów Unit** (formerly: Natural Gas Denitriding Plant "KRIO" in Odolanów) and new denitriding plant in **Grodzisk Wielkopolski** (a part of **POGC - Zielona Góra Unit**). Plant in Odolanów produces ***liquid*** and ***gaseous helium***, while plant in Grodzisk Wielkopolski - ***liquid helium*** only. Until 2004, information on helium production was not available. In 2010–2012, according to POGC, the plants produced 3.1–3.4 Mm^3py of ***helium*** (Tab. 1). ***Liquid helium*** makes over 90% of total production, while ***gaseous helium*** the remaining under 10%. Data on helium mining output, officially reported in the ***Mineral Resources Datafile***, are significantly lower than commercial production. It is a consequence of a fact that the remaining quantity of helium is recovered from gases with subeconomic concentrations of helium. The helium bearing gas came primarily from three deposits: **Bogdaj-Uciechów** (contains over 0.27% He), **Wilków**, and **Grochowice**. Very small amounts of ***helium*** are recovered from air by some domestic commercial gases plants, e.g. in Łódź. Only estimated data on total domestic helium production are available.

Trade

Helium foreign trade is listed in separate CN position, but in the weight units, what makes impossible to evaluate properly helium management in Poland. Almost the entire

Tab. 1. Helium statistics in Poland

Mm³

Year	2008	2009	2010	2011	2012
Production from natural gas deposits	1.03	1.05	1.01	0.97	0.91
Production[e,1]	2.20	2.50[r]	3.10[r]	3.40	3.30

Source: ***Mineral Resources Datafile***, [(1)]***POGC***

production of ***helium*** is exported. In 2010–2012, exports decreased by ca. 23% and the main recipients were Belgium, France, Germany and UE countries, Turkey, Ukraine and India (Tab. 2). Until 2008, small amounts of helium — 3–15 tpy — were imported to Poland from the US, Germany, Russia and Austria. In 2008, imports jumped to 96.4 t, but recently they dropped to 27.9 t in 2012, with the largest amounts coming from Austria, Algeria, and Hungary.

Tab. 2. Polish exports of helium, by country — CN 2804 29 10

t

Year	2008	2009	2010	2011	2012
Exports	**333.1**	**647.8**	**474.6**	**545.3**	**500.7**
Austria	0.0	0.2	15.0	35.6	76.8
Belgium	–	120.9	364.0	281.6	9.4
Bulgaria	1.1	1.1	0.2	1.4	1.7
Czech Republic	2.8	6.0	2.2	6.0	12.3
Denmark	3.1	2.4	2.4	2.2	0.5
France	–	–	1.0	47.6	145.9
Germany	45.7	227.5	5.7	66.6	171.5
Greece	4.7	23.8	–	0.1	4.8
Hungary	6.0	0.9	0.3	2.6	4.7
India	–	–	9.3	–	–
Italy	70.2	84.7	–	–	0.4
Lithuania	0.7	0.7	1.6	1.6	1.6
Latvia	0.2	0.1	0.5	0.3	0.3
Romania	–	0.1	0.1	0.6	1.2
Russia	–	–	–	0.2	2.0
Slovakia	0.8	0.3	1.1	2.0	0.4
Sweden	4.5	–	–	0.0	–
Turkey	50.7	57.1	58.4	60.0	41.7
Ukraine	8.3	5.8	12.8	36.5	6.1
United Arab Emirates	–	4.6	–	–	–
United Kingdom	134.3	111.1	–	0.0	18.4
Others	0.0	0.5[r]	0.0[r]	0.4	1.0

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***helium*** is consistently positive, but in 2012 it rose rapidly to 122 million PLN, due to strong increase of exports unit values (Tabs. 3, 4). Imports unit values after decrease in 2010 to ca. 118,000 PLN/t, in 2011–2012 recovered to 153,550 PLN/t, i.e. 2009 level.

Tab. 3. Value of helium trade in Poland — CN 2804 29 10

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	15,124	23,371	35,380	46,156	126,020
Imports	4,781	8,147	8,139	5,098	4,288
Balance	**+10,343**	**+15,224**	**+27,241**	**+41,058**	**+121,732**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of helium exports from Poland — CN 2804 29 10

Year	2008	2009	2010	2011	2012
PLN/t	45,401	36,078	74,554	84,645	251,674
USD/t	19,331	11,478	24,925	28,793	77,092

Source: ***The Central Statistical Office (GUS)***

Consumption

There are no data available on the structure of ***helium*** consumption in Poland.

Companies involved in helium production in Poland as of December 2012

- PGNiG S.A. Oddział w Odolanowie (Polish Oil and Gas Company Joint Stock Co., Odolanów Unit), ul. Krotoszyńska 148, 63–430 Odolanów, tel. +48 62 7364441, fax. +48 62 7365989, www.pgnig.pl/odolanow — *liquid helium, gaseous helium.*
- PGNiG S.A. Oddział w Zielonej Górze (Polish Oil and Gas Company Joint Stock Co., Zielona Góra Unit), ul. Bohaterów Westerplatte 15, 65–034 Zielona Góra, tel. +48 68 3291216, fax. +48 68 3291337, www.zielonagora.pgnig.pl/zielonagora — *liquid helium.*

INDIUM

Overview

In spite of the considerable quantity of **indium** (**In**) in the Earth's crust (comparable to the amount of silver), concentrations are rare. Indium occurs in over 100 minerals, mainly in ***zinc***, ***tin***, ***lead***, ***tungsten***, and ***iron ores***, or ***pyrite***. **Black indium** is a primary commodity of indium obtained through hydrometallurgical extraction from the ***cinders of sulfide zinc ore***. **Indium metal** is most often recovered from ***black indium*** by electrochemical processing, vacuum distillation (at a billing temperature of approx. 2,045°C), and zone refining.

In recent years, the most dynamically growing **indium** application has been the production of thin films on glass (especially for the liquid crystal monitors of ***high definition*** TV sets, portable computers, video display sets, etc.), as well as on the surface of silver or other metals. To a lesser extent it is used for the production of solders and other very important alloys.

Sources

There are no ***indium-bearing ore*** deposits in Poland.

Production

No data about the production of ***indium*** in Poland are available.

Trade

Domestic demand is covered by variable imports of ***indium metal***, which in the years of 2008–2009 was quite low, changing between 48 and 84 kg, in 2010 soared up to 20,051 kg (mostly some very cheap indium-bearing material from Germany), but in the next two years dropped to only 9 kg in 2012. The regular and main suppliers were the US, and other countries, such as: China, Belgium, Germany (in 2010), Japan and the United Kingdom, delivered on occasional basis (Tab. 1). ***Indium*** occurs also in many other products imported or exported by Poland, e.g. electronic elements, but these are not evaluated statistically.

The trade balance of indium metal has always been negative (Tab. 2), depending on the quality of traded material, quantity of imports and market price, influencing the unit value of imports, especially for 2010 (Tab. 3).

Tab. 1. Indium statistics in Poland — CN 8112 92 81

kg In

Year	2008	2009	2010	2011	2012
Imports	**77**	**48**	**20,051**	**66**	**9**
China	–	–	2	–	4
Germany	–	5	20,017	–	1
Italy	–	–	6	2	0
Japan	–	12	8	2	–
USA	76	31	15	57	4
United Kingdom	1	–	3	5	0
Exports	**–**	**–**	**20**	–	–
Consumtion[a]	**77**	**48**	**20,031**	**66**	**9**

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of indium trade in Poland — CN 8112 92 81

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	–	–	36	–	–
Imports	116	75	120	119	18
Balance	**-116**	**-75**	**-84**	**-119**	**-18**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit value of indium imports to Poland — CN 8112 92 81

Year	2008	2009	2010	2011	2012
PLN/kg	1,506.5	1,562.5	5.9	1,800.2	2,023.2
USD/kg	610.3	510.4	2.0	632.6	616.4

Source: ***The Central Statistical Office (GUS)***

Consumption

There are no data available on the structure of ***indium*** consumption in Poland.

IODINE

Overview

Iodine (**I**) forms its own minerals, which may be found in ***nitrate rocks*** (***Chile saltpeter***). However, its main sources are brines: ***iodine***, ***iodine-bromine***, and ***bromine-iodine*** (see: **BROMINE**), which occur either individually or in ***natural gas*** and ***petroleum*** deposits. ***Sea water*** is a potential unlimited source of iodine, as are certain seaweeds, e.g. from the ***Laminaria*** family.

Iodine reacts with almost all elements, except sulphur, selenium, and noble gases, which accounts for the multitude and diversity of its uses. In the form of ***iodine tincture*** it has been widely used to disinfect wounds. Since the mid-1800s iodine has also come to be important as a chemical reagent in photography and chemistry. In many applications it has no substitutes, e.g. in catalysts, drugs, food additives.

Sources

In Poland there are ***bromine-iodine*** and ***iodine-bromine brines***, which are utilized for balneological purposes, e.g. in **Rabka** and **Łapczyca** near Bochnia. The ***brines*** contain from 5 to above 100 mg/l (in **Dębowiec** deposit) of ***iodine***. Total investigated domestic reserves of ***iodine-bromine brines*** are estimated at 32.2 Mm^3. Moreover, ***water pumped from coal mines*** in the **Upper Silesia** contains considerable amounts of iodine.

Production

Iodine has not been recovered in Poland from existing sources. The only attempt was made in the 1970s when the technology for complex utilization of ***iodine-bromine brines*** from the **Bochnia** region was developed, where it was produced in a pilot scale. Since the early 2000s the ***curative*** and ***cosmetic salts*** rich in J and Br have been obtained by the **Iodine-Bromide Brine Processing Plant Salco** of **Łapczyca**. The salt has been produced in boiling pan through water evaporation from the brine extracted from the **Łapczyca** deposit. Between 2008 and 2012 the production of ***iodine-bromine salt*** increased by 21%, exceeding 900 tons last year (see: **BROMINE**).

Trade

The domestic demand for ***iodine commodities*** is satisfied entirely by imports, ranging between 10 and 25 tpy. In recent years the major deliveries have come from Azerbaijan and Italy (Tab. 1). Among other ***iodine commodities***, there were also ***iodides*** and ***oxyiodides*** regularly purchased (Tab. 2). In 2009 their deliveries increased up to 127 tons, i.e. more than four-fold as compared to the previous year, but in the following years they came back to the usual volume of 30-50 tpy. There were also some re-exports of iodine in the range of several tons per annum, the recipients of which were the neighbouring countries (in 2012 mainly Ukraine). The trade balances in both ***iodine*** and their commodities have been consistently negative, depending on the import volume and iodine prices (Tab. 3). In 2012 the deficit in ***iodine*** and ***iodine compounds*** trade deepened to 2 and almost 5 million PLN, respectively.

Tab. 1. Imports of iodine to Poland, by country — CN 2801 20

t

Year	2008	2009	2010	2011	2012
Imports	**19**	**10**	**25**	**12**	**12**
Azerbaijan	–	–	9	6	3
Belgium	8	6	6	0	1
Chile	2	4	2	1	1
Germany	5	0	0	0	0
Italy	–	–	4	5	4
Netherlands	–	–	3	0	0
United Kingdom	–	–	–	0	4
Others	4	–	1	–	–
Exports	**5**	**5**	**16**	**4**	**3**
Consumption[a]	**14**	**5**	**9**	**8**	**9**

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Iodides and oxyiodides statistics in Poland — CN 2827 60

t

Year	2008	2009	2010	2011	2012
Imports	31	127	52	36	41
Exports	4	24	23	10	13
Consumption[a]	27	103	29	26	28

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of iodine commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Iodine CN 2801 20					
Exports	317	471	1,566	436	968
Imports	1,101	936	2,188	1,945	3,094
Balance	**-784**	**-468**	**-622**	**-1,509**	**-2,126**
Iodides and oxyiodides CN 2827 60					
Exports	276	2,017	1,962	1,232	2,374
Imports	1,911	3,508	4,192	4,324	6,995
Balance	**-1,635**	**-1,491**	**-2,230**	**-3,092**	**-4,621**

Source: ***The Central Statistical Office (GUS)***

The unit values of ***iodine*** imports to Poland followed the tendencies on the international market, reflecting the rise in prices in resent years, as well as stocks changes. However, they depended on the terms of contracts between buyers and sellers and costs of transportation (Tab. 4).

Tab. 4. The unit value of iodine imports to Poland — CN 2801 20

Year	2008	2009	2010	2011	2012
PLN/t	58,239	89,144	87,882	169,165	257,795
USD/t	24,849	30,479	29,115	56,433	77,770

Source: ***The Central Statistical Office (GUS)***

Consumption

The consumption of ***iodine*** and ***iodine compounds*** by end-users in Poland is difficult to ascertain. These commodities are primarily utilized for the production of catalyst and pharmaceuticals, photography, and as an additive to edible salt.

Companies involved in iodine commodities production in Poland as of December 2012

- Zakład Przeróbki Solanek Jodowo-Bromowych Salco S.C. (Iodine-Bromide Brine Processing Plant Salco), 32–744 Łapczyca 445, tel. +48 14 6127519, fax. +48 14 6127922, www.salco.pl — *iodine-bromide curative and cosmetic salt.*

IRON AND STEEL

Overview

Iron (**Fe**) is one of the most common elements in the lithosphere. **Iron oxide ores** and **concentrates** (mainly of ***hematite*** Fe_2O_3 and ***magnetite*** Fe_3O_4) are the basic primary commodities for pig iron, and for direct reduced iron. Other types of iron ore, such as **carbonate** (**siderite**) **ore**, **silicate ore**, **iron-bearing sand**, are not regarded as economic in most of the world.

Pig iron is obtained in blast furnaces by the coke reduction of ***iron oxide ores*** and ***concentrates***, which are ***sintered*** or ***pelletized*** before being fed into the furnace. Pig iron is produced in two grades: **foundry pig iron** (for **cast iron** and **cast steel** production) and **steelmaking pig iron**. In recent years, the importance of **direct reduced iron** (**DRI**) has been continually increasing. It competes with pig iron, having comparable production costs and energy consumption.

A batch of pig iron for **raw steel** production is supplemented with **steel** and **cast iron scrap**, or with the appropriate ***ferroalloys*** for **alloyed steel**. The raw steel production process is carried out in ***open-hearth furnaces***, lately replaced by ***oxygen converters*** and ***electric furnaces***, more and more frequently using the ***continuous steel casting*** method. The **raw steel** is further processed by plastic working and thermal operations. Two main types are distinguished: **carbon steel** (containing considerable amounts of carbon) and **alloyed steel**. On the basis of its different applications, steel types are sub-divided into ***construction***, ***tool***, and ***special steel***, manufactured in many varieties and types, standardized and marked with trade marks. The production of **carbon steel** (***unalloyed***, ***ordinary***, ***commercial steel***) is decreasing, with an attendant increase in the production volume of **alloyed steel** (***quality***, ***noble steel***), improved by additives of Co, Cr, Mn, Mo, Nb, Ni, Ta, Ti, V, Zr, etc. Raw steel is used to make a variety of **rolled products** (sheets, zinc-plated sheets, tin-plated sheets, steel pipes, cold rolled bands, sheet-metal sections, etc.) and **forged** or **drawn products** (bars, wires). **Pure iron** is produced in very small amounts, for special purposes.

Iron Ore and Concentrates

Sources

Poland has no recognized deposits of any type of ***iron ore***.

Production

Since 1990 there has been no production of ***iron ore*** in Poland.

Trade

The Polish steel industry is based exclusively on imported ***iron ores*** and ***concentrates***. In the years 2008–2012 these imports were very variable, changing between 3.8 Mt and 7.8 Mt, with stabilization in last three years at the level of 6.0–6.6 Mtpy (Tab. 1). Imports volume reflects very unstable economical condition of Polish steel industry, connected with trends on international steel market.

Tab. 1. Iron ores and concentrates statistics in Poland — CN 2601

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Imports	7,783	3,792	6,489	5,977	6,576
Exports	10	15	16	4	2
Consumption[a]	7,773	3,777	6,473	5,973	6,574

Source: ***The Central Statistical Office*** *(GUS)*

The main sources of ***iron ores and concentrates*** imports to Poland are Ukraine, Russia, Bosnia and Herzegovina, and - in recent three years - Canada and Slovakia (Tab. 2). Following world trends, the share of ***ores*** and ***agglomerates*** in Polish demand is declining, whereas the significance of ***concentrates*** and ***pellets*** is increasing. Exports of small amounts of ***iron ores and concentrates*** have been noted (Tab. 1).

Tab. 2. Polish iron ores and concentrates imports, by country — CN 2601

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Imports	**7,783.4**	**3,791.9**	**6,489.4**	**5,977.4**	**6,576.5**
Bosnia and Herzegovina	254.3	116.0	90.0	229.2	429.9
Brazil	92.8	64.7	–	–	0.5
Canada	–	–	134.9	68.3	67.7
Liberia	–	–	–	–	97.8
Norway	3.0	10.5	13.7	17.4	13.9
Russia	3,763.3	514.0	941.7	835.9	1,368.3
Slovakia	–	–	–	49.0	290.0
Sweden	30.4	17.0	11.0	11.1	16.3
Ukraine	3,638.6	3,006.4	5,297.9	4,765.9	4,291.4
USA	–	62.8	0.0	0.0	0.0
Others	1.0	0.5	0.2	0.6	0.7

Source: ***The Central Statistical Office*** *(GUS)*

The trade balance of ***iron ores and concentrates*** trade has always been negative, varying in the years 2008–2012 between 773–2,119 million PLN/y (Tab. 3), depending on imports volume, but in recent years also on the unit values of their imports, especially for 2012, when increased imports volume did not deepen the negative balance of trade (Tab. 3 and 4). The unit values of iron ores and concentrates imports expressed in USD/t reflect the changes of iron ore prices on international markets (Tab. 4).

Tab. 3. Value of iron ore and concentrate trade in Poland — CN 2601

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	3,225	3,483	9,610	17,554	6,705
Imports	1,935,484	776,714	1,840,387	2,136,144	2,036,512
Balance	**-1,932,259**	**-773,231**	**-1,830,777**	**-2,118,590**	**-2,029,807**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit value of iron ores and concentrate imports to Poland — CN 2601

Year	2008	2009	2010	2011	2012
PLN/t	248.7	204.8	283.7	357.4	309.7
USD/t	107.4	69.5	92.8	120.1	94.7

Source: ***The Central Statistical Office (GUS)***

Consumption

Iron ores and concentrates are consumed in Poland entirely for ***pig iron*** production by domestic steelworks.

Pig Iron

Production

Poland is a significant producer of ***pig iron***. In 2008 the production amounted to 4.9 Mt, in 2009 there was recorded minimum of output at almost 3.1 Mt, and in period 2010-2012 production increased to almost 4.0 Mtpy (Tab. 5). Production volume decrease in 2009 was caused mainly by limited production in the biggest Polish steel producer — **ArcelorMittal Poland S.A.** In October 2008 it closed temporarily for routine repair two blast furnaces – one in Dąbrowa Górnicza Unit and one in Kraków Unit. Since 2007, only ***steelmaking pig iron*** is manufactured in Poland, while ***foundry pig iron*** manufacturing was ceased (Tab. 5).

Tab. 5. Pig iron statistics in Poland — CN 7201

'000 t

Year	2008	2009	2010	2011	2012
Production	4,933.8	3,095.0	3,638.0	3,974.9	3,944.0
Imports	236.4	156.4	178.8	228.7	200.4
Exports	5.5	10.2	67.7	0.9	80.4
Consumption[a]	5,164.7	3,241.2	3,749.1	4,202.4	4,064.0

Source: ***The Central Statistical Office (GUS)***

Currently, ***steelmaking pig iron*** is produced in two large metallurgical plants of **ArcelorMittal Poland S.A.:** in Dąbrowa Górnicza at the level of 2.0–3.5 Mtpy, and in Kraków — 1.0–1.5 Mtpy.

Trade

Pig iron imports in the years 2008–2012 were variable, between 156,400 in 2009 and 236,400 t in 2008 (Tab. 5). By contrast, exports of ***pig iron***, mainly to Western European countries, reported strong fluctuations: between 80,400 t in 2012 and only 900 t in 2011 (Tab. 5).

The trade balance in ***pig iron*** had a negative value in the years 2008–2012, changing between 146.7 and 371.7 million PLN (Tab. 6).

Tab. 6. Value of pig iron trade in Poland — CN 7201

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	6,981	10,973	46,886	3,935	126,394
Imports	317,699	157,722	248,750	375,622	325,303
Balance	**-310,718**	**-146,749**	**-201,864**	**-371,687**	**-198,909**

Source: ***The Central Statistical Office (GUS)***

Consumption

Steelmaking pig iron is used entirely for ***steel*** production. ***Foundry pig iron*** is used to produce ***cast iron*** and ***cast steel***.

Iron and Steel Scrap, and other Secondary Iron-Bearing Materials

Production (recovery)

Iron scrap consists of the waste from the on-going operations of steelworks, used steel, used cast steel or cast iron constructions, and used machinery and equipment collected from outside. Until the end of 2000 the collection of used ***steel***, ***cast steel***, and

Tab. 7. Secondary iron materials statistics in Poland

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Iron and steel scrap CN 7204					
Production	NA	NA	NA	NA	NA
— *steel scrap*	*1,429.4*	*NA*	*NA*	*NA*	*NA*
Imports	491.3	603.2	382.3	408.8	383.4
Exports	1,378.3	960.0	1,396.6	1,889.3	1,989.2
Consumption[a]	NA	NA	NA	NA	NA
Iron bearing wastes CN 2619					
Production	NA	NA	NA	NA	NA
Imports	21.5	3.3	1.7	26.7	20.4
Exports	2.1	9.3	29.9	20.7	2.6
Consumption[a]	NA	NA	NA	NA	NA

Source: ***The Central Statistical Office (GUS)***

cast iron was recorded by the **Central Statistical Office**. In 2000 the supply of collected scraps reached the level of 1.9 Mtpy. These were mainly ***steel scrap***, with only small amounts of ***cast steel*** and ***cast iron*** (26,000 t). ***Iron-bearing wastes*** were also collected, and at the level of 296,000 t in 2000. The steel scrap recovery in steelworks is estimated to be even higher than the level of scrap collection, i.e. more than 3.0 Mtpy. In the years 2001-2008 there were recorded data about production of steel scrap only, while data on production of other types of scrap were not available (Tab. 7). Domestic production of ***steel scrap*** in 2008 amounted to 1.4 Mt (Tab. 7), and in period 2009–2012 data of iron and steel scrap production were not given by the Central Statistical Office.

Trade

Iron and ***steel scrap*** exports from Poland in the years 2008–2009 decreased to under 1.0 Mtpy, but in period 2010-2012 went up to the record of nearly 2.0 Mtpy (Tab. 7). The scrap is shipped mainly to Western European countries. In the period 2008–2010, increasing amounts (up to 29,900 tpy) of ***iron-bearing wastes*** have also been exported, but in next two years their exports sharply decreased, down to only 2,600 t (Tab. 7). Imports of ***iron*** and ***steel scrap*** were continuously increasing to 603,200 t in 2009, with the Czech Republic as the main supplier, but in period 2010–2012 at the lower level of 380,000–410,000 tpy (Tab. 7), with Czech Republic, Slovakia and Russia as main suppliers. Imports of ***iron-bearing wastes*** were of marginal importance in last years.

The trade balance in ***secondary iron commodities*** has been extremely positive in the years 2008–2012, ranging between 0.65–2.4 billion PLN/y (Tab. 8). The exception was trade balance value in ***iron-bearing wastes***, being negative in 2008 and in 2012 (Tab. 8).

Tab. 8. Value of secondary iron materials trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Iron and steel scrap CN 7204					
Exports	1,795,782	1,090,583	1,972,758	2,882,939	2,918,139
Imports	485,053	444,528	421,175	549,858	514,534
Balance	**+1,310,729**	**+646,055**	**+1,551,583**	**+2,333,081**	**+2,403,605**
Iron-bearing wastes CN 2619					
Exports	712	3,534	18,185	15,029	1,893
Imports	7,274	443	307	3,743	3,045
Balance	**-6,562**	**+3,091**	**+17,878**	**+11,286**	**-1,152**

Source: ***The Central Statistical Office (GUS)***

Consumption

The share of ***iron*** and ***steel scrap*** in the input for ***raw steel*** production has been estimated at nearly 40% in recent years (approx. 60% of the input is ***steelmaking pig iron***). This scrap is even more important in the foundry industry. Its share in the input for ***cast iron*** and ***cast steel*** production is estimated at as much as 60–70% (the rest consists of ***foundry pig iron***).

Steel and Steel Products

Production

Poland is a significant European producer of ***raw steel*** and ***steel products***. There were 17 active steelworks producing raw steel and/or steel products, including two large plants belonging to the **ArcelorMittal Poland S.A.**: plant in **Kraków** and plant in **Dąbrowa Górnicza**. Only five steelworks are located outside of Upper Silesia: **ArcelorMittal** plant in Kraków, **ISD Częstochowa, CELSA Huta Ostrowiec**, **Stalowa Wola,** and **Arcelor Warszawa** in Warsaw.

In the period 2008–2012 production of ***raw steel*** was very variable and reached maximum of 9.7 Mt in 2008 and minimum of 7.1 Mt in 2009, while in years 2010-2012 fluctuated between almost 8.0 and 8.8 Mtpy (Tab. 9).

Tab. 9. Crude steel statistics in Poland — CN 7206

'000 t

Year	2008	2009	2010	2011	2012
Production	9,727	7,128	7,996	8,777	8,539
— *from electric arc furnace*	*4,502*	*3,893*	*4,001*	*4,353*	*4,206*
— *from converters*	*5,225*	*3,235*	*3,995*	*4,424*	*4,333*
Imports	35	7	1	1	1
Exports	19	12	21	26	24
Consumption[a]	9,743	7,129	7,976	8,752	8,516

Source: ***The Central Statistical Office (GUS)***

Approximately 50% of the raw steel in last years was produced in electric arc furnaces at **CMC Zawiercie, CELSA Huta Ostrowiec, ISD Huta Częstochowa, Arcelor Warszawa, Stalowa Wola, Batory,** and **Ferrostal Łabędy**. The biggest is **CMC Zawiercie** (capacity of ca. 1.2 Mtpy), **CELSA Huta Ostrowiec** and **ISD Częstochowa** - both with capacities 0.6–0.8 Mtpy. The other 4 plants are of minor importance, with production much lower than 0.4 Mtpy. The remaining 50% of the raw steel was produced in oxygen-blown converters in the two largest steelworks belonged to **ArcelorMittal Poland S.A. — Unit** in **Dąbrowa Górnicza** and **Unit** in **Kraków**.

Crude steel breakdown by grades is in recent years stable. From total crude steel melted in Poland, low-alloy represented on average 94%, while high-alloyed accounted to approx. 6% and stainless steel production is very marginal, for example in 2012 amounted to only 0.03%.

The implemented in 2001 by the Polish Cabinet **"Iron and Steel Restructuring Program"** has ended in 2007. The biggest Polish steel company — **Polskie Huty Stali S.A.** (**PHS S.A.**), which existed as a single State Treasury-owned company and consisted of four companies: **Huta Katowice S.A.**, **Huta im. T. Sendzimira S.A.**, **Huta Cedler S.A.**, and **Huta Florian S.A.,** was sold to **LNM Holding B.V. LNM,** which undertook to buy back the debts of largest creditors to **PHS S.A.** It was also agreed that LNM injects 800 million PLN into PHS S.A. equity, and invests 2.4 billion PLN soon after the take-over. Later on the new owner converted **PHS S.A.** into the new company

Mittal Steel Poland S.A. In October 2007 as a result of former merger of **Arcelor** and **Mittal Steel**, the company name was changed into **ArcelorMittal Poland S.A.** Privatization was agreed with European Commission, and was the essential point of the Restructuring Program of the Polish steel making industry. The key points of business plan were four investments, which allow to modernize all of the four steelworks, guaranteed further operate of the company. All the investments were finished in the years 2006–2007, and the Government of Poland and the European Commission have recognised that the restructuring programme was successfully implemented. The domestic steel industry has changed in a positive way. Technical developments, organizational changes and privatization processes made this sector a modern and sustainable one. Final privatisation process of the **Polskie Huty Stali S.A.** was finished on 16th October 2007, when Minister of State Treasury sold to the **ArcelorMittal Poland S.A.** the rest of possessed shares — 25.21% - for 436 million PLN.

The difficult economic situation of Polish steel industry in the first years of 21th century beated several plants to declare insolvency, and forcing them to change ownership and organizing structure. Bankruptcy was declared in case of **Częstochowa, Baildon, Ostrowiec, Małapanew, Jednośćć,** and **Andrzej** plants. Basing on their productive assets, new companies were created, as for example **Huta Stali Częstochowa Sp. z o.o.**, **Małapanew Zakłady Odlewnicze Sp. z o.o.**, and next prepared for privatisation. In case of **Huta Ostrowiec S.A.**, Spanish concern **CELSA** became the new owner of company. Moreover, **American Commercial Metals Company** signed the contract to buy from **Impexmetal S.A.** 71% of **Huta Zawiercie S.A.** shares. Moreover, there were further changes to the ownership of Polish steel mills. Huta **Batory**, Huta **Bankowa** and Huta **Andrzej** came to be owned by a listed company **Alchemia S.A.**, **Huta Stali Częstochowa Sp. z o.o.** by the **Industrial Union of Donbas** from Ukraine, **Ferrostal Łabędy** and **HSW Quality Steel Unit** came to be owned by **ZŁOMREX S.A.**, which is specialised in scrap processing, while the **Arcelor Group** became the new owner of **Huta Lucchini-Warszawa Sp. z o.o.**, and Russian concern **Severstal** became the owner of **Technologie Buczek S.A.** in Sosnowiec.

Trade

Generally speaking, international trade in ***raw steel*** is of marginal importance (Tab. 9).

Consumption

The level of domestic ***raw steel*** consumption has shown tendencies similar to those of the production (Tab. 9).

The most important final products of steelworks are ***hot rolled products***, ***cold rolled products***, ***pipes***, ***bars***, and ***wires*** (Tab. 10). Most of the steelworks specialize in certain product assortments. For example:

- ***hot rolled sheets*** — **ArcelorMittal Poland Unit** in **Kraków, ISD Częstochowa, Pokój, Batory, Stalowa Wola;**
- ***cold rolled sheets*** and ***tinplated sheets*** — **ArcelorMittal Poland Unit** in **Kraków** and **Stalowa Wola;**
- ***galvanized sheets*** — **ArcelorMittal Poland Unit** in **Kraków** and **ArcelorMittal Poland Unit** in **Świętochłowice;**

- *cold rolled strips* — **ArcelorMittal Poland S.A. Unit** in **Kraków, ArcelorMittal Poland Unit** in **Świętochłowice**, **ArcelorMittal Poland Unit** in **Sosnowiec, Arcelor Warszawa;**
- *pipes* — **ArcelorMittal Poland Unit** in **Kraków, ISD Częstochowa, Andrzej, Ferrum, Batory, Severstallat Silesia.**

Tab. 10. Production of the main steel products in Poland

'000 t

Year	2008	2009	2010	2011	2012
• Hot rolled rails	128.3	164.3	259.8	245.9	171.9
• Hot rolled bars and sections	4,774.6	4,102.4	4,533.9	4,906.1	3,874.1
• Hot rolled sheets	2,473.9	1,917.6	2,113.3	2,295.6	1,969.2
• Cold rolled sheets	689.4	557.7	834.7	806.6	1,353.5
• Cold rolled galvanized sheets	437.4	395.9	455.2	453.1	676.0
• Cold rolled roll-formed sections	529.3	531.5	545.4	596.8	577.9
• Pipes	408.7	346.5	383.7	407.8	592.2
• Wires	271.5	213.6	258.0[r]	290.6	309.4

Source: ***The Central Statistical Office (GUS)***

Almost all the steelworks produce ***hot rolled products*** (excluding sheets). The exceptions are **Andrzej, Severstallat Silesia, ISD Częstochowa,** and **Ferrum.** The **Małapanew,** and **Zabrze** steelworks do not produce steel products at all, but only ***cast iron*** and ***cast steel***.

The structure of steelworks production is still characterized by a high proportion of ***hot rolled bars***, ***sections***, and ***semis***. One negative feature, in discordance with world trends, is still inadequate production of ***hot rolled sheets***, and slow increase of production of ***galvanized sheets***. Implemented Restructuring Program improved condition of the Polish steel industry. **Arcelor Mittal Poland** has built in **Kraków Unit** a completely new, the most modern in Europe, hot-rolling mill (instead of modernization of existing one); in Dąbrowa Górnicza Unit there was built the steel continuous casting line of the production capacity of ca. 3.0 Mtpy; in Sosnowiec unit there was modernized the quality blank mill; in Świętochłowice Unit there was constructed the new coated sheets production line. Arcelor Mittal Poland, the largest steel maker in Poland, which produces ca. 65% of Polish steel, became a modern producer, offering the wide assortment of steel products, capable of competing on international markets. In period 2009-2012 the modernization works were continued at several Polish steel companies, i.e. **ArcelorMittal Poland S.A.** has commissioned a new caster and a tundish, and has modernized blast furnace; **ArcelorMittal Warszawa Sp. z o.o.** has commissioned new bar mill; **Celsa Huta Ostrowiec Sp. z o.o.** modernized caster and electric arc furnance; **ISD Huta Częstochowa Sp. z o.o.** commissioned three chamber furnaces for plate heat treatment and modernized Heavy Plate Mill's furnace; and **CMC Zawiercie S.A.** commissioned new rod mill commissioned. Moreover, two new hot rolling mills for long products were launched (in **Celsa Huta Ostrowiec Sp. z o.o.** and in **CMC Zawiercie S.A.**) and cold rolling mill for thin sheets was upgraded (in **ArcelorMittal Poland S.A. Unit** in

Kraków). Thanks to these investments steel plants extended and improved their product range, which provided the customers with a comprehensive range of technologically advanced products which are more suited for their needs.

During three first quarters of 2008 very good production and economic performances were reported by the Polish steel sector. From Q4 2008 onward, the market reversed entirely. Order book declined by 40–60% against annual average. Apparent consumption Q4 2008 clearly fell against Q4 2007 and first three quarters of 2008. Automotive, home appliances, machinery and building reported down times. Domestic steel output in Q4 2008 was down against Q4 2007 by 37% while capacity utilisation was 49%. In 2009 situation in the domestic steel market was influenced by negative impact of global crisis, which was more extensive and heavier than forecasted at the beginning of 2009. As a result, recession experienced by industries consuming steel for production of investment and consumer goods heavily impacted production in steel plants (in most regions of the world, in Europe, as well as in Poland) and revenues in the whole steel industry. This was unfavorable for several major industries. Domestic steel consumption in 2009 decreased by as much as 30% in comparison with 2008, which led to reduction in steel production by approximately 26%. Market difficulties forced the producers to reduce costs even more and to search for new opportunities for future.

In period 2010–2011 Poland's economy was still developing, and GDP has grown total by 8.1%, mainly due to high internal demand and investments coming back. Positive impact was brought by infrastuctural projects co-financed from the European Union, for example Cohesion Fund. As a result steel consuming industry sectors recorded further production increase, in spite of intra-EU market slowdown, and in effect domestic steel consumption in this period has risen by as much as 31% in comparison with 2009. In 2012 the rate of economic growth in Poland slowed down to 1.9%, and it has been the weakest growth for 3 years. In addition, the effects of global economic downturn were also influencing on condition of domestic steel mills. Steel production decreased by 5%, which clearly reflected the attitude and condition of the buyers. Poland's contribution to the overall EU steel production was 5%, at the same level as in 2011. In 2012, the average capacity utilization in the domestic steel industry decreased by 4%, in comparison to 2011, and amounted to ca. 64%, however this capacity utilization in steel mills based on electric arc furnances was well above 85%. All the installations for the production of pig iron, as well as steel from oxygen-blown converters and electric arc furnaces in the domestic steel mills are advanced and fully meet the requirements of BAT.

Steel products are among the Poland's main export commodities. However, their imports are still rising in recent years. The value of their exports in 2008 amounted to 12.2 billion PLN, in next two years dropped to 7.1–8.7 billion PLN/y (Tab. 11). However, requirements of domestic steel products market are met only in a part by assortment offered by the Polish steelworks. Therefore, the imports of steel products have been quickly increasing in recent years, coming mainly from the UE and CEFTA countries. The value of these imports reached over 20 billion PLN/y in 2008 (Tab. 11). In 2009 metallurgical industry was one of the industries most badly affected by crisis. Almost 30% decline in steel consumption caused reduction of domestic steel production and low demand contributed to the significant decrease in finished goods prices. As an effect the value of exports decreased by almost 42%, and value of imports decreased by 32%. In the years

2010–2012 there was recorded significant improvement in domestic economic condition, so imports value rose by 67% and amounted to 23.3 billion PLN, while exports value increased by almost 85% and amounted to 13.2 billion PLN (Tab. 11). By products, the main imported item were highly-processed flat products (their share in 2012 was 66%), while exports were predominantly longs. Semis and ingots accounted for a large exports share, while their imports were negligible. Polish assortments offered continue having insufficient amounts of certain steel grades (e.g. alloyed steel and specialty steel) as well as some steel products sorts (e.g. highly processed sheets and strips). Steel products imports to Poland in 2008 amounted to 8.0 Mt, but exports amounted to 5.4 Mt. In 2009 steel products imports significantly decreased and amounted to 5.2 Mt, while exports decreased to 4.0 Mt, but in the years of 2010-2012 steel market recovery had caused sharp increase in steel products trade, and in 2012 their imports amounted to the record of 8.1 million tons and exports amounted to 5.6 Mt.

Apparent consumption of finished steel products in Poland in 2012 amounted to 10.4 million tons, and was by 5.4% lower, in comparison to 2011. Recorded decline in apparent consumption in 2012 was a consequence of the decrease in real domestic consumption of steel in the second half of the year. The structure of domestic consumption of finished steel products was in recent years dominated by flat products, that acounted in 2012 for 58% of the total apparent consumption. The share of long products in total domestic consumption accounted for 30%, but pipes and hollow sections balanced off the remaining 12%.

Tab. 11. Value of steel products trade in Poland — CN 7207–7217, CN 7219–7223, CN 7225–7229

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	12,209,156.7	7,136,058.7	8,703,997.8	11,982,836.1	13,194,614.4
Imports	20,571,345.4	13,954,292.6	18,144,762.3	23,201,012.2	23,307,368.2
Balance	**-8,362,188.7**	**-6,818,233.8**	**-9,440,765.5**	**-11,218,176.1**	**-10,112,753.8**

Source: ***The Central Statistical Office (GUS)***

As a consequence, ***steel products*** trade balance in the past five years was negative, and in the years 2011-2012 exceeded 10 billion PLN/y (Tab. 11).

Companies involved in iron and steel production in Poland as of December 2012

- Walcownia Rur "Andrzej" Sp. z o.o. w Zawadzkiem ("Andrzej" Tube Mill Ltd. of Zawadzkie) ul. Ks. Wajdy 1, 46–059 Zawadzkie, tel. +48 77 4561300, fax +48 77 4561115, www.wra.pl — *pipes and tubes.*
- Huta "Bankowa" Sp. z o.o. w Dąbrowie Górniczej ("Bankowa" Steelworks Ltd. of Dąbrowa Górnicza), ul. Sobieskiego 24, 41–300 Dąbrowa Górnicza, tel. +48 32 2957400, fax. +48 32 2623628, www.hutabankowa.com.pl — *hot rolled products.*
- Huta "Batory" Sp. z o.o. w Chorzowie ("Batory" Steelworks Ltd. of Chorzów) ul. Dyrekcyjna 6, 41–506 Chorzów, tel. +48 32 7722237, fax +48 32 7722061, www.hutabatory.com.pl — *raw steel, special steels, pipes, tubes.*

- Severstallat Silesia Sp. z o.o. w Sosnowcu (“Severstallat Silesia” Steelworks Ltd. of Sosnowiec) ul. Nowopogońska 1, 41–200 Sosnowiec, tel. +48 32 3642401, fax +48 32 3642302, www.severstallat.eu — *pipes, tubes, rolls.*
- ArcelorMittal Poland S.A., Oddział w Krakowie (ArcelorMittal Poland S.A., Unit in Krakow) ul. Ujastek 1, 30–969 Kraków, tel. +48 12 6449866, fax +48 12 6447496, www.arcelormittal.com/poland — *steelmaking pig iron, raw steel, hot rolled products, cold rolled products, pipes, cast iron, tinplated sheets, galvanized sheets.*
- ArcelorMittal Poland S.A., Oddział w Dąbrowie Górniczej (ArcelorMittal Poland S.A., Unit in Dabrowa Gornicza) Al. Piłsudskiego 92, 41–308 Dąbrowa Górnicza, tel. +48 32 7945333, fax +48 32 7955200, www.arcelormittal.com/poland — *steelmaking pig iron, raw steel, hot rolled products, cast steel.*
- ArcelorMittal Poland S.A., Oddział w Świętochłowicach (ArcelorMittal Poland S.A., Unit in Swietochlowice) ul. Metalowców 5, 41–600 Świętochłowice, tel. +48 32 2452071, fax +48 32 2455363, www.arcelormittal.com/poland — *raw steel, hot rolled products, galvanized sheet, cold rolled strip.*
- ArcelorMittal Poland S.A., Oddział w Sosnowcu (ArcelorMittal Poland S.A., Unit in Sosnowiec) ul. Niwecka 1, 41–200 Sosnowiec, tel. +48 32 2994550, fax +48 32 2993966, www.arcelormittal.com/poland — *hot rolled products, cold rolled strip, cast iron.*
- ISD Huta “Częstochowa” Sp. z o.o. w Częstochowie (ISD “Częstochowa” Steelworks Ltd. of Częstochowa) ul. Kucelińska 22, 42–207 Częstochowa, tel. +48 34 3231261, fax +48 34 3230904, www.hcz.com.pl — *steelmaking and foundry pig iron, raw steel, hot rolled sheets, pipes, cast iron.*
- FERROSTAL Łabędy Sp. z o.o. w Gliwicach (FERROSTAL Łabędy Ltd. of Gliwice) ul. Zawadzkiego 47, 44–109 Gliwice, tel. +48 32 2347600, fax +48 32 2347650, www.ferrostal.com.pl — *raw steel, semi-finished hot rolled products, bars.*
- Huta “Ferrum” S.A. w Katowicach (“Ferrum” Steelworks Joint Stock Co. of Katowice) ul. Hutnicza 3, 40–241 Katowice, tel. +48 32 2555677, fax +48 32 2554150, www.ferrum .com.pl — *pipes.*
- Huta “Królewska” Sp. z o.o. w Chorzowie (“Królewska” Steelworks Ltd. of Chorzów) ul. Metalowców 13, 41–500 Chorzów, tel. +48 32 2412221, fax +48 32 2416821, www.hutakrolewska.pl — *hot rolled products, rails, bars.*
- “Arcelor Huta Warszawa” Sp. z o.o. w Warszawie (“Arcelor Huta Warszawa” Steelworks Ltd. of Warsaw) ul. Kasprowicza 132, 01–949 Warszawa, tel. +48 22 8350011, fax +48 22 8354222, www.arcelormittal.com/poland — *raw steel, special steels, hot rolled products, cold rolled strip.*
- Huta “Łabędy” S.A. w Gliwicach (“Łabędy” Steelworks Joint Stock Co. of Gliwice) ul. Zawadzkiego 45, 44–109 Gliwice, tel. +48 32 2347201, fax +48 32 2342141, www.hutalab.com.pl — *hot rolled products.*
- CELSA “Huta Ostrowiec” Sp. z o.o. w Ostrowcu Świętokrzyskim (CELSA “Huta Ostrowiec” Steelworks Ltd. of Ostrowiec Świętokrzyski) ul. Samsonowicza 2, 27–400 Ostrowiec Świętokrzyski, tel. +48 41 2492302, fax +48 41 2492222, www.celsaho. .com/po/zonapublica/index.aspx — *raw steel, rods, hot rolled products.*
- Huta “Pokój” S.A. w Rudzie Śląskiej (“Pokój” Steelworks Joint Stock Co. of Ruda Śląska) ul. Niedurnego 79, 41–709 Ruda Śląska, tel. +48 32 7721111, fax +48 32 2486709, www.hutapokoj.com.pl — *hot rolled products, rails.*

- Huta “Stalowa Wola” S.A. w Stalowej Woli (“Stalowa Wola” Steelworks Joint Stock Co.) ul. Kwiatkowskiego 1, 37–450 Stalowa Wola, tel. +48 15 8434111, fax +48 15 8435310, www.hsw.com.pl — *raw steel, hot rolled products, cold rolled sheet.*
- Huta “Zabrze” S.A. w Zabrzu (“Zabrze” Steelworks Joint Stock Co. of Zabrze) ul. Bytomska 1, 41–800 Zabrze, tel. +48 32 2713211, fax +48 32 2753505, www.huta-zabrze.com.pl — *raw steel, cast iron, cast steel.*
- CMC “Zawiercie” S.A. w Zawierciu (CMC “Zawiercie” Steelworks Joint Stock Co. of Zawiercie) ul. Piłsudskiego 82, 42–400 Zawiercie, tel. +48 32 6721621, fax +48 32 6722536, www.cmcpoland.com — *raw steel, hot rolled products, cast iron, cast steel.*

IRON OXIDE PIGMENTS

Overview

Iron oxide pigments are the most widely used kind of inorganic pigments. They are nontoxic, relatively low-cost, and have a wide range of applications, mainly as a **mineral colours** for the production of paints and varnishes, and for cements, bricks, roof tile, and mortars used in building construction, as well as for rubber, plastics, paper, glass, cosmetics, inks, and animal feed. **Natural iron oxide pigments** usually contain a few iron oxides, with one of them predominating, which determines the color of pigment, e.g. ***black*** — based on magnetite (Fe_3O_4); ***red*** — on hematite (Fe_2O_3); ***brownish*** and ***yellow*** pigments — on goethite (FeOOH). There are also some traditional names of natural pigments, known and used for centuries, for example: ***ocher***, ***sienna***, and ***umber***.

The scarcity of deposits of natural iron oxide pigments, as well as increased demand for high quality pigments, has resulted in the development of **synthetic iron oxide pigments** production, usually obtained from basic chemicals.

Sources

Occurrences of ***natural iron oxide pigments*** are known in the area of the Świętokrzyskie Mountains (e.g. **Dolina Kamienna** and **Baranów**), the Cracow-Silesia Monocline (**Jaroszowiec** near Klucze), the Sudety Mountains (**Kowary**, **Nowa Ruda**), and the Carpathian Mountains (**Janowice** and a recently discovered small deposit in **Czerwonki Hermanowskie** with resources ca. of 3,000 t). Moreover, in the Kielce region (**Końskie**) there are two recognized deposits of ***clays***, in which ***ochers*** form lenses, i.e. the **Buk** (reserves exhausted in 1976) and the **Baczyna** (undeveloped) with three varieties of ***ocher***, i.e. ***yellow***, ***red***, and ***brown*** of total reserves of 578,000 t (as of 31 December 2012).

As a source for the production of ***iron oxide pigments*** there are also utilized waste materials such as spent pickle liquor from steelmaking rich in iron salts, and waste Ferich residues from water purification. The huge potential source for iron oxides recovery is the waste dump of the **Police Chemical Plant**.

Production

Natural iron oxide pigments makes currently margin of production and almost entirely has been displaced by ***synthetic pigments*** obtained in course of synthesis of a variety of secondary materials. The characteristic feature of recent years is also production of iron oxide pigments based on natural components imported from China and India, being properly mixed and processed in the domestic plants. **ZPiF Ferrokolor Ltd.** of

Częstochowa is currently the sole manufacturer of ***natural iron oxide pigments*** (***yellow ocher*** with 8–10% of iron oxide contents). Small annual production of 50-60 tpy, based on ***ocher clays*** occurring in Kielce region, especially in **Końskie** and **Przysucha,** rose to 135 tpy in 2012. According to official production statistics, the supply of ***mineral pigments*** containing min. 70% Fe_2O_3 (**PKWiU 24121315**) has ranged between 1,000 t and 1,100 t until 2008. The level of ***synthetic iron oxides*** production recorded in position of ***iron oxides*** and ***hydroxides*** (**PKWiU 24121313**) is almost four times higher, but its supply decreased significantly in 2008 (Tab. 1). Since 2009, due to the change of PKWiU classification it is possible to present only the total production of pigments, both synthetic and mineral. Production of both was in fact included in the common item PKWiU 20.12.19.10. After a significant decline in their total production observed in 2009, the level of supply has exceeded 6,000 tpy since 2010 (Tab. 1). Most of the manufacturers for economic reasons, including the necessity of REACH registration, discontinued the synthesis of iron oxide pigments in the recent years. Instead of this syntesis they conduct only so-called standardization process, consisting of physical processes (mixing or grinding) of iron oxide powders without chemical modification.

Tab. 1. Iron oxide pigments statistics in Poland

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Year	2008	2009	2010	2011	2012
Synthetic pigments[1] **CN 2821 10, PKWiU 20.12.19.10**					
Production	4,223	4,006*	6,217*	6,161*	6,099*
Imports	15,185	13,683	17,828	19,437	17,936
Exports	4,369	2,606	4,049	3,370	3,943
Mineral iron oxide pigments[2] **CN 2821 20, PKWiU 20.12.19.10**					
Production	1,118	NA	NA	NA	NA
Imports	389	397	536	1055	899
Exports	40	10	4	12	4

[1] iron oxides and hydroxides [2] containing more then 70% Fe_2O_3

* production of both groups: synthetic and mineral iron oxide pigments registered together

Source: ***The Central Statistical Office (GUS)***

The most important producers of ***synthetic iron oxide pigments*** are the following:

- the **Ferrokolor** of **Częstochowa**, supplying mainly ***synthetic iron oxide pigments***, including ***blacks*** (over 55% of production), ***reds*** (21%), ***browns***, and ***ferrite yellow iron oxide*** (18%) in total amount over 3,500 t in 2011 and slightly lower 3,100 t in 2012, small amount of which (ca. 20%) is exported to Moldavia and Baltic states;
- the **Boruta-Zachem Kolor Ltd.** in **Bydgoszcz** (in **Ciech Joint Stock Company** structure), with production of recent years of 750–1,020 tpy, and with their significant reduction to 575 t in 2009; primarily of ***ferrite yellow iron oxide*** (38-48% of supply) and, in smaller quantities, ***synthetic blacks*** (16-31%), ***reds***, and ***browns*** for the domestic market and export. In 2010 due to economical reasons, the company discontinued the own synthesis, leading only the sales of pigments obtained by stan-

dardization of the finished ground powders of oxides of domestic origin (waste) or imported currently from Ukraine;

- **Nofar** in **Mroczków** near **Bliżyn** with production of 130–280 tpy synthetic iron oxides, including 60 t of ***red iron-BH*** – the only one pigment manufactured in company, while the other pigments of ***red, black, browns*** and ***yellows*** were obtained by a mixture of powders of the appropriate colors of waste oxides domestic origin or imported from China.
- **Permedia Chemical Enterprise** of **Lublin**, supplying a wide range of ***synthetic reds***, ***blacks***, ***browns***, and ***ferrite yellow iron oxide***, due to the economic reasons, ceased their synthesis in 2009, and offered to acquire only iron oxide pigments manufactured by simple mixing of finished products imported from China. The production volume in 2008, the last year when the synthesis was conducted, did not exceed 12 t. The level of pigments manufacture by mixing recorded in Central Statistical Office reached 200 t in 2011 and only 100 t in 2012.

The domestic demand has been satisfied by imports of both ***synthetic*** and ***natural pigments***. After the period of systematical decline to less then 14,000 t in 2009, their deliveries increased significantly to almost 19,500 t in 2011, what was justified by a significant development of construction projects in the same period (Tab. 1). Fluctuations in the level of purchases are directly related to the fluctuations in construction. ***Synthetic pigments*** (***iron oxides*** and ***hydroxides***) were purchased basically from Germany (65-75% of imports) and the Czech Republic, and most recently — from China, Denmark and Italy. Since 2011, the group of suppliers was supplemented by Spain, and the volume of purchases from this country accounted for more than 20% in 2011 and 32% in 2012. Periodically increased deliveries to China, especially in the group of oxides and hydroxides (60–77% of exports during last years), has a character of re-exports. The trade balance in all kinds of ***iron oxide pigments*** has been consistently negative (Tab. 2). The deep deficit in trade in all species of pigments, especially for synthetic pigments (Tab. 2), confirms the advantage of foreign materials on the Polish market, especially low-cost pigments from China and Ukraine.

Tab. 2. Value of trade in iron oxide pigments in Poland

‘000 PLN

Year	2008	2009	2010	2011	2012
Synthetic pigments[1] **CN 2821 10**					
Exports	18,148	11,993	19,251	16,682	19,858
Imports	44,765	51,892	57,606	65,635	63,804
Balance	**-26,617**	**-39,899**	**-38,355**	**-48,953**	**-43,946**
Mineral iron oxide pigments[2] **CN 2821 20**					
Exports	244	68	94	145	63
Imports	2,133	2,361	2,868	4,982	4,534
Balance	**-1,889**	**-2,293**	**-2,774**	**-4,837**	**-4,471**

[1] iron oxides and hydroxides [2] containing more then 70% Fe_2O_3

Source: ***The Central Statistical Office (GUS)***

The average unit values of imports of ***mineral iron oxide pigments*** showing increasing tendency in recent years dropped to 5,349 PLN/t in 2010. This decline was marked also in 2011 (4,721 PLN/t) and was associated with the appearance of Spain in the group of suppliers. Raw materials from this direction, imported in large quantities, had the lowest unit value of imports - less than 2,000 PLN/t. The unit values of imported ***iron oxides*** and ***hydroxides*** (***synthetic pigments***) had a similar tendency, except the years 2008 and 2010 when they dropped respectively to 2,948 PLN/t and 3,231 PLN/t (Tab. 3).

Tab. 3. The unit value of iron oxide pigments imports to Poland

Year	2008	2009	2010	2011	2012
Synthetic pigments[1] **CN 2821 10**					
PLN/t	2,948	3,793	3,231	3,377	3,557
USD/t	1,285	1,224	1,062	1,166	1,088
Mineral iron oxide pigments[2] **CN 2821 20**					
PLN/t	5,485	5,947	5,349	4,721	5,040
USD/t	2,351	1,849	1,769	1,650	1,545

[1] iron oxides and hydroxides [2] containing more then 70% Fe_2O_3

Source: ***The Central Statistical Office (GUS)***

Consumption

The consumption of ***iron oxide pigments*** is dominated by two branches: the paint and varnish industry, where they are principally used for anti-corrosive paints, and the building construction to manufacture color cements, concrete mix, mortars, plasters, roofing tiles, pitchers, joints, bricks, terrazzo, etc. They are also used as a colorant and filler in the production of plastics, ceramics, rubber, glass, leather, textile; as polisher in abrasives; and as powder for casting mould in the foundry engineering. ***Micaceous iron pigments***, due to their mica-like structure, are utilized in the production of high quality waterproof anti-corrosive coating, resistant to atmospheric oxygen, pollution, and UV radiation.

The level of apparent consumption of both natural and synthetic pigments is difficult to ascertain because significant part of domestic production is based on natural semi-products imported from China and India.

Companies involved in synthetic and natural iron oxide pigments production in Poland as of December 2012

- “Ferrokolor” Sp. z o.o. (“Ferrokolor” Ltd.), ul. Ks. Piotra Skargi 37/39, 42–209 Częstochowa, tel. +48 34 3604010, fax +48 34 3643280, www.ferrokolor.pl — *synthetic red, black, and brown iron oxide; synthetic ferrite yellow; natural ocher*.
- “Boruta-Zachem Kolor” Sp. z o.o. w Bydgoszczy (“Boruta-Zachem Kolor” Ltd. of Bydgoszcz), ul. Wojska Polskiego 65, 85–825 Bydgoszcz, tel. +48 52 3747100, fax +48 52 3610962, www.zachembarwniki.pl — *synthetic red, black, and brownish iron oxide pigments; synthetic ferrite yellow*.

- “Nofar” Co., Mroczków 4, 26–120 Bliżyn, tel./fax +48 41 2541019, www.nofar.pl — *synthetic red, brown and black iron oxide pigments*.
- Zakłady Chemiczne “Permedia” S.A. w Lublinie (“Permedia” Chemical Plant Joint Stock Company of Lublin), ul. Grenadierów 9, 20–331 Lublin, tel. +48 81 7441271, tel./fax +48 81 7440374, www.permedia.pl — *synthetic red, black, brown, and yellow iron oxide pigments*.

KAOLIN

Overview

Kaolin is a rock wealthy in ***kaolinite***, formed by the weathering of aluminosilicate rocks rich in feldspar and mica, e.g. granite, gneiss, or arkose. The amount of kaolinite in typical kaolin is 20–30% by weight.

Kaolin is applied as ***unprocessed*** raw material in the production of quartz-chamotte refractory materials, while in a ***processed*** form (***water washed***, ***calcined***, ***airfloat***, ***delaminated***) it is commonly used by the ceramic industry, especially for the production of porcelain tableware, and also for paper coating and filler applications, fiberglass production, in the paint and rubber industry, for petroleum cracking catalyst (***calcined kaolin***), etc.

Sources

Deposits of ***primary kaolin*** occur in Lower Silesia in the ***granite massifs*** of **Strzegom-Sobótka** and **Strzelin-Otmuchów**. They are not operated, though their total resources amount to 109.0 Mt. The source for kaolin recovery are deposits occurring in the **Bolesławiec Syncline** in Lower Silesia, especially the **Maria III** deposit (79.8 Mt of reserves) of ***kaolin sandstone*** containing about 22% kaolinite. Kaolin is also recovered from the **Dunino** deposit (previously classified as ***halloysite***) and from deposits of ***glass*** and ***foundry sand***, where kaolinite occurs as an accompanying mineral, i.e.: **Osiecznica II** in the **Bolesławiec Syncline**, as well as deposits in the **Tomaszów Syncline**: **Biała Góra** and **Grudzeń Las**. The total domestic resources of ***kaolin*** amounted to 212.9 Mt (as of 31 December 2012); however, the reserve base does not include kaolin in deposits of kaolinite-rich quartz sand.

Production

The domestic output of ***washed kaolin***, after significant drop to 125 kt in 2010, in the following year increased by 30% approaching 164 kt. This was a consequence of improved demand for kaolin in the ceramic industry, especially in the ceramic tiles and sanitaryware sectors, being its main consumers (Tab. 1). Last year, owing to reduced demand of the ceramic tile industry, the production declined by ca. 13%. The structure of domestic kaolin production has been overwhelmed by the ceramic grades, the share of which oscillated around 90% in the recent two years, while the proportion of paper grades was merely 3-4% (Tab. 2).

Tab. 1. Kaolin statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Kaolin sands					
Mining output[1]	318.0	261.0	238.0	285.2	249.1
Raw and washed kaolin CN 2507 00 20					
Production[2]	155.9	136.0	124.6	163.6	137.8
Imports	123.9	89.3	107.7	118.9	120.0
Exports	8.0	11.6	8.0	12.8	11.1
Consumption[a]	271.8	213.7	224.3	269.7	246.7

[1] the output from the **Maria III** the **Dunino** deposits

[2] includes kaolin obtained at the **Surmin-Kaolin** by processing of kaolin-containing waste material from the **Osiecznica** glass sand mine

Source: ***The Central Statistical Office (GUS), Mineral Resources Datafile, producer's data***

Tab. 2. Structure of kaolin production in Poland

'000 t

Year	2008	2009	2010	2011	2012
Total production	**155.9**	**136.0**	**124.6**	**163.6**	**137.8**
• ceramic grade[1]	136.1	124.0	112.3	150.2	122.7
— *for ceramic tiles[e]*	*110.0*	*105.0*	*93.0*	*125.0*	*105.0*
• paper grade[2]	9.7	5.4	5.0	4.8	5.3
• for rubber, paint, polymers etc.[3]	10.1	6.6	7.3	7.4	9.8

[1] production from **Surmin-Kaolin S.A.** (including fiber-glass and refractory grades), **Biała Góra**, and **Grudzeń Las**

[2] production only from **Surmin Kaolin S.A.**

[3] production from **Surmin-Kaolin S.A.**, and **Minerał Minerals Processing Plant Ltd.** (until 2008)

Source: ***Producers' data***

The domestic producers of kaolin have been the following:

- **Surmin-Kaolin Joint Stock Co.** of **Nowogrodziec**, supplying 70–87 ktpy of various kaolin grades obtained from its own **Maria III** deposit of kaolinite-rich sandstone, and from waste material of quartz sand processing at the **Osiecznica** mine (40-46 ktpy, except 2012 when it was 29 kt);
- **Grudzeń Las Ltd.** of **Sławno** near Opoczno — kaolin recovered in course of quartz sand washing from its own deposits: **Grudzeń Las** and **Piaskownica Zajączków Wschód** (total production of 42-60 ktpy);
- **Biała Góra Mineral Mines of Tomaszów Ltd.** of **Smardzewice** — kaolin recovered as a by-product of silica sand processing from its own deposits, i.e. **Biała Góra I** and **II Wschód**, and **Unewel Zachód** (total production 14-19 ktpy);
- **Minerał Minerals Processing Plant Ltd.** of **Krępsko** (until 2008) — kaolin recovered from raw material of the **Rusko-Jaroszów** refractory clay deposit, operated

by another company — the **Jaro S.A.**; the raw material (100–300 tpy) was utilised for specific applications (production of ***pesticides*** and in local ***foundries***);

- **Dunino Mine Ltd.**, operating the **Dunino** deposit of the kaolinite raw material (previously classified as halloysite) which has been utilised by the **Intermark**, Gliwice for the production of ***sorbents*** and ***geomats***. Other potential uses included: coagulants, feed additives, fertilizers, mineral pigments.

Among Polish producers, the largest and the only one offering both a wide range of high-purity washed ceramic grades and those for non-ceramic applications, is **Surmin-Kaolin S.A.** of Nowogrodziec. The main shareholder of the company's stocks is **Quarzwerke Group**. The recent **Surmin**'s share in the total domestic production has ranged between 53 and 55%. The company offers a broad assortment of ***kaolin grades***, including the ***ceramic*** — 76% of the total output in 2012, as well as ***glass fibre***, ***paper*** (***filler***), for the ***rubber***, ***paint***, and ***polymers*** industries.

The remaining Polish manufacturers provide kaolin, usually with relatively high content of colouring oxides (above 2% Fe_2O_3), only for the ceramics, e.g. for wall tiles, and to lesser extent — also sanitaryware and semi-vitreous chinaware. The majority of the output at the **Biała Góra Mineral Mines** of **Tomaszów** has been utilized for the production of ceramic tiles at the **Opoczno** and **Paradyż Group** plants. Also another producer of glass and foundry sand in the region, **Grudzeń Las**, offers the by-product kaolin suitable for the ceramic applications other than porcelain. Its principal customers have been the largest tile manufacturers in Poland: **Opoczno**, **Paradyż Group**, and **Tubądzin**. The main shareholder of the enterprise is **Atlas Co.**, the leading domestic producer of mortars for the building industry.

Trade

Most of ***kaolin*** offered by domestic producers has not met the requirements of the whiteware industry, due to relatively high content of Fe_2O_3. Therefore, the demand for higher purity grades has been met by importation. In 2012 the share of foreign kaolin in the domestic consumption approached 49%, while in 2009 it was 42% (due to significant drop in the importation of Ukrainian raw materials). The principal recipients of foreign kaolin in Poland were: the porcelain (tableware, electrical porcelain, and porcelain sanitaryware), and the paper industries. The tiles manufacturers have utilised basically the domestic raw material.

Tab. 3. Polish imports of kaolin, by country — CN 2507 00 20

'000 t

Year	2008	2009	2010	2011	2012
Imports	**123.9**	**89.3**	**107.7**	**118.9**	**120.0**
Austria	0.1	0.0	0.1	0.0	–
Belgium	–	–	0.5	0.3	0.0
China	–	–	–	–	0.5
Czech Republic	28.5	24.9	30.3	38.4	30.6
France	0.9	1.2	3.4	2.1	1.4
Germany	61.0	55.2	63.4	67.4	73.2
Italy	0.1	0.2	0.1	0.1	0.1

Spain	2.1	0.1	0.1	0.1	0.0
Ukraine	21.4	2.2	4.2	4.8	5.5
United Kingdom	6.7	3.5	4.2	4.4	7.0
USA	3.0	1.7	1.1	1.1	1.6
Others	0.1	0.3	0.3	0.2	0.1

Source: ***The Central Statistical Office (GUS)***

The major suppliers of ***washed kaolin*** were Germany (basically **Amberger Kaolinwerke**) — 61% of the total deliveries in 2012, and the Czech Republic (**Keramika Horni Briza** — a part of **Lasselsberger**, and **Sedlecky Kaolin**, **Kaolin Hlubany/WBB**) — 26%. Smaller quantities were supplied by the United Kingdom (**Imerys**).

The regular but rather small exportation of kaolin (8–13 ktpy) should be attributed to foreign sales of **Surmin-Kaolin** through the **Quarzwerke** commercial network, and probably re-exports of material of foreign origin (Tab. 1). The most regular export recipient was Germany, while the largest in 2012 - Slovakia. The ***kaolin*** trade balances have been always negative. In the last three years the deficit was aligned at around 48 million PLN (Tab. 4).

Tab. 4. Value of kaolin trade in Poland — CN 2507 00 20

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	1,895	3,183	2,555	3,673	3,573
Imports	40,914	36,322	50,447	51,830	51,703
Balance	**-39,019**	**-33,139**	**-47,892**	**-48,157**	**-48,130**

Source: ***The Central Statistical Office (GUS)***

The unit values of kaolin importation to Poland followed the quotations of ceramic and porcelain grades on the British market. Since 2010 they have decreased from 155 to 132 USD/t (Tab. 5). In 2012 the unit cost of importation from Ukraine amounted to 188 USD/t (while in 2008 it was 55 USD/t), from the Czech Republic – to 114 USD/t (a decrease from 193 USD/t in 2011), from Germany — to 106 USD/t, while the unit value of high-grade kaolin imported from the United Kingdom — to 280 USD/t (drop from 464 USD/t in 2011).

Tab. 5. The unit value of kaolin imports to Poland — CN 2507 00 20

Year	2008	2009	2010	2011	2012
PLN/t	330	407	468	436	431
USD/t	140	131	155	148	132

Source: ***The Central Statistical Office (GUS)***

Consumption

In 2012 the domestic demand for kaolin amounted to around 250 kt, i.e. 8.5% less than in the previous year (Tab. 1). The main consumer of kaolin in Poland has been the ceramic tile industry. Current tile capacities of domestic factories are estimated at 120-140 Mm^2py, and Poland has ranked the fourth largest producer of ceramic tiles in Europe.

The important consumers of kaolin have been also manufacturers of ***chinaware***, especially of ***porcelain tableware***. There were eight producers involved in this sector, with total capacities of about 40,000 tpy, among which the largest were: **Lubiana S.A.** near **Kościerzyna** (15,000 tpy), which together with **Porcelana Chodzież S.A.** and **Ćmielów Ltd.** was incorporated into one holding of combined capacity of 23,000 tpy, owned by private holder Mr. Marian Kwiecień. The remaining producers, manufacturing up to 6,000 tpy, were the following: **Karolina Ltd.** (6,000 tpy), **Wałbrzych S.A.** (in liquidation), **Krzysztof S.A.** (**Wawel** trade mark), and **Porcelana Śląska/Giesche** (until 2009, since then the porcelain goods have been manufactured in Bagladesh, but decorated in Poland and sold under Porcelana Śląska trade mark). In recent years the production of porcelain tableware has distinctly declined. That resulted from unfavourable exchange rates and a "flood" of imported ceramic goods from Asia (especially from China) that affected all the domestic manufacturers and forced them to reduce their production. The share of foreign sales in the total output decreased from over 80% to 72-73% in 2011-2012, respectively (Tab. 6). The most important recipients were western European countries, i.e. Germany, Italy, France, Spain, and the Netherlands. Small production and exports of ***electrical porcelain*** (by e.g. **Radpol Elektroporcelana** of **Ciechów**, **ZPE Zapel** of **Boguchwała, Argillon Polska Ltd.** of **Jedlina-Zdrój** – former **Zofiówka Electrical Porcelain Plant**) stabilized in resent years at ca. 8 and ca. 2 ktpy, respectively.

Tab. 6. Porcelain statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Tableware CN 6911 10–90, 6913 10					
Production	27.1	24.0	25.4	23.7	24.3
Imports	13.4	9.2	12.5	16.1	13.7
Exports	19.7	15.8	17.5	17.0	17.8
Consumption[a]	20.8	17.4	20.4	22.8	20.2
Sanitaryware CN 6910					
Production	111.4	89.1	93.8	93.3	83.7
Imports	24.1	18.6	20.2	19.6	18.0
Exports	85.2	59.3	67.6	70.3	67.0
Consumption[a]	50.3	48.4	46.4	42.6	34.7
Porcelain sanitary ware CN 6910 10					
Production	*52.5*	*38.8*	*36.0*	*38.9*	*30.1*
Imports	*7.8*	*5.7*	*4.7*	*4.4*	*4.9*
Exports	*36.6*	*15.6*	*28.6*	*28.4*	*24.8*
Consumption[a]	*23.7*	*28.9*	*12.1*	*14.9*	*10.2*
Electrical porcelain CN 6909 11, 8546 20					
Production	5.7	5.4	8.6	8.0	8.0
Imports	0.7	0.3	0.4	1.2	1.0
Exports	1.5	0.9	1.2	2.2	2.1
Consumption[a]	4.9	4.8	7.8	7.0	6.9

Source: ***The Central Statistical Office (GUS)***

In 2012 the production and exportation of ***sanitaryware*** decreased by about 10 kt as compared to the previous two years (Tab. 6). There were seven producers in the domestic market, among which the largest were: **Cersanit I Ltd.** of Krasnystaw (a part of publicly listed **Cersanit Group –** in 2012 it renamed for **Rovese Group**) — 3.5 million items per year, and **Sanitec Koło Ltd.** (belonging to the **Sanitec-Metra Group**) operating plants in Koło and Włocławek — total production capacity of 3.0 million items per year. The remaining smaller producers were the following: **Roca Polska** of Gliwice (1.3 million items per year), **Jopex** of Zabrze (in liquidation since 2009), **Ceramika Pilch** of Jasienica near Bielsko Biała, **Hybner** of Środa Wielkopolska, and **Deger Ceramika Ltd.** of Jezuicka Struga near Inowrocław. In 2012 the foreign sales of sanitaryware made 80% of the domestic output (66–81% in previous years). A significant contribution to the production and exporation of these goods has been usually made by ***porcelain sanitaryware*** (with the exception of 2009). The largest foreign recipients have been Ukraine, Germany, Russia, France, the Czech Republic, and Lithuania.

The remaining consumers, such as white cement and stoneware, had little contribution to the total kaolin demand in Poland. Relatively small consumption has been also reported by the paper industry, as the majority of domestic factories replaced ***kaolin*** by ***precipitated calcium carbonate*** (**International Paper** of Kwidzyn, **Frantschach** of Świecie, **Konstans** of Konstancin Jeziorna, and **Stora Enso Poland** of Ostrołęka – formerly **Intercell**). The consumption pattern of kaolin can be assumed as follows: ***ceramics*** and ***glass*** — ca. 85–90% (including production of ***tiles*** — 70-75%, ***porcelain tableware*** — 10–15%, ***sanitaryware*** — 10–15%, ***electrical porcelain*** and ***semi-vitreous chinaware*** — around 2% each), the ***papermaking*** — 5–7%, ***polymers*** and others — 7-8%.

Companies involved in kaolin production in Poland as of December 2012

- Kopalnie Surowców Mineralnych Surmin-Kaolin S.A. w Nowogrodźcu, (Surmin-Kaolin S.A. of Nowogrodziec), ul. Kaolinowa 35, 59–730 Nowogrodziec, tel. +48 75 7350044, fax +48 75 7350043, www.quarzwerke.com/surmin — *kaolin for ceramics, paper, rubber, polymers, and fiberglass applications*.
- Grudzeń Las Sp. z o.o. (Grudzeń-Las Ltd.), 26–332 Sławno near Opoczno, Grudzeń Las 28, tel. +48 44 7550910, tel./fax +48 44 7573234, www.grudzenlas.pl — *ceramic kaolin*.
- Tomaszowskie Kopalnie Surowców Mineralnych Biała Góra Sp. z o.o. (Biała Góra Mineral Raw Materials Mines of Tomaszów Ltd.), 97–213 Smardzewice, ul. Łozińskiego 6, tel. +48 44 7261801, fax +48 44 7245760, www.piasek.com.pl — *ceramic kaolin*.
- Kopalnia Dunino Sp. z o.o. (Dunino Mine Ltd.), Krotoszyce 9, 59–223 Krotoszyce, tel./fax +48 60 6906231, www.intermark.pl/haloizyt — *sorbents and geomats*.

LEAD

Overview

Lead (**Pb**) forms many minerals, but the main commercial one is ***galena***, which usually occurs together with ***sphalerite*** and other sulfide or carbonate minerals in many deposits. Galena concentrate is obtained from ***lead*** and ***zinc ore***, and to a lesser extent from ***silver*** and ***copper ore***, ***barite***, and others.

Another important source of **lead** is ***lead-bearing scrap and waste***, basically of spent lead-acid batteries. Despite environmental constraints, lead is considered a strategic metal in the world economy due to its numerous applications, e.g. in the production of batteries, ammunition, building construction materials, coverings for power and communications cables, alloys, and anticorrosive agents.

Sources

There are no individual deposits of ***lead ore*** in Poland of commercial importance. The primary sources of ***lead*** are ***zinc-lead ore*** deposits of Missisipi Valley type in the **Silesia-Cracow** region, with resources of 1.45 Mt Pb, 19% of which in operating mines (as of 31 December 2012), and ***copper ore*** deposits in the **Fore-Sudetic Monocline** with approximate resources of 1.6 Mt Pb (ca. 85% in deposits currently extracted).

An important secondary source of ***lead metal*** is ***lead-bearing scrap***, basically of lead-acid batteries, as well as of power cable coverings, lead alloys etc. The proportion of secondary lead in the total domestic supplies reached almost 70% in 2012. There are two domestic companies specialized in handling scrapped lead-acid batteries, i.e. **Orzeł Biały S.A.** of **Bytom**, and **Baterpol S.A.** of **Świętochłowice**, which combined processing capacities are estimated at ca. 170,000 tpy of spent lead-acid batteries. These plants have recycled 100% of used automotive batteries from the domestic market (the merger of both plants has been considered). Some quantities of scrapped batteries have been also imported. Taking into account the number of cars registered in Poland, by 2014 the quantity of lead-acid batteries scrap available in the market is estimated at around 130,000 tpy.

Lead Ores and Concentrates

Production

The mining output of ***lead*** in Zn-Pb ore has been on constant decrease in recent years. In 2012 it dropped to around 27 kt (Tab. 1). That basically resulted from the depletion of the ore extracted by the **Olkusz-Pomorzany** mine (from 1.62% in 2008 to 1.14% Pb in 2012) and the closure of the **Trzebionka** mine in the mid-2009. The sufficiency of reserves in the **Silesia-Cracow** region is estimated until 2016. Although there are some prospects for development of new reserves in this region, i.e. to the north and west of deposits currently operated (**Olkusz**, **Pomorzany**, and **Klucze I**). Furthermore, in 2011 the only Polish mine producer of lead - **ZGH Bolesław,** took over the **Gradir Montenegro** Zn-Pb-Ag ore mine in Montenegro and started exploration for zinc ores in Serbia. In 2011-2012 around 2,300 and 2,900 tpy of galena concentrates came from its foreign subsidiary. Currently, **ZGH Bolesław** is dominant company in a capital group, comprising 7 subsidiaries, including **HC Miasteczko Śląskie S.A.**, **Boloil S.A.**, **Bolesław Recycling Ltd.**, and **Gradir Montenegro d.o.o.**

Tab. 1. Lead ore and concentrates statistics in Poland — CN 2607

'000 t Pb

Year	2008	2009	2010	2011	2012
Mining output	87.7	80.4	60.2	53.1	89.0
— *from Zn-Pb deposits*	*66.4*	*51.5*	*35.3*	*28.2*	*26.6*
— *from Cu deposits*	*21.3*	*28.9*	*24.9*	*24.9*	*62.4*
Concentrates production	47.9	36.9	23.1	18.1	17.1
Imports[1]	0.4	0.8	2.3	2.5	2.2
Exports	49.0	38.8	21.5	17.2	37.0
Concentrates consumption[a]	-0.7	-1.1	3.9	3.4	-17.7

[1] excludes imports of collective concentrates to the **Miasteczko Śląskie** smelter — the official statistics give the importation of Zn-Pb and Zn concentrates together under a code of **CN 2608**

Source: ***The Central Statistical Office (GUS)***

Galena has been also extracted in association with ***copper ore*** from the deposits of the **Fore-Sudetic Monocline**. In 2012 the output of lead in run-off-mine exceeded 60 kt due to extraction of richer in Pb part of the deposit (Tab. 1). The lead percentage in particular types of copper-bearing rocks varied widely, from 0.01% in sandstone and 0.11% in limestone to 0.67% in shales (approaching 11.3% Pb locally in the **Lubin** mine). Neither ***galena concentrate*** nor ***mixed Cu-Pb concentrate*** are obtained in course of ***copper ore*** processing. Lead contained in ***copper concentrate*** (1.0–3.0% Pb) is recovered in a form of ***pig lead*** from various waste materials of metallurgical processes, particularly those accumulated in the process of furnace gases dedusting.

Galena concentrates have been exclusively obtained from ***Zn-Pb ore***. Over the last five years their domestic supply decreased by almost 65%, down to 17 kt last year (Tab. 1). In 2012 the concentrates were manufactured at the **Olkusz Processing Plant** of **ZGH Bolesław**. There were obtained: ***flotation concentrate*** of ***galena*** with around 61% Pb, and mixed ***zinc-lead concentrate*** graded at about 15% Pb and 33% Zn.

Trade

The most important lead concentrate traded is the ***galena*** one. Its total foreign sales were gradually decreasing, down to around 17 kt Pb in 2011, as **Trzebionka plant** reduced and finally stopped the production (Tab. 1). However in 2012 the exportation level more than doubled amounting 37 kt. From among lead concentrate recipients the most regular were China and – until 2011 – also Romania (Tab. 2). In 2012 Belgium emerged as the major customer. In the last couple of years some small quantities of galena concentrates were also imported - in 2010-2012 basically from the United Kingdom (Tab. 1). The trade statistics of ***lead concentrates*** exclude ***bulk Zn-Pb concentrates*** which are included in the statistics for ***sphalerite concentrates***. Until 2011 the values of trade balance have showed a decrease, while in 2012 the trade financial revenues rose by 27% as a result of the LME quotations improvement (Tab. 3). The unit value of concentrates exportation was reduced last year probably as a result of the growth of their foreign sales (Tab. 4).

Tab. 2. Polish exports of lead concentrates, by country — CN 2607

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Exports	**69.8**	**59.8**	**34.8**	**28.0**	**60.5**
Belgium	26.0	–	–	2.8	56.8
Bulgaria	–	9.9	11.1	3.0	–
China	19.1	35.4	16.7	15.7	3.7
Germany	9.2	8.0	–	1.5	–
Romania	15.5	6.5	7.0	5.0	–

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of lead concentrates trade in Poland — CN 2607

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	157,105	113,050	96,879	92,428	113,905
Imports	537	1,704	6,182	6,587	5,163
Balance	**+156,568**	**+111,346**	**+90,697**	**+85,841**	**+108,742**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. The unit value of lead concentrate exports from Poland — CN 2607

Year	2008	2009	2010	2011	2012
PLN/t	2,250	1,892	2,781	3,300	1,881
USD/t	960	594	916	1,118	577

Source: ***The Central Statistical Office (GUS)***

Pig Lead

Production

Pig lead (with 96–99% Pb) has been manufactured at the following plants: the **Miasteczko Śląskie Zinc Smelter** (mostly primary), the **Lead Plant** at the **Głogów Copper Smelter** (recovered from metallurgical waste), **Orzeł Biały**, **Baterpol**, and **ZAP Sznajder Batterien** (secondary). Over the last five years the total domestic ***pig lead*** supplies varied between 70 and 96 ktpy (Tab. 5).

Tab. 5. Pig lead production in Poland — CN 7801 99 10

'000 t Pb

Year	2008	2009	2010	2011	2012
Total pig lead	**75.2**	**69.6**	**71.7**	**96.6**	**86.3**
— primary	24.5	19.6	20.3	24.7	22.7
— recovered	23.7	24.1	22.0	30.0	30.0
— secondary	27.0	25.9	29.4	41.9	33.6

Source: ***Producers' data***

Substantial quantities of ***pig lead*** have been recovered from wastes of pyrometallurgical processing of copper concentrate at the **Lead Division** of **Głogów I Copper Smelter** of **KGHM Polska Miedź S.A.** The capacity of the smelter has been recently expanded to 30 ktpy of pig lead. The principal raw materials for its production have been ***lead-bearing converter dust*** (45–55% Pb) and ***electric furnace dust*** (32–44% Pb), as well as ***shaft slimes*** (38–50% Pb). Other waste materials, such as ***coarse shaft dust*** with 9–11% Pb, ***converter slag*** with 3–10% Pb, ***anode slime*** with 25–37% Pb, as well as ***waste slag*** from **Kaldo** furnace of **Głogów Smelter Precious Metals Plant** (65% Pb) have not been utilized. The technology utilized at the **HM Głogów I** involves one-stage melting in rotary and rocking Dörschel-type furnaces to recover 30–31% of lead contained in the concentrate. The material, which had been previously sent to the **Miasteczko Śląskie** for further treatment, since January 2007 has been processed in a new **Refining Department** at the **Legnica Smelter**.

Secondary pig lead obtained from scrapped lead-acid batteries at the **Orzeł Biały S.A.** has been entirely processed into ***refined lead*** and ***lead alloys***. The **Orzeł Biały** operates the installation for comprehensive lead-acid battery recycling (recovery of pure electrolyte H_2SO_4, polypropylene granulate and 99% of metal) of annual processing capacity of 100 kt of scrapped lead-acid batteries and lead-bearing wastes. Another domestic recycler — the **Baterpol Ltd.** operates an installation for recycling of scrapped lead-acid batteries licensed by the **Engitec Impianti** of Italy (processing capacity of 70 ktpy) in Świętochłowice and the **Refining Section** in Katowice-Szopienice. In 2011 another secondary pig lead producer debuted on the market – **ZAP Sznajder Batterien** of Piastów, being hitherto one of the domestic manufacturers of car batteries. Secondary lead obtained from scrapped lead-acid batteries is basically utilized for the production of new batteries, while electrolyte — for manufacturing of sodium sulfate for the chemical, glass, paper and textile industries.

Trade

Pig lead was traded on a limited scale as the majority of this material was domestically refined and processed into lead products (Tab. 9). Some amounts, of the order of ca. 1 ktpy in 2009, and only 10-50 tpy in the following years, were exported, principally to Germany. Negligible quantities were also occasionally imported. The trade balances, which in the years 2009–2010 were positive, in the last two years turned negative.

Refined Lead

Production

Refined lead was produced at the following plants:

- **HC Miasteczko Śląskie S.A. —** ***refined lead*** (recently 18-22 ktpy), registered at the London Metal Exchange as ***standard lead*** of **H.20MS** brand (99.97%), and other ***refined metal*** grades (ave. 99.9% Pb), e.g.: **Pb990** (99.99%), **Pb985R** (99.985%) and **STP06002** (with reduced contents of Ag and Bi); the production has based on ***pig lead*** obtained in-house and sometimes imported, and occasionally on some secondary materials (scraps, waste, oxides).
- **KGHM Polska Miedź S.A.**, **Lead Refinery** at the **Legnica Copper Smelter** of the capacity of 35 ktpy of ***refined lead*** — grade ***Pb985R*** and ***lead alloys*** (total production of 25-28 ktpy in 2011-2012); the raw materials utilised were: ***pig lead*** obtained in-house, and small amounts of lead scrap.
- **Refining Section** of **Baterpol S.A. —** ***refined lead*** in three grades **PB990R**, **PB970R**, **PB940R** with 99.99%, 99.97% and 99.94% Pb respectively, and various ***lead alloys*** (total production of around 36 ktpy in the last two years); the plant is sourced entirely from secondary sources, basically metallic fraction obtained in-house from recycled lead-acid batteries.
- **Orzeł Biały S.A. —** ***refined lead*** (99.97-99.99% Pb) - since 2010 brand registered under the name **EAGLE 9997**, and ***alloys*** (***Pb-Sb***, ***Pb-Ca, Pb-As***) from its own ***secondary pig lead***; in 2010 the plant's output exceeded 52 kt (growth from 46 kt in 2011), following the expansion and modernization of the pyrometallurgical section and developing of ***lead alloys*** manufacturing;
- **ZAP Sznajder Batterien S.**A. (since 2011) – ***secondary refined lead*** from scrapped lead-acid batteries.

The domestic ***refined lead*** production, after a contraction to 100 kt in 2009, in the following years significantly improved exceeding 140 kt in 2012 (Tab. 6). Its substantial percentage has come from secondary sources (especially from **Orzeł Biały S.A.**) and from the lead refining section at the **Legnica Copper Smelter**. That compensated reduced supplies from the **Miasteczko Ślaskie Zinc Smelter**.

Tab. 6. Refined lead statistics in Poland — CN 7801 10

'000 t Pb

Year	2008	2009	2010	2011	2012
Production	108.2	100.4	120.3	135.5	141.0
Imports	14.2	13.0	19.8	24.5	24.2
Exports	31.9	38.5	31.6	40.6	48.1
Consumption[a]	90.5	74.9	108.5	119.4	117.1

Source: ***The Central Statistical Office (GUS)****, producer's data*

Trade

Refined lead has been traditionally exported from Poland (31–48 ktpy). Recently the largest recipients have been the Czech Republic, and Germany (Tab. 7). The importation of lead that were reduced to 13-14 ktpy in the years 2008-2009, since 2010 has been increasing up to 24 ktpy in the last two years. The largest quantities have come from Sweden and Romania (Tab. 8). The increased foreign sales resulted in significant growth of the trade revenues that exceeded 150 million PLN in 2012 (Tab. 10). The unit values of both importation and exportation of ***refined lead*** followed the changes in its LME quotations (Tab. 11). It is worth mentioning that almost each year these values were higher than the respective average market prices. In 2011 they increased distinctly, owing to improvement of international lead prices quotations.

Tab. 7. Exports of refined lead from Poland, by country — CN 7801 10

'000 t Pb

Year	2008	2009	2010	2011	2012
Exports	**31.9**	**38.5**	**31.6**	**40.6**	**48.1**
Austria	6.8	9.1	1.4	2.2	0.7
Belgium	0.6	0.2	0.2	0.2	0.4
Czech Republic	10.8	15.6	17.2	21.8	22.1
Germany	10.5	4.4	3.7	4.7	11.1
Greece	–	–	–	0.7	0.2
Italy	1.7	–	1.2	4.3	5.6
India	–	0.7	0.5	–	–
Romania	–	2.4	2.4	2.5	2.0
Slovakia	–	–	–	–	0.6
Slovenia	–	–	2.1	1.8	1.4
Sri Lanka	–	0.5	–	–	–
Switzerland	0.2	0.2	0.3	0.3	0.3
Taiwan	–	0.5	–	–	–
Turkey	–	0.6	–	–	–
United Kingdom	0.3	3.3	1.9	2.0	3.2
Others	1.0	1.0	0.7	0.1	0.5

Source: ***The Central Statistical Office (GUS)***

Tab. 8. Imports of refined lead to Poland, by country — CN 7801 10

'000 t Pb

Year	2008	2009	2010	2011	2012
Imports	**14.2**	**13.0**	**19.8**	**24.5**	**24.2**
Belgium	–	–	0.6	0.3	0.4
Bosnia and Herzegovina	–	–	–	0.4	0.1
Bulgaria	–	–	0.4	1.5	0.6
Czech Republic	3.3	0.5	0.1	0.0	–
Estonia	0.3	–	0.3	0.7	1.0
Germany	0.1	0.6	1.9	4.1	4.7
Italy	–	–	0.8	–	–

Kazakhstan	0.8	0.1	0.1	0.4	–
Netherlands	–	–	–	–	1.7
Romania	6.6	3.0	3.3	5.4	6.0
Russia	0.2	0.9	2.4	3.2	0.3
Serbia	–	–	0.6	–	0.1
Sweden	2.2	4.1	7.2	7.5	8.3
Ukraine	0.4	3.5	1.9	0.2	–
United Kingdom	–	–	–	0.0	0.4
Others	0.3	0.3	0.2	0.8	0.6

Source: ***The Central Statistical Office (GUS)***

In the last five years the exportation of ***lead wastes and scrap*** varied from 950 to 1,500 tpy. Simultaneously, the importation of these commodities, after the rise to 7 kt in 2010, in the following two years were reduced to ca. 6 and 5 ktpy respectively. The resulting trade balances was negative, deepening to -30 million PLN due to much higher volume and costs of importation than foreign sales. Two other important export lead commodities are ***lead alloys*** and ***antimonial lead*** (Tab. 9). The sales of ***lead alloys*** rose considerably to almost 12 kt in 2011, while last year it dwindled by 55%. That was followed by reduced by 43% trade revenues (Tab. 10). The prevalence of importation over the sales of ***antimonial lead*** generated negative financial results of that commodity turnover. In the case of ***lead oxides***, despite significant fluctuations of both imports and exports, until 2011 their trade balances have been improving year by year. In 2012 their trade value decreased a lot due to a drop in the sales.

Tab. 9. Trade in selected lead commodities (other than refined lead) in Poland

t

Year	2008	2009	2010	2011	2012
Lead oxides (minium, massicot) CN 2824					
Imports	1,585	628	491	589	674
Exports	1,846	4,159	5,966	5,086	2,014
Nonrefined antimonial lead CN 7801 91					
Imports	10,728	10,523	18,635	19,536	16,955
Exports	4,066	5,081	5,132	6,187	8,509
Lead for refining with >0.02% Ag (pig lead) CN 7801 99 10					
Imports	0	0	0	320	168
Exports	0	967	10	47	24
Lead alloys CN 7801 99 90					
Imports	3,979	1,655	3,841	7,661	2,647
Exports	1,996	3,160	6,820	11,715	5,272
Lead wastes and scrap CN 7802 00					
Imports	2,371	2,276	7,164	6,365	5,306
Exports	960	1,517	1,506	947	1,277

Source: ***The Central Statistical Office (GUS)***

Tab. 10. Value of selected lead commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Lead oxides (minium, massicot) **CN 2824**					
Exports	11,693	24,394	34,646	40,625	15,716
Imports	8,512	3,872	4,558	5,439	5,850
Balance	**+3,181**	**+20,522**	**+30,088**	**+35,186**	**+9,866**
Refined lead **CN 7801 10**					
Exports	182,792	195,246	197,600	285,784	324,069
Imports	77,591	68,801	131,176	184,719	170,158
Balance	**+105,201**	**+126,445**	**+66,424**	**+101,065**	**+153,911**
Nonrefined antimonial lead **CN 7801 91**					
Exports	18,155	20,865	26,693	38,368	50,591
Imports	58,992	55,883	118,885	139,504	118,382
Balance	**-40,837**	**-35,018**	**-92,192**	**-101,136**	**-67,791**
Lead for refining with **> 0.02% Ag (pig lead)** **CN 7801 99 10**					
Exports	0	9,958	295	1,628	485
Imports	0	0	0	2,376	1,196
Balance	**0**	**+9,958**	**+295**	**-748**	**-711**
Lead alloys **CN 7801 99 90**					
Exports	10,776	19,677	47,760	90,950	38,681
Imports	26,093	12,228	25,535	57,234	19,553
Balance	**-15,317**	**+7,449**	**+22,225**	**+33,716**	**+19,128**
Lead wastes and scrap **CN 7802**					
Exports	4,867	6,163	7,355	4,792	7,095
Imports	11,058	9,850	35,099	35,372	37,840
Balance	**-6,191**	**-3,687**	**-27,744**	**-30,580**	**-30,745**

[1] the total for the **CN 7801 99**

Source: ***The Central Statistical Office (GUS)***

Tab. 11. The unit values in refined lead trade in Poland — CN 7801 10

Year	2008	2009	2010	2011	2012
Import unit value					
PLN/t	5,465	5,299	6,616	7,531	7,030
USD/t	2,327	1,755	2,202	2,567	2,155
Export unit value					
PLN/t	5,724	5,070	6,245	7,030	6,740
USD/t	2,481	1,647	2,086	2,404	2,060

Source: ***The Central Statistical Office (GUS)***

Consumption

In recent years the apparent consumption of ***refined lead*** in Poland has approached 120 ktpy which has been a significant increase as compared to 2008-2009. That was connected with the overpassing the crisis in the automotive industry, being one of the dominant lead end-user. In the last five years the production of lead-acid batteries in Poland usually has oscillated around 6 million units, except 2010 when it reached 7.7 million units. Other important applications, beside the production of lead-acid batteries, include: manufacturing of coverings for cables, shot, tubes and sheets (protection shields against ionizing radiation), and chemical compounds, i.e. ***minium*** (***red lead***), ***massicot*** (***litharge***), and ***battery powder***. ***Minium*** is utilized in manufacturing of anticorrosive paint, ceramic glazes, putties, and lead glass, while ***massicot*** — for the production of other lead compounds, e.g. solid solutions of lead zirconate and titanate which have piezoelectric properties. The domestic output of ***lead oxides***, including ***minium*** for glass (26-33% PbO_2) and batteries (25-33% PbO_2) as well as ***battery powder*** called ***Barton*** (65-82% PbO), has ranged from 7 to 10 ktpy. Its principal producer has been the **Oława Smelter S.A.** (since 2007/2008 a subsidiary of **Silesia Metallurgical Plant** in the **Impexmetal Group**) — one of the largest ***lead oxides*** manufacturer in Europe (around 7 ktpy in recent years). Relatively smaller quantities (around 3 ktpy) have been produced at the **Złoty Stok Lead Minium Plant** – also a subsidiary of **ZM Silesia**. One of the most important consumers of lead commodities was **Hutmen Wrocław**, manufacturing ***lead alloys*** and ***tin-lead solders*** and ***wire***. ***Lead alloys*** (***Sn-Pb*** and ***Pb-Sb***) have been also recovered from various tin-lead containing residues by the **Fenix Metals Ltd**. of Tarnobrzeg.

Companies involved in lead commodities production in Poland as of December 2012

- ZGH Bolesław S.A. (Bolesław Mining and Smelting Plant Joint Stock Co.), Kolejowa 37, 32–332 Bukowno, tel. +48 32 2955100, fax +48 32 2955000, www.zgh.com.pl — *Zn-Pb ore, galena and complex sphalerite-galena concentrates*.
- KGHM Polska Miedź S.A. w Lubinie (KGHM “Polska Miedź” Joint Stock Co.), Skłodowskiej-Curie 48, 59–301 Lubin, tel. +48 76 8478200, fax +48 76 8478500, www.kghm.pl — *Pb as an accompanying element in Cu ore run off mine, pig lead (primary), refined lead*.
- Huta Cynku Miasteczko Śląskie S.A. (Miasteczko Śląskie Zinc Smelter Joint Stock Co.), 42–610 Miasteczko Śląskie, Woźnicka 36, tel. +48 32 2888444, fax +48 32 2851885, www.hcm.com.pl — *pig lead (primary), refined lead*.
- Orzeł Biały S.A. (Orzeł Biały Joint Stock Co.), Siemanowicka 98, 41–902 Bytom, tel. +48 32 2813481, fax. +48 32 2813491, www.orzel-bialy.com.pl — *antimonial lead, refined lead (secondary)*.
- Baterpol S.A. (Baterpol Joint Stock Co.), Obrońców Westerplatte 108, 40–335 Katowice, tel. +48 32 7792000, fax +48 32 7792009, www.baterpol.pl — *pig lead (secondary), refined lead*.
- ZM Silesia S.A., Oddział Huta Oława, Oddział Złoty Stok (Metallurgical Plant Silesia Joint Stock Company, Oława Smelter Division, Zloty Stok Division), 55–200

Oława, Sikorskiego 7, tel. +48 71 3134031, fax +48 71 3134035, www.silesiasa.pl — *lead oxides*.

- ZAP Sznajder Batterien S.A., 05-820 Piastów, Warszawska 47, tel. +48 22 7237711, www.zap.pl – *secondary pig and refined lead*.

LIGNITE

Overview

Lower grades of coal, with a calorific value less than 24 MJ/kg, are classified as **brown coal**, which forms both small and huge deposits, mainly of Tertiary and late Mesozoic age. Brown coal is divided into **subbituminous coal** (hard form, with calorific value above 17.5 MJ/kg) and **lignite** (soft form, with calorific value below 17.5 MJ/kg). In many countries lignite is one of the most common and inexpensive sources of energy. It is usually consumed directly at nearby power stations. Exports or imports are now rare.

Sources

Deposits of ***lignite***, mainly of the Miocene age, occur in the central and western parts of Poland. The raw material has a low calorific value (7–11 MJ/kg), soft form, a low alkali content, and — in the majority of deposits — a low sulphur content (0.2–1.2% S in exploited deposits, 0.4–3.9% S in undeveloped deposits). The high moisture level (above 50%) and rather high ash content (4–12% in extracted deposits, 11–28% in undeveloped deposits) do not allow most of this lignite to be chemically processed.

The total recognized resources of the 90 deposits were 22,584 Mt (as of 31 December 2012). In 2011, their volume rose significantly (by ca. 3,000 Mt to 22,663 Mt) due to recognition of 5 new deposits (previously initially recognized) and actualization of reserves of deposits previously recognized. In 2012, level of resources was reduced mostly due to mining output. 10 deposits were developed, and their total reserves are 1,560 Mt, including 1,219 Mt of available reserves.

Production

Poland is now the world's eight largest producer of ***lignite***. In the period of 1990–2002 the production has slightly declining tendency, while in the years 2003–2005 it increased by 5.8% to ca. 61.6 Mt, in the years 2006–2010 declined by 7.1% to ca. 56.5 Mt, and in 2011–2012 dynamically increased by 13.8% to ca. 64.3 Mt (Tab. 1). Lignite's share in the structure of primary energy in Poland amounted to ca. 18%.

Lignite is extracted in four large mines (**Bełchatów**, **Turów**, **Konin**, and **Adamów**), and one small mine (**Sieniawa**). The largest mine is **Bełchatów** with two open-pits: **Bełchatów** and **Szczerców**, and total annual capacity of ca. 42 Mt (output 40.2 Mt in 2012). New large **Szczerców** open-pit started in 2009, and in 2011-2012 its production increased to 11-14 Mtpy. The deposit has total reserves ca. 844 Mt and available reserves ca. 589 Mt. **Szczerców** open-pit should achieve maximal capacity of ca. 38 Mtpy in 2013. It will gradually replace **Bełchatów** open-pit (planned reserves exhaustion in

Tab. 1. Lignite statistics in Poland — CN 2702 10

'000 t

Year	2008	2009	2010	2011	2012
Production	59,668	57,108	56,510	62,841	64,280
Exports	1	68	115	145	134
Stocks change	36	-14	-174	63	138
Consumption	59,631	57,084	56,569	62,633	64,008

Source: ***The Central Statistical Office (GUS)***

2019). The **Turów** mine extracting **Turów** deposit, located close to the Czech and German borders in the extreme southwest corner of Poland, has an annual output capacity of ca. 11 Mtpy. However, the output fell to 10.3–12.1 Mtpy in the last years. The **Konin** mine has an annual capacity of ca. 11 Mt (10.1 Mt in 2012) and now operates 3 open-pits: **Drzewce**, **Pątnów IV**, and **Tomisławice** (commenced in 2011 instead of closed **Pątnów III** open-pit). There are also a few satellite deposits, which are planned for future exploitation. The **Adamów** mine has an annual output of 3.5–4.5 Mt (3.6 Mt in 2012), and now has 3 open-pits in operation (**Adamów**, **Koźmin**, and **Władysławów**) and a few small satellite deposits. Since 2000, all large lignite mines are joint stock companies of the State Treasury, while in 2002 a new small private company — **Sieniawa Lignite Mine Ltd.** — was established (output 0.07 Mt in 2012).

After significant organization and ownership changes in the Polish power industry in the years 2002-2009, in 2010 significant structural changes occurred in the dominant company on the Polish lignite market - **Polish Power Group Capital Group (Grupa Kapitałowa Polska Grupa Energetyczna S.A. - PGE S.A.**). 13 joint stock companies were consolidated into one company **- PGE Mining and Conventional Power Industry (PGE Górnictwo i Energetyka Konwencjonalna S.A.**). **Bełchatów** and **Turów** mines, and adjacent **Bełchatów** and **Turów** power plants started to be dependent units of this company. In July 2012 **Zespół Elektrowni Pątnów-Adamów-Konin S.A.** (**ZE PAK S**.A.), which controls four power plants: **Pątnów**, **Pątnów II**, **Konin** and **Adamów**, bought **Konin** and **Adamów** lignite mines from the State Treasury. Lignite for Pątnów, Pątnów II and Konin power plants is delivered by Konin lignite mine, while for Adamów power plant by Adamów lignite mine. **Sieniawa** lignite mine remains the only independent domestic lignite mine.

Trade

Until 1995 greater amounts of ***lignite*** were exported, mainly by belt conveyors from the **Turów** mine located in the vicinity of German power stations. However, these exports were gradually decreasing to zero in 2007. However, in 2008 ca. 1,000 t were exported to Germany, Hungary, and the Czech Republic, while in 2009–2012 exports rose to ca. 133,530 t, with the Czech Republic as the main recipient with smaller amounts sold to Austria, Germany, Hungary and Slovakia (Tab. 2). In the years 2008–2012, the Central Statistical Office reported ***lignite*** imports in item **CN 2702 10** (ca. 19,900, 30,140, 24,880, 76,480, and 147,260 t respectively). High unit value of these imports (Tab. 4) suggest, that probably there were ***lignite briquettes***, not ***lignite***. So, ***lignite briquettes*** were imported from the Czech Republic and Germany, in total amounts of ca. 27,900 t in 2008, ca. 37,300 t in 2009, ca. 50,100 t in 2010, ca. 92,800 t in 2011, and ca. 186,900 t in 2012.

Tab. 2. Polish exports of lignite, by country — CN 2702 10

'000 t

Year	2008	2009	2010	2011	2012
Exports	**1.0**	**68.3**	**115.2**	**144.6**	**133.5**
Austria	–	0.8	0.5	0.9	0.7
Czech Republic	0.1	62.6	110.6	141.9	131.4
Germany	0.5	0.5	3.1	0.1	0.0
Hungary	0.4	4.2	0.9	1.6	0.4
Slovakia	–	0.1	0.0	0.1	1.0
Others	0.1	–	–	–	–

Source: ***The Central Statistical Office (GUS)***

Trade balance in ***lignite*** and ***lignite briquettes*** were positive until 2006. In 2006–2008, imports of expensive ***lignite briquettes*** resulted in trade deficit at ca. 9.2 million PLN, but in 2009–2010 - due to lignite exports increase - trade deficit was reduced to 7.8 million PLN. In the years 2011-2012 increasing imports of expensive ***lignite briquettes*** resulted in deficit deepening to 56.8 million PLN (Tabs. 3, 4).

Tab. 3. Value of lignite and lignite briquettes trade in Poland — CN 2702

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	111	7,091	12,816	17,513	16,400
Imports	9,264	15,522	20,568	36,476	73,150
Balance	**-9,153**	**-8,431**	**-7,752**	**-18,963**	**-56,750**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of lignite trade in Poland

Year	2008	2009	2010	2011	2012
Lignite CN 2702 10					
Exports unit values					
— PLN/t	109.6	103.6	106.2	111.4	122.8
— USD/t	36.3	34.9	36.2	36.8	37.7
Imports unit values					
— PLN/t	350.5	430.3	526.9	412.5	428.4
— USD/t	146.7	139.6	174.8	137.9	131.3
Lignite briquettes CN 2702 20					
Imports unit values					
— PLN/t	284.8	356.1	295.7	301.5	253.6
— USD/t	103.7	121.4	99.7	101.0	76.4

Source: ***The Central Statistical Office (GUS)***

Consumption

Almost all ***lignite*** is consumed in Poland by the energy sector (Tab. 5), so the level of production is dependent on domestic electricity demand. Level of consumption depends on the capacities of the nearby power plants — **Bełchatów**, **Turów**, **Pątnów**,

Pątnów II, **Adamów**, and **Konin** — and their utilization. In 2011, in Bełchatów power plant a new 858 MW power unit was commenced. Total capacities of Polish power plants based on lignite rose from 9.1 GW to 9.9 GW. Lignite had a 12% share in the total domestic ***primary energy*** consumption, and accounted for 33% of ***electric energy*** production in 2012. Electricity generated from lignite is the cheapest type of energy in Poland.

Tab. 5. Structure of lignite consumption in Poland — CN 2702 10

'000 t

Year	2008	2009	2010	2011	2012
Consumption	**59,631**	**57,054**	**56,569**	**62,633**	**64,008**
Energy transformation	58,646	56,059	55,732	61,800	63,334
Direct consumption	725	901	1,020	909	822
Balance losses and differences	260	94	-183	-76	-148

Source: ***The Central Statistical Office (GUS)***

Less than 1.0% of lignite is consumed as a fuel by small industry and households. Marginal amounts are used as a ***fertilizer***. In 2001, the only domestic ***briquette*** plant **Marantów** of **Konin Lignite Mine** (with a capacity of 160,000 tpy) was closed. It delivered 21,400 t of ***lignite briquettes*** in 2000. It is probable, that some small installation for lignite briquetting is producing such briquettes or products qualified as lignite briquettes.

Companies involved in lignite production in Poland as of December 2012

- PGE Górnictwo i Energetyka Konwencjonalna (PGE GiEK) S.A. – Oddział Kopalnia Węgla Brunatnego Bełchatów w Rogowcu (PGE Mining and Conventional Power Industry Joint Stock Co. – Bełchatów Lignite Mine Unit of Rogowiec), Rogowiec, ul. Św. Barbary 3, 97–400 Bełchatów, P.O. Box nr 100; tel. +48 44 7373000, 7374000, fax +48 44 7373456; www.kwbbelchatow.pgegiek.pl — *lignite*.
- PGE Górnictwo i Energetyka Konwencjonalna (PGE GiEK) S.A. – Oddział Kopalnia Węgla Brunatnego Turów w Bogatyni (PGE Mining and Conventional Power Industry Joint Stock Co. – Turów Lignite Mine Unit of Bogatynia), ul. Górników Turowa 1, 59–916 Bogatynia 3; tel. +48 75 7735300, 7735200, fax +48 75 7733000; www.kwbturow.pgegiek.pl — *lignite*.
- PAK Kopalnia Węgla Brunatnego "Konin" S.A. w Kleczewie (PAK "Konin" Lignite Mine Joint Stock Co. of Kleczew), ul. 600 Lecia 9, 62–540 Kleczew; tel. +48 63 2476000, fax +48 63 2476514; www.kwbkonin.pl — *lignite*.
- PAK Kopalnia Węgla Brunatnego "Adamów" S.A. w Turku (PAK "Adamów" Lignite Mine Joint Stock Co. of Turek), ul. Uniejowska 9, 62–700 Turek; tel. +48 63 2787302, fax +48 63 2785109; www.kwbadamow.com.pl — *lignite*.
- Kopalnia Węgla Brunatnego "Sieniawa" Sp. z o.o. w Sieniawie ("Sieniawa" Lignite Mine Ltd. of Sieniawa), Os. Górnicze 11A, 66–220 Łagów, Sieniawa Lubuska; tel./fax +48 68 3412022, www.sieniawa.com — *lignite*.

LIMESTONE AND LIME

Overview

Limestone is sedimentary rock, containing mainly ***calcite*** $CaCO_3$, isomorphous with magnesite $MgCO_3$, ***siderite*** $FeCO_3$ and other ***anhydrous carbonates***. That is why limestone often contains admixtures of Mg, Fe, etc. **Limestone** is of ***organic origin***, formed in a maritime environment (concentrations of calcite in the skeletons of living organisms) or, rarely, of ***chemical origin*** (precipitated calcium carbonate, e.g. **travertine**). Only a few types are of land origin, of which the most important is **limestone** of ***lake origin***; sometimes called **"lake chalk"** (***Seekreide***). In limestone, calcite is accompanied by clay minerals, quartz, and other minerals. When the proportion of clay minerals amounts to 5–20%, the rock is called **marly limestone**. Limestone containing more clay minerals is known as **marl**, or even **clay marl**. Similarly, the transition types between limestone and organogenic siliceous rock types are **gaizes**, whereas the transition types between limestone and sandstone are **sandy limestone** and **calcareous sandstone**. Very often limestone contains admixtures of ***dolomite*** $CaMg[CO_3]_2$ in mixed rock: thus there is **dolomitic limestone** and **limestone dolomite**. **Chalk** is a special variety of limestone rock, due both to its genesis and to its properties and utilization. In conditions of high pressure and high temperature, limestone re-crystallizes into **marble**. Other limestones, re-crystallized at lower temperatures, increased their compactness and mechanical strength as geologic time elapsed; they are also called **"marbles,"** and are used as dimension stones.

One of the most important derivatives of limestone, apart from **cement**, is **lime**, generally obtained by burning relatively pure limestone. It is one of the oldest binding materials used in residential construction. **Lime** is a generic name for a variety of products used also as a raw material in metallurgy and chemistry, and in other industries, such as paper-making and sugar-making. The most important varieties are **burnt lime** in lumps or milled, **slack lime** (**lime putty**), **hydrated lime**, and **hydraulic lime**. Various grades of **ground limestone** (**ground calcium carbonate**) are the other important group of limestone products. The most important are: **grade for bituminous mixes**, **grade for glass & ceramics**, **sorbent for flue gas desulfurization**, **explosion-proof grade**, **fodder chalk**, **technical chalk**. The lime industry also offers **limestone** (**carbonate**) and **lime** (**oxide**) **fertilizers**, made of waste fine fraction, and sometimes **crushed aggregates**. Some plants produce significant amounts of **limestone for sale**, used in metallurgy as **flux** in blast furnaces, or by sugar plants to make **burnt lime** for the sugar production process. **Limestone** and **lime fertilizers** are produced by milling limestone or lime, respectively. They are also obtained from ***limestone of lake origin***, ***soda waste***, ***sulfur cake***, ***cellulose waste***, and other sources.

Sources

Poland has numerous deposits of ***limestone rock***, except for the most valuable ***sculpture*** and ***architectonic marbles***. The reserves of limestone are divided, according to their applications, into ***limestone for the lime industry***, ***limestone*** and ***marl for the cement industry***, ***crushed*** and ***dimension limestones***, and ***limestone of lake origin*** (***"lake chalk"***).

Deposits of ***limestone for the lime industry*** occur mainly in the Świętokrzyskie voivodeship (60% of the total resources), and Łódzkie, Opolskie and Śląskie voivodeships (10–11% each). At the end of 2012, the total resources of 117 deposits amounted to 5,647 Mt. The total resources of 71 deposits of ***limestone*** and ***marl for the cement industry*** amounted to 12,793 Mt (see: **CEMENT**).

Approximately 90% of the reserves of ***crushed*** and ***dimension limestone*** are concentrated in the Świętokrzyskie voivodeship. Many deposits of limestone of this grade are located in the Silesia-Cracow region, and a few also in the Carpathians, Lower Silesia (marbles), the Lublin Plateau, and elsewhere. In 2012, the total resources of ***construction*** and ***building limestone*** amounted to 1,913 Mt, in 142 recognized deposits, but in 8 of them limestone occurs together with dolomite, whereas the resources of ***marbles*** were 53.5 Mt in 11 deposits. ***Calcite***, a related mineral, is competitive to the purest grades of limestone, but its resources in the four undeveloped deposits near Kielce are only 0.29 Mt (as of 31 December 2012).

Deposits of ***limestone of lake origin*** (***"lake chalk"***) occur in the northern part of Poland (Zachodniopomorskie, Pomorskie, and Warmińsko-Mazurskie voivodeships). In 2012, the resources of ***"lake chalk"*** were 162 Mt in 172 recognized deposits.

There are only limited ***secondary sources*** of raw materials for the production of lime products. In the construction industry, ***carbide residue*** (at least 65% CaO+MgO in dry mass) is obtained during the production of acetylene. Larger amounts of ***soda waste***, ***sulfur cake***, and ***cellulose waste*** are used in the production of ***carbonate fertilizers***.

Production

Limestones of different types and quality in 2012 were mined in 68 mines, including 16 mines of limestone (or marl) for the cement industry, 16 mines of limestone for the lime industry, 2 mines of limestone for cement & lime industry, 36 mines of limestones (or marble) for crushed aggregates and dimension stone, and one mine of "lake chalk" A lot of open pits of "lake chalk," previously extracted, are not exploited currently due to unprofitability of limestone fertilizers production (Tab. 1). Due to the significant increase of demand for building materials, stimulated by utilisation of EU funds in the construction sector (mainly road construction) and implementation of investments connected with EURO 2012, considerable growth of limestone mining output was recorded during last years, reaching 69.6 Mt in 2011 (Tab. 1). In 2012 their total mining output dropped significantly to ca. 56.9 Mt. The largest decrease (over 23%) was recorded in a group of ***limestone for the lime industry*** and the ***crushed*** and ***dimension limestone***, the smallest - in the case of ***limestone for the cement industry*** (only 11%, Tab. 1).

Limestone is used in the production of ***cement*** (see: **CEMENT**), ***lime*** and ***limestone products***, ***limestone crushed aggregates***, ***dimension stone***, and ***fertilizers***. Lime and limestone products are manufactured by over a dozen plants, which in majority were privatised with the participation of foreign investors. Lime products are currently produced in six plants belonging to two international concerns:

Tab. 1. Limestone statistics in Poland — CN 2521

'000 t

Year	2008	2009	2010	2011	2012
Mining output	**46,888**	**43,764**	**53,116**	**69,632**	**56,906**
— *limestone for the cement industry*	*22,301*	*20,278*	*22,431*	*27,303*	*24,322*
— *limestone for the lime industry*	*16,110*	*14,881*	*17,588*	*21,703*	*16,728*
— *limestone for crushed aggregates and fertilizers*	*8,426*	*8,560*	*13,080*	*20,610*	*15,840*
— *lake limestone for fertilizers*	*51*	*45*	*17*	*16*	*16*
Production, recorded	**32,958**	**29,821**	**33,235**	**40,977**	**38,211**
— *limestone for sale*	*12,844*	*12,316*	*14,882*	*19,799*	*18,960*
Imports	**53**	**52**	**40**	**77**	**168**
Exports	**399**	**224**	**150**	**387**	**414**
Consumption[a]	**32,612**	**29,649**	**33,125**	**40,667**	**37,965**

Source: ***The Central Statistical Office (GUS), Minerals Resources Datafile***

- four plants of Belgian group **Lhoist** — three production units situated in: **Tarnów Opolski**, **Górażdże** and **Wojcieszów** included in the **Lhoist Lime Plant Joint Stock Company** (in July 2011) and one separate big plant: **Lhoist Bukowa**, with total estimated production of 900,000–1,100,000 tpy;
- two large plants in Bielawy and Sitkówka, both belonging to Irish concern **CRH**, jointed to one company **ZPW "Trzuskawica" S.A.**, with production level of almost 600,000–700,000 tpy.

Unburnt limestone products in very wide assortment: from limestones for sale, limestones fertilizers, limestones aggregate, to ground limestone, ground calcium carbonate, fodder chalk, sorbent for desulfurization, and others — are produced in Sitkówka plant (in structure of **ZPW "Trzuskawica" S.A.**), all plants of **"Lhoist"** concern, and moreover in **"Czatkowice" Limestone Mine Ltd.** (with production level of over 2 Mtpy); **Nordkalk** — exploiting the deposits: **Ostrówka** and **Ołowianka**, **Chęciny-Wolica**, and **Owadów Brzezinka**; **Labtar**, **Road Materials Quarries** of **Kielce**, **Piotrowice**, **Minerał** of **Wałcz**, **APG** of **Sokołów,** and recently also **GiGa Ltd**. of **Płaza**.

Limestone for sale is also delivered in significant amounts by some limestone aggregates producers, e.g. **Road Materials Quarries** of **Kielce**, **Morawica Limestone Mine** and a few smaller producers in the Kielce area. The share of suppliers from the Świętokrzyskie voivodeship exceeded 40% of the total supply of this limestone product. Total deliveries of ***limestone for sale*** after a period of stabilization at around 12.3-12.8 Mtpy in 2008-2009, increased significantly to 19.8 Mt in 2011. Despite a slight decrease of 4% of their sales in 2012, the supply remained within the limits of almost 19 Mt (Tab. 1), mainly due to the increasing demand of steelworks and non-ferrous metals industry. Apart from the metallurgical branch it is mainly sold to companies in the sugar-making and the chemical industries.

Lime production after a clear drop to just over 1.7 Mt in 2009, began to rebuild in the next years, slightly in 2010 and strongly in 2011, reaching a level of more than 2.0 Mt (Tab. 2). As in the case of limestone, decline of lime production was also noticed in 2012, but its production reached almost the same level as in 2010 (Tab. 2). The structure of lime production is dominated by ***burnt lime***, which account for about 85% of total production and the level of its production was related to changes in economic conditions in the construction sector. Production of ***hydrated lime*** in recent years has become a declining trend, and ***hydraulic lime*** makes a fraction of a percent of the total production (0.1%, Tab. 2). About 84% of its production originated from the lime plants listed above (mostly the plant from Świętokrzyskie voivodeship – almost 56% in 2012), the rest from the lime units at the **Arcelor Mittal Poland** steelworks in Kraków and Dąbrowa Górnicza, and the sugar-making industry, mainly in Mazowieckie, Wielkopolskie, Lubelskie, Podkarpackie, Podlaskie and Pomorskie voivodeships. The share of sugar-making industry in the lime production is now below 1% due to EU regulations dictated by reducing sugar production in Poland.

Tab. 2. Lime statistics in Poland — CN 2522

'000 t

Year	2008	2009	2010	2011	2012
Production	1,951.6	1,715.9	1,798.9	2036.3	1798.8
— *burnt lime*	*1,429.7*	*1,229.0*	*1,392.4*	*1,738.7*	*1,517.1*
— *hydrated and other lime*	*502.7*	*472.5*	*404.4*	*294.9*	*279.3*
Imports	107.1	54.8	58.8	100.3	61.2
Exports	12.8	37.0	88.3	98.1	93.7
Consumption[a]	2,045.9	1,733.6	1,769.4	2,038.5	1,766.3

Source: ***The Central Statistical Office (GUS)***

Burnt lime in lumps for sale makes about 25–35% of total burnt lime supply and is delivered mainly from **Trzuskawica**, **Lhoist Tarnów Opolski**, **Lhoist Bukowa**, and **Lhoist Górażdże**. The rest of burnt lime is sold in the form of ***ground burnt lime***, coming entirely from four plants: **Trzuskawica (Sitkówka and Bielway plants)**, **Lhoist Bukowa**, and **Lhoist Tarnów Opolski**. The production of ***hydrated lime*** and ***other grades of lime*** (***dolomitic***, ***hydraulic***) delivered mainly from the plants: **Trzuskawica (Sitkówka and Bielway plants)**, **Lhoist Górażdże**, **Lhoist Bukowa**, **Lhoist Tarnów Opolski**, **Wojcieszów** - has dramatically decreased in recent years and in 2012 was 44% less than in 2008 (Tab. 2). Various grades of ***ground limestone*** (***ground calcium carbonate***) are the important group of limestone products. Their combined production rose probably even to over 3 Mtpy. They are manufactured at the following plants:

- ***sorbent for flue gas desulfurization*** at **Lhoist Tarnów Opolski**, **Lhoist Bukowa**, **Trzuskawica**, **Czatkowice**, **Nordkalk**, and **Płaza**;
- ***grades for bituminous mixes*** at **Trzuskawica**, **Lhoist Tarnów Opolski**, **Lhoist Bukowa**, **Płaza**, **Lhoist Górażdże**, **Nordkalk**, and **Road Materials Quarries** of **Kielce**;
- ***grades for glass & ceramic*** at **Trzuskawica**, **Lhoist Bukowa**, **Omya**, and **Nordkalk**;
- ***explosion-proof grade*** for hard coal mines at **Labtar**, **Lhoist Bukowa**, and **Road Materials Quarries** of **Kielce**;
- ***fodder chalk*** at **Lhoist Tarnów Opolski**, **Lhoist Bukowa**, **Labtar**, **Warta Cement Plant**, and **Minerał** of **Wałcz**;
- ***technical chalk*** at **Trzuskawica**, **Piotrowice**, **Lhoist Bukowa**, and **APG Sokołów**.

Limestone crushed aggregates are produced by aggregates manufacturers, as well as by some lime plants. The fine fraction after crushed aggregates production is often used to produce ***calcium carbonate fertilizers***. Most of them come from the Świętokrzyskie Mountains, mainly from large producers such as: the **Morawica Limestone Mine**, exploiting the **Morawica** deposit; the **Trzuskawica Lime Works**; **Dolomite Quarries** of **Sandomierz**, extracting limestone from the **Budy** and **Wymysłów** deposits; the **Road Materials Quarries** of **Kielce**, extracting the **Górki Szczukowskie**, **Głuchowiec**, **Józefka**, and **Kostomłoty** deposits; the **Mineral Mines** of **Kielce**, mining the **Jaźwica** dolomite and limestone deposit; **Granit Quarry of Kamienna Góra Ltd.**, operating the **Celiny I** deposit; **Surowce Mineralne** of **Kielce**, mining the **Ptasznik**, **Gnieździska-Góra Maćkowa**, and **Drugnia-Rządowa** deposits. Limestone aggregates are also produced in a few smaller quarries, in the Silesia-Cracow region (e.g. **Kosbud Ltd.** mining the **Leszna Górna** deposit), and in other regions of the country.

Limestone dimension elements (***blocks***, ***slabs***) are also produced basing on the output from the deposits of limestone and related rocks for building and road construction. Structure of their production and the major suppliers has been discussed in a separate chapter (see: **STONE, DIMENSION**).

Lime (***oxide***) and ***limestone*** (***carbonate***) ***fertilizers*** are produced from waste limestone by lime plants and cement-lime plants, and by manufacturers of aggregates. The majority of their production (carbonate fertilizers only) is obtained from ***limestone of lake origin*** (***"lake chalk"***) extracted by private producers in the northern part of Poland. Their extraction, carried out still in 2009 from four deposits in Zachodniopomorskie, Warmińsko-Mazurskie and Wielkopolskie voivodeships, was systematically decreasing. Since 2010 only one Lubiatowo III deposit in the Zachodniopomorskie voivodeship has been exploited. The total production of limestone fertilizers registered by Central Statistical Office since 2009 was included into position PKWiU 08.11.00000101 ***Mineral agents for agricultural lime (oxide and carbonate)*** and probably fertilizers made a majority of this group. The volume of their production in period of 2009-2012, except for 2010, ranged between 450,000-505,000 t CaO per year (i.e. 1,020,700-1,157,000 t gross weight). However, real calcium fertilizers production could bee a little higher than reported by the **Central Statistical Office**, because not all small producers are obliged to report it.

Trade

Among all lime products — ***burnt lime*** was traditionally mainly exported, although in 2008 ***hydrated lime*** predominated in the exports structure, coming mainly from the **Lhoist Bukowa** and **Lhoist Tarnów Opolski** plants, with a smaller contribution of **Lhoist Górażdże** and **Trzuskawica**. Total exports since 2010 rose significantly and ranged between 88,000-98,000 t per year (Tab. 3). It was due to fluctuations of ***burnt lime*** exports. The main importers of lime in recent years were: Lithuania, Finland and Ukraine, while the importance of Germany declined (Tab. 5).

In case of lime imports, level of which two to four times exceeded its exports, the main suppliers were Germany and Slovakia, occasionally also the Czech Republic and Belarus (Tab. 4). Burnt lime made recently 60-80% of imports and predominated in its structure (Tab. 4). In recent years, the increase of hydrated lime imports was noticed,

Tab. 3. Polish exports of lime, by country — CN 2522

'000 t

Year	2008	2009	2010	2011	2012
Exports	**12.8**	**37.0**	**88.3**	**98.1**	**93.7**
• ***burnt lime***	***3.9***	***24.9***	***73.3***	***80.9***	***77.0***
• ***hydrated lime***	***8.9***	***11.8***	***14.8***	***17.1***	***16.6***
• ***hydraulic lime***	***0.0***	***0.3***	***0.2***	***0.1***	***0.1***
Belgium	–	0.2	0.0	0.0	5.5
Belarus	0.7	0.7	0.8	0.0	5.5
Czech Republic	0.1	0.7	2.6	0.9	0.7
Denmark	2.1	1.7	1.9	0.1	0.0
Estonia	0.0	–	0.0	4.2	1.3
Finland	0.3	0.0	43.4	0.2	4.5
France	1.0	–	–	35.3	15.7
Germany	1.9	3.0	5.0	5.6	5.5
Ghana	–	2.0	1.5	–	–
Latvia	0.2	–	–	4.0	5.1
Lithuania	2.4	15.3	21.0	21.9	26.8
Nigeria	0.4	0.4	–	–	–
Russia	1.7	1.8	2.2	3.0	3.4
Slovakia	0.0	3.6	1.0	8.0	5.5
Sweden	–	–	0.0	0.0	0.0
Ukraine	1.8	7.1	8.6	14.2	19.4
Others	0.4	0.7	0.3	0.7	0.3

Source: ***The Central Statistical Office (GUS)***

with Germany as a main supplier (Tab. 4). The high growth in imports, along with falling exports, had influenced negatively the lime trade balance in 2005-2008, value of which deepened year by year (Tab. 5). Since 2009, the positive balance in lime trade was recorded (Tab. 7), mainly due to the limitation of imports, and expansion of exports especially ***burnt lime*** (Tab. 3, 4).

Tab. 4. Polish imports of lime, by country — CN 2522

'000 t

Year	2008	2009	2010	2011	2012
Imports	**107.1**	**54.8**	**58.8**	**100.3**	**61.2**
• ***burnt lime***	***84.9***	***39.0***	***35.0***	***77.1***	***44.7***
• ***hydrated lime***	***21.2***	***15.4***	***23.5***	***23.0***	***16.3***
• ***hydraulic lime***	***1.0***	***0.4***	***0.3***	***0.2***	***0.2***
Belarus	10.4	5.0	2.1	0.3	0.4
Czech Republic	2.5	0.7	0.5	21.7	6.4
Germany	56.8	32.8	35.7	40.5	34.8
Slovakia	37.1	16.1	20.3	37.4	18.7
Others	0.3	0.2	0.2	0.4	1.0

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Value of lime and limestone trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Limestones CN 2521					
Exports	9,473	6,846	4,740	15,327	21,721
Imports	1,629	2,838	2,708	5,505	9,599
Balance	**+8,114**	**+4,008**	**+2,032**	**+9,822**	**+12,122**
Lime CN 2522					
Exports	4,184	13,358	34,205	40,997	39,132
Imports	27,999	16,677	18,507	33,086	22,191
Balance	**-23,815**	**+3,319**	**+15,698**	**+7,911**	**+16,941**

Source: ***The Central Statistical Office (GUS)***

Exports of ***limestone*** has shown recently a decreasing tendency and in 2010 reached less then 150,000 t (Tab. 1). It was sold almost entirely to Germany. As compared to exports, limestone imports are marginal, and during last two years they were limited to only 40,000 t in 2010 (Tab. 1). They come mainly from the Czech Republic. Export/import proportion results in a highly positive limestone trade balance, but due to a significant reduction in exports in 2009-2010, the balance of trade declined more than fourfold (Tab. 5). ***Ground limestone*** trade is reported in common item **CN 2521** with limestone rock. Some trade in ***dimension limestone*** and ***marble*** has also been noted (see: **STONE, DIMENSION**).

The average unit values of ***limestone rock*** production since 2007 has exceeded 10 USD/t (Tab. 6). The average unit values in exports in the same period were considerably lower (9.2–10.7 USD/t), whereas in case of imports since 2008 these values have shown the increasing tendency with maximum 24.2 USD/t in 2011, and strong reduction in 2012 (Tab. 6). Domestic prices of ***ground limestone*** are very variable, depending on proportions between various grades, as well as on competition between domestic producers. Since 2005 their average unit values are difficult to ascertain, because their production has been registered together with limestone rock. According to the price list published on the web site of the domestic producers they ranged from 119 to 208 PLN/t in the last year.

Tab. 6. Average unit values of limestone and lime production and trade in Poland

Year	2008	2009	2010	2011	2012
Limestone CN 2521					
Production unit values					
— PLN/t	33.9	35.9	34.8	33.7	35.4
— USD/t	14.1	11.5	11.6	11.4	10.9

Exports unit values					
— PLN/t	24.4	30.6	31.7	39.6	52.5
— USD/t	10.2	9.6	10.7	13.0	16.0
Imports unit values					
— PLN/t	30.6	54.9	68.0	71.5	57.2
— USD/t	12.1	18.9	23.1	24.2	17.5
Lime, burnt CN 2522 10					
Production unit values					
— PLN/t	291.4	301.8	298.9	317.7	341.5
— USD/t	120.9	96.8	99.3	107.2	104.9
Exports unit values					
— PLN/t	350.2	359.5	392.4	439.7	432.3
— USD/t	151.5	116.9	130.1	150.7	132.3
Imports unit values					
— PLN/t	255.5	312.9	330.5	328.2	361.2
— USD/t	109.9	100.9	109.7	110.8	110.9
Lime, hydrated CN 2522 20					
Production unit values					
— PLN/t	315.1	323.6	330.6	NA	381.3
— USD/t	130.8	103.8	109.8	NA	117.1
Exports unit values					
— PLN/t	318.7	376.9	364.4	311.2	348.3
— USD/t	138.4	117.2	116.7	107.4	106.4
Imports unit values					
— PLN/t	281.0	283.8	290.4	334.8	366.5
— USD/t	121.7	92.9	95.9	114.9	111.3

Source: ***The Central Statistical Office (GUS)***

The average unit values of ***burnt lime*** imports were reportedly lower (59–110 USD/t) than their domestic prices (80–121 USD/t, Tab. 6) in 2005-2008, but in last years they slightly exceeded the value of domestic production. The average unit values of ***burnt lime*** exports were also higher than domestic prices. Domestic prices of ***hydrated lime*** were variable, with general increasing tendency and until 2007 they were higher then value of import and export. Since 2008 the highest level have achieved the average unit values of ***hydrated lime*** exports (Tab. 6).

Consumption

The structure of ***limestone*** consumption is as complicated as the structure of production. The reason for this is the large number of possible uses. ***Limestone*** is used mainly by steelworks as ***blast furnace flux*** (it enables the binding of SiO_2 and Al_2O_3 in slag) and for in-house production of ***burnt lime***. It is used also as a flux in the nonferrous metals industry. Considerable amounts of limestone are used by the chemical industry in the production of ***calcined soda***, ***carbide***, ***nitro-chalk*** and other calcium compounds. Limestone is also used by sugar plants, which produce ***burnt lime*** after the sugar campaign to clarify beet saft, and by the paper-making industry, for the production of ***cellulose*** in the sulfite process. The road-building industry is also an important consumer of limestone, which is utilised for road foundations and for the production of aggregates for bituminous pavements, and after grinding in form of GCC as a component of aggregates/asphalt mixture (in amount of 2–11% of mixes).

The most important material produced from limestone is ***burnt lime***, which may be ***milled*** or ***hydrated***. Burnt lime in lumps is used mainly in the chemical industry (e.g. for the production of ***carbide***), in metallurgy (as ***flux*** in the steel-making process), in the sugar-making industry (for sugar plants that do not produce their own lime), in the cellulose and paper-making industries (for softening water and boiling rags), etc. The majority of the ***milled burnt lime*** is used in the production of ***lime-sand products***, some types of ***cellular concrete***, and other construction materials such as dry plaster mortars. Moreover, it is utilised for soil drying in highway engineering, in paints & varnishes (as well as technical chalk and hydrated lime), in chemical industry for chemical compounds production, e.g. epichlorohydrin and propylene oxide etc. Almost all the ***hydrated lime*** production is consumed by the construction industry. In small amounts (1–2% of mixes) it is also utilised as a component of aggregates/asphalt mixture, improving physical properties of mixes. This solution is applied in small scale in Poland, but commonly used in the US and many European countries. Application mentioned above, and some factors such as: improvement in the domestic highway engineering and construction sector, and rising possibilities of lime utilisation in the environment protection, makes prospect for growth of future hydrated lime consumption. According to the information from the Central Statistical Office, the structure of the lime consumption in 2012 was as follows: steel-making processes in the metals production - 41.6%; manufacture of lime-sand products and cellular concrete - 24.6%, electricity generation, mostly for the gases desulfurization - 6.8%; chemical industry - 6.7%, construction (hydrated lime for mortars and plasters) - 4.5%, underground mining - 2.1%; water and waste treatment - 1.2%, pulp and paper industry - 0.3%, sugar industry - 0.3%; production of rubber and plastic - 0.2%; the remaining 11.7%.

Until recently, fine-grained assortments of limestone, unsuitable for the production of burnt lime or aggregates, were considered waste material and dumped. Currently, this material is being utilized, mainly to produce ***limestone fertilizers*** for agriculture. Fine grained wastes after lime burning, utilized as ***lime*** (***oxide***) ***fertilizers***, are also used for the same purpose.

Other fine-grained assortments of limestone are used at the following applications: ***standard grade of ground calcium carbonate*** as a filler in bituminous mixes for road pavements; ***high purity ground calcium carbonate*** for the glass and ceramics industries; ***explosion-proof grade*** used by hard coal mines; ***fodder chalk*** as a nutritive supplement for animals; ***technical chalk*** by the paints & varnishes, plastics, rubber, paper, chemical, and construction industries; ***limestone sorbents*** to desulfurize the off-gases from power plants, which have also the largest potential for the future growth of demand.

Limestone aggregates are offered by aggregates producers, and are also a by-product of lime plants. Due to its physical and mechanical parameters (the compression strength does not usually exceed 100 MPa), limestone aggregates are used in the production of low and medium class concrete, and in the road-building industry. In practice, limestone aggregate is not used for railroad building. Some amounts of ***limestone grits*** are applied in the production of ***terrazzo***. The ***dimension "marbles"*** from the Świętokrzyskie Mountains and the Cracow area, like the ***marbles*** from Lower Silesia, are used in the construction industry as ***dimension slabs*** and similar elements.

Principal companies involved in limestone and lime products production in Poland, as of December 2012

Lhoist plants

- Zakłady Wapiennicze Lhoist S.A. (Lhoist Lime Works Joint Stock Company) consisting of three plants:
  - Plant in Tarnów Opolski, ul. Świerczewskiego 5, 46–050 Tarnów Opolski, tel. +48 77 4516375, fax +48 77 4516377, www.lhoist.pl — *burnt lime, milled burnt lime, hydrated lime, ground calcium carbonate for bituminous mixes, fodder chalk, sorbent for desulfurization, limestone for sale, lime fertilizers,*
  - Plant in Chorula, 47–316 Górażdże, ul. Fabryczna 22, tel. +48 77 4530291, fax +48 77 4671049, www.lhoist.pl — *burnt lime, hydrated lime, ground calcium carbonate for bituminous mixes, sorbent for desulfurization, limestone for sale, limestone and lime fertilizers*.
  - Plant in Wojcieszów, 56–550 Wojcieszów, ul. B. Chrobrego 77B, tel./fax +48 75 7512339, www.lhoist.pl — *burnt lime, hydrated lime, aggregates, limestone for sale, lime fertilizers*.
- "Lhoist Bukowa" Sp. z o.o. w Bukowej ("Lhoist Bukowa" Ltd. of Bukowa), ul. Osiedlowa 10, 29–105 Krasocin, tel. +48 41 3889105, fax +48 41 3889106, www.lhoist.pl — *burnt lime, milled burnt lime, hydrated lime, ground calcium carbonate for bituminous mixes and coal mines, fodder chalk, technical chalk, sorbent for desulfurization, limestone for sale, lime fertilizers*.

CRH plants

- Zakłady Przemysłu Wapienniczego "Trzuskawica" S.A. w Sitkówce ("Trzuskawica" Lime Plants Joint Stock Co. of Sitkówka), 26–052 Sitkówka, tel. +48 41 3469130, fax +48 41 3466139, www.trzuskawica.pl — *burnt lime, milled burnt lime, hydrated lime, ground calcium carbonate for glass & ceramics and bituminous mixes, technical chalk, sorbent for desulfurization, aggregates, limestone for sale, limestone and lime fertilizers*.
- "Kujawy Wapno" Sp. z o.o. w Bielawach ("Kujawy Wapno" Ltd. of Bielawy, a subsidiary of ZPW "Trzuskawica" S.A.), Bielawy, 88–192 Piechcin, tel. +48 52 5643400, fax +48 52 5643497, www.trzuskawica.pl — *burnt lime, milled burnt lime, hydrated lime, aggregates, limestone for sale, lime fertilizers*.

Other plants

- Kopalnia Wapienia "Czatkowice" Sp. z o.o. w Czatkowicach ("Czatkowice" Limestone Mine Ltd. of Czatkowice), 32–063 Krzeszowice, Czatkowice 248, tel. +48 12 2821020, fax +48 12 2821025, www.czatkowice.com.pl — *sorbent for desulfurization, aggregates, limestone for sale*.

- "Nordkalk" Sp. z o.o. w Krakowie ("Nordkalk" Ltd. of Kraków), 31–038 Kraków, ul. Starowiślna 13/15, tel. +48 12 4286580, fax +48 12 4295005, www.nordkalk.com — *aggregates, limestone for sale, ground calcium carbonate for bituminous mixes, sorbent for desulfurization, limestone fertilizers*.
- GiGa Sp. z o.o.(GiGa Ltd.), ul. J. Sobieskiego 43, 32–552 Płaza, tel. +48 32 6131205, fax +48 32 6131208 — *aggregates*.
- Przedsiębiorstwo "Labtar" Sp. z o.o. w Tarnowie Opolskim ("Labtar" Enterprise Ltd. of Tarnów Opolski), 46–050 Tarnów Opolski, ul. Św. Jacka 12, tel. +48 77 4644596, fax +48 77 4645660, www.labtar.pl — *ground calcium carbonate for coal mines, fodder chalk*.
- Zakłady Przetwórcze Surowców Chemicznych i Mineralnych "Piotrowice" Sp. z o.o. w Piotrowicach ("Piotrowice" Chemical & Mineral Commodities Processing Works Ltd. of Piotrowice), 27–630 Zawichost, tel. +48 15 8364142, fax +48 15 8364020, www.piotrowice.com.pl — *technical chalk*.
- Zakład Produkcyjno-Handlowy "APG" s.c. w Sokołowie ("APG" Production and Trade Plant Civil Co. of Sokołów), 28–305 Sobków, Sokołów Górny 73, tel./fax +48 41 3871193 — *technical chalk*.
- Zakład Przerobu Surowców Mineralnych "Minerał" Sp. z o.o. w Wałczu ("Minerał" Minerals Processing Plant Ltd. of Wałcz), 78–600 Wałcz, ul. Papieża Jana XXIII 3, tel. +48 67 2584001, fax +48 67 2584781 — *fodder chalk*.
- Kopalnia Wapienia "Morawica" w Morawicy ("Morawica" Limestone Mine of Morawica), 26–026 Morawica, tel. +48 41 3441401, fax +48 41 3114532, www. kwmorawica .kielce.pl — *aggregates, limestone for sale, limestone fertilizers*.
- Kieleckie Kopalnie Surowców Mineralnych S.A. w Kielcach (Mineral Mines of Kielce Joint Stock Co.), ul. Ściegiennego 5, 25–950 Kielce, tel. +48 41 3612711, fax +48 41 3613999, www.kksm.com.pl — *aggregates, limestone for sale, limestone fertilizers*.
- Kopalnie Odkrywkowe Surowców Drogowych w Kielcach (Road Materials Quarries of Kielce), ul. Ściegiennego 177, 25–116 Kielce, tel. +48 41 3614791, fax +48 41 3614863, www.kosd.kielce.pl — *aggregates, ground calcium carbonate for bituminous mixes and coal mines, limestone fertilizers*.
- Kopalnie Dolomitu S.A. w Sandomierzu (Dolomite Quarries Joint Stock Co. of Sandomierz), ul. Błonie 8, 27–600 Sandomierz, tel. +48 15 8323036, fax +48 15 8323037, www.kopalnie-dolomitu.pl — *aggregates, limestone fertilizers*.
- Spółdzielnia Pracy "Surowce Mineralne" w Kielcach ("Surowce Mineralne" Cooperative of Kielce), ul. Wspólna 5, 25–950 Kielce, tel./fax +48 41 3454823 — *aggregates, limestone fertilizers*.
- Przedsiębiorstwo Wydobycia i Obróbki Marmuru "Marmur-Sławniowice" ("Marmur-Sławniowice" Marble Mining and Working Enterprise), Sławniowice, 48–355 Burgrabice, tel. +48 77 4398018, fax +48 77 4398019, www.marmur-slawniowice.pl — *marble blocks and slabs, grits*.

LITHIUM

Overview

Lithium (**Li**) forms many minerals, the most important of which are ***amblygonite***, ***spodumene***, ***petalite***, ***lepidolite***, etc. They occur mainly in pegmatite-type and greisene-type deposits. Another important primary source of lithium is ***lake brine*** and ***lithium-bearing thermal water***, from which lithium is obtained in the form of ***carbonate***.

Lithium has broad and various applications. Currently, it is used primarily in the form of **carbonate** in the ceramics and glass-making industries, in primary aluminum metallurgy, and as auxiliary material for the manufacture of lubricants and greases, in the production of synthetic rubber, parts for television sets, etc.

Sources

There are no ***lithium*** or ***lithium-bearing*** ore deposits in Poland.

Production

Lithium commodities are not produced in Poland.

Trade

Domestic demand is entirely satisfied by imports, mainly of ***lithium oxide*** and ***hydroxide*** (decreasing amounts) and ***lithium carbonate*** (Tab. 1). The major deliveries came from China, Chile, Belgium, Germany, France, UK, the US, Russia, the Netherlands, and Switzerland. The balance of ***lithium commodities*** trade has always been negative (Tab. 2), and in 2009 and in 2012 the trade deficit increased, mainly in case of ***lithium carbonate***, though in 2008 significantly lower imports of ***oxide*** and ***hydroxide*** caused some improvement in trade balance value. In 2010 lower prices on international markets brought the slight decrease of trade deficit, in spite of the higher imports volume. The unit values of imported to Poland ***lithium commodities*** were higher than at US market (Tab. 3).

Tab. 1. Lithium statistics in Poland

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Year	2008	2009	2010	2011	2012
Lithium oxide and hydroxide CN 2825 20					
Imports	59	86	90	114	141
Exports	7	4	15	4	21
Consumption[a]	52	82	75	110	120

Lithium carbonate CN 2836 91					
Imports	155	156	185	176	177
Exports	13	30	31	31	32
Consumption[a]	142	126	154	145	145

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of lithium commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Lithium oxide and hydroxide CN 2825 20					
Exports	146	97	246	100	461
Imports	1,036	1,808	1,702	1,844	2,731
Balance	**-890**	**-1,717**	**-1,456**	**-1,744**	**-2,270**
Lithium carbonate CN 2836 91					
Exports	289	650	619	633	696
Imports	2,824	3,390	3,435	3,245	3,812
Balance	**-2,535**	**-2,740**	**-2,816**	**-2,612**	**-3,116**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of lithium commodities imports to Poland

Year	2008	2009	2010	2011	2012
Lithium oxide and hydroxide CN 2825 20					
PLN/kg	17.6	21.0	19.0	16.2	19.4
USD/kg	7.7	6.7	6.2	5.5	5.9
Lithium carbonate CN 2836 91					
PLN/kg	18.2	21.7	18.6	18.6	21.5
USD/kg	7.7	7.0	6.1	6.3	6.6

Source: ***The Central Statistical Office (GUS)***

Consumption

Imported ***lithium commodities*** are used by the glass-making industry, ceramics and electronics, but no detailed information on the consumption pattern is available.

MAGNESITE AND MAGNESIA

Overview

Magnesite (**$MgCO_3$**) occurs in two forms: crystalline and compact (kryptocrystalline). ***Crystalline magnesite*** is used almost entirely by the refractory industry in the form of **dead-burned magnesite** (crystalline species roasted at 1,450–1,600°C to obtain MgO) and **fused magnesite** (dead-burned magnesite fused at 3,000°C). These both types of magnesite are used in the civil construction industry, the glass-making industry, ceramics, and abrasives, in the form of **calcined magnesite** (calcined at 800–1,000°C). Magnesites are also a source of **magnesium compounds** used in other branches of industry, such as pharmaceuticals, paper, chemicals, plastics, etc. **Dead-burned**, **calcined**, and **fused magnesite**, produced from **natural magnesite**, can be replaced by higher purity grades of **synthetic magnesia** (MgO), obtained from ***seawater***, ***brines***, and ***dolomites***.

Sources

Compact magnesite deposits containing a considerable admixture of silica occur in Lower Silesia. These deposits are connected with ***serpentinite*** massifs on both slopes of the **Sowie Góry Unit**, northern (the massifs of **Sobótka** and **Gogołów-Jordanów**) and southern (the massifs of **Szklary** and **Braszowice-Grochów**). There are 6 recognized deposits, with total resources of 14.5 Mt (as of 31 December 2012), of which 4.3 Mt are in **Braszowice**, the only extracted deposit.

Production

In the last several years, ***magnesite*** has been exploited exclusively by the **"Magnezyty Grochów" S.A.** in the **Konstanty Mine** (open-pit) from the **Braszowice** deposit. The low quality material is processed — by crushing, optical sorting and classification — into ***raw magnesite concentrate*** with MgO content 43–45%. Its production increased significantly since 2004, up to 65,000 t in 2007, with some reduction to ca. 47,000 t in 2009, recovery to 63,000 t in 2010 and increase up to 84,000 t in 2012 (Tab. 1). Magnesite concentrate is used for the production of a few grades of ***milled magnesite*** (so-called ***R40 grade***) sold as intermediate raw material to numerous fertilizer producers for the manufacture of multicomponent NPKMg fertilizers (20,000-30,000 tpy). ***Crushed raw magnesite concentrate*** is also manufactured (25,000–35,000 tpy), being sold e.g. to domestic chemical plants for the production of magnesium compounds (e.g. ***magnesium sulfate***). Braszowice plant utilizes also accompanying magnesite-serpentinite rock, which is used for the production of so-called ***milled magnesite R35*** and ***R30***. Their total production (R40, R35, and R30) amounts to 90,000–130,000 tpy. In 2001, the **"Magne-**

zyty Grochów" S.A. started to produce ***active*** (***calcined***) ***magnesite*** containing 70–86% MgO. This production does not exceed 50 tpy (Tab. 1).

Tab. 1. Magnesite and magnesia statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Magnesite, raw CN 2519 10					
Production	60.0	47.0	63.0	75.0	84.0
Imports	6.0	4.8	3.2	1.9	1.5
Exports	1.4	0.5	0.1	0.1	0.1
Consumption[a]	64.6	51.3	66.1	76.8	85.4
Calcined, dead-burned and fused magnesite and magnesia CN 2519 90					
Production	0.0	0.0	0.0	0.0	0.0
Imports	120.9	81.4	116.4	140.0	116.3
Exports	2.4	0.2	0.9	0.5	3.3
Consumption[a]	118.5	81.1	115.5	139.5	113.0

Source: ***The Central Statistical Office (GUS), Mineral Resources Datafile, producer's data***

Trade

Trade in ***raw magnesite*** is minimal, commonly not exceeding 5,000 tpy (Tab. 1). It was imported almost entirely from Slovakia. On the contrary, small amounts of raw magnesite were exported, primarily to the Czech Republic and Germany. However, the main imported products are ***dead-burned***, ***fused***, and ***calcined magnesite*** from magnesite, as well as ***dead-burned***, ***fused***, and ***calcined magnesia*** from ***seawater*** and ***brines*** (Tab. 2).

In terms of volume, ***dead-burned magnesite*** is still the main imported commodity. Its imports were recently varying between 68,000 and 108,000 tpy due to variable demand for magnesite refractories. Its main suppliers have been recently China, Brazil, and Slovakia, with minor supplies from Australia, Russia and others. Imports of ***dead-burned magnesia*** from ***seawater*** and ***brines*** in the last years dropped 2,000-6,000 tpy, partly due to competition of fused magnesia. Ireland and the Netherlands are the main suppliers. Only in 2011, it temporarily rose to ca. 19,100 t due to single growth of imports from the Netherlands (Tab. 2). ***Fused magnesite*** and ***magnesia*** were imported from China, Australia and Israel (currently 5,000–6,000 tpy). ***Calcined magnesite*** and ***magnesia*** are primarily imported from Germany, Greece, France, and other European countries, for a total of 5,000–7,000 tpy, with single increase to ca. 10,000 t in 2010. In this group, imports of so-called ***Mg-Cr*** and ***Mg-Al co-clinkers*** are also reported from the United Kingdom and Austria (total of under 1,000 tpy).

The trade balance in ***magnesite*** and ***magnesia*** is consistently negative. It increased to record lvele of almost 265 million PLN in 2011, with reduction to almost 180 million PLN in 2012 (Tab. 3).

Tab. 2. Polish imports of magnesite and magnesia, by country — CN 2519

'000 t

Year		2008	2009	2010	2011	2012
Imports		**126.9**	**86.2**	**119.6**	**141.9**	**117.8**
• ***raw magnesite***		***6.0***	***4.8***	***3.2***	***1.9***	***1.5***
• ***calcined magnesite and magnesia***		***5.1***[e]	***6.6***[e]	***10.5***[e]	***7.2***[e]	***7.0***[e]
• ***dead burned magnesite***		***107.8***[e]	***68.5***[e]	***95.2***[e]	***107.7***[e]	***97.2***[e]
• ***dead burned magnesia from seawater and brines***		***2.0***[e]	***1.3***[e]	***4.7***[e]	***19.1***[e]	***6.1***[e]
• ***fused magnesite and magnesia***		***6.0***[e]	***5.0***[e]	***6.0***[e]	***6.0***[e]	***6.0***[e]
Australia	d,f	4.8	5.6	8.7	17.9	16.7
Austria[1]	d	0.2	0.2	0.4	0.8	1.2
Brazil	d	33.5	22.7	26.0	14.7	13.8
China	d,f	40.0	24.4	34.5	44.9	34.7
France	c	1.4	0.5	0.5	1.4	1.0
Germany	c	1.3	2.1	6.7	3.3	1.1
Greece	c	2.2	1.3	1.9	1.3	1.4
Ireland	s	1.1	0.4	1.7	2.2	1.7
Israel	b,f	0.2	0.1	0.4	0.3	0.3
Netherlands	b	0.5	0.7	1.7	16.4	3.9
Russia	d	1.1	0.9	2.5	2.9	1.9
Slovakia	d,r	36.5	24.5	30.8	33.5	36.4
Spain	c	–	0.1	0.2	0.1	0.6
United Kingdom[1]	s	0.2	0.1	0.2	0.2	0.2
Others	c	3.9	2.6	3.4	2.0	2.9

Legend: **b** — dead-burned magnesia from brine, **c** — calcined magnesite and magnesia, **d** — dead-burned from magnesite, **f** — fused magnesite and magnesia, **r** — raw magnesite, **s** — dead-burned from seawater

[1] almost entirely Mg-Cr and/or Mg-Al. co-clinkers

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of magnesite and magnesia trade in Poland — CN 2519

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	4,843	783	1,758	1,358	33,918
Imports	147,225	129,089	177,585	266,234	212,309
Balance	**-142,382**	**-128,306**	**-175,827**	**-264,876**	**-178,391**

Source: ***The Central Statistical Office (GUS)***

The average unit values of ***magnesite*** and ***magnesia*** (all grades) imports to Poland (in USD/t) significantly increased in the years 2008–2012 (Tab. 4), according to world tendencies. The average unit values for various grades is different: ***calcined magnesite*** and ***magnesia*** — 400–2,000 USD/t, ***dead-burned magnesite*** — 250–600 USD/t, ***dead-***

burned magnesia — 600–1,500 USD/t, ***fused grades*** — 600–1,500 USD/t, ***specialised magnesia grades*** — even over 2,000 USD/t.

Tab. 4. Average unit values of imports of thermally processed magnesite and magnesia to Poland — CN 2519 90

Year	2008	2009	2010	2011	2012
PLN/t	1,159.8	1,569.9	1,526.5	1,892.9	1,812.8
USD/t	491.9	512.9	508.3	646.7	553.3

Source: ***The Central Statistical Office (GUS)***

Consumption

Crude magnesite concentrates are currently used mainly for fertilizer production (over 50%, see: Production). Up to 45% is consumed for ***magnesium sulfate*** (suitable for water treatment) and ***other magnesium compounds*** production, i.e. in **Złotniki** plant. ***Active*** (***calcined***) ***magnesite***, produced in marginal amounts by the **"Magnezyty Grochów" S.A.** since 2001, finds application for water and sewage treatment, as well as for abrasives and fertilizers.

Imported ***dead-burned*** and ***fused magnesite***, and ***magnesia***, as well as ***co-clinkers***, are entirely used to produce magnesite products, magnesite-graphite products, magnesite-chromite products, and magnesite-spinel products in refractory plants, mainly in: the **"Ropczyce" Magnesite Works**, and the **ArcelorMittal Refractories** of **Cracow**. Imported ***calcined magnesite*** and ***magnesia*** is used mainly for ***magnesium compounds*** production, with the abrasives sector playing a minor role.

Companies involved in magnesite production in Poland as of December 2012

- "Magnezyty Grochów" S.A. w Grochowej ("Magnezyty Grochów" Joint Stock Co. of Grochowa), Grochowa 3, 57–257 Brzeźnica, tel./fax +48 74 8170907, www.magnezyty.com.pl — *raw magnesite concentrates, milled magnesite, active (calcined) magnesite*.

MAGNESIUM

Overview

Magnesium (**Mg**) can be recovered from ***seawater***, ***underground brines***, and ***lake brines***, as well as from ***magnesite*** and ***dolomite***, the resources of which are virtually unlimited and globally available. Seawater, with a magnesium content of 0.13% by weight, is an inexhaustible resource. **Magnesium** can be commercially produced by the electrolysis of ***magnesium chloride*** or thermal processing of ***dolomite***, which are very energy-consuming technologies. **Metallic magnesium** and its alloys are used in the automotive industry, and in aeronautics.

Sources

Deposits of ***dolomite*** are the only potential source of ***magnesium*** in Poland. Despite such deposits are common in Poland, they have not been utilized for the production of ***magnesium*** (see: **DOLOMITE**).

Production

Magnesium has not been produced in Poland despite in the 1950s the technology for ***metallic magnesium*** and ***magnesium oxide*** manufacturing was developed in the pilot scale in **Trzebinia Metallurgical Works**. However, the Central Statistical Office has reported some output of ***magnesium and magnesium products*** in Poland that amounted from 720 t in 2009 to 445 t and 393 t in the last two years, respectively. The majority of these commodities have been probably ***high pressure die-castings*** (HPCD) made of magnesium at the plants of **Finnveden Metal Structures** in Bielsko Biała, **Euromag** and **Polmag** – both in Kędzierzyn Koźle, all located in the south of Poland.

Trade

The entire demand for ***magnesium metal*** and ***magnesium alloys*** in Poland has been satisfied by imports. In recent years the volume of these deliveries has ranged from 3.6 to 5.7 ktpy (Tab. 1). The large portion of these deliveries has come from China (60-65%), while the rest from Germany, Hungary, Austria, the Czech Republic, the Netherlands, in 2012 joined by Switzerland (Tab. 2). Some quantities of ***magnesium scrap*** have been also exported. Since 2008 these sales have been gradually increasing, exceeding 1,000 tons last year. Most recently the major recipients of ***magnesium scrap*** have been Hungary and Austria. At the same time there were ***magnesium powder***, ***shavings***, ***fillings***, and ***granules*** deliveries recorded. In 2012 they originated mainly from Germany, China and Austria.

Tab. 1. Magnesium commodities statistics in Poland

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Year	2008	2009	2010	2011	2012
Magnesium metal CN 8104 11, 19					
Imports	4,558	3,622	4,821	5,713	5,177
Exports	85	299	172	196	192
Consumption[a]	4,473	3,323	4,649	5,517	4,985
Mg-bearing scrap and wastes CN 8104 20					
Imports	18	–	0	0	0
Exports	641	782	889	961	1,044
Magnesium shavings, filings, and granules; powders CN 8104 30					
Imports	141	82	184	898	1,396
Exports	4	2	2	412	673

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Imports of magnesium metal to Poland, by country — CN 8104 11, 19

t Mg

Year	2008	2009	2010	2011	2012
Imports	**4,558**	**3,622**	**4,821**	**5,713**	**5,177**
Austria	208	353	285	452	194
China	2,908	1,771	2,378	2,607	3,393
Canada	1	1	1	–	–
Cyprus	23	–	–	–	–
Czech Republic	302	399	293	278	13
Denmark	–	–	2	–	–
France	2	0	–	–	–
Germany	352	373	669	785	362
Hungary	364	150	598	672	579
Israel	–	–	–	–	23
Netherlands	308	208	302	449	58
Russia	–	238	63	–	51
Serbia	–	–	–	92	24
Slovakia	–	–	–	96	–
Slovenia	–	–	–	45	–
Sweden	3	5	93	96	24
Switzerland	–	–	–	–	449
United Kingdom	86	118	136	140	8
Others	1	6	1	1	0

Source: ***The Central Statistical Office (GUS)***

The trade balances of ***magnesium commodities*** have been always negative, and followed the changes in importation volume and international prices fluctuations. In the last five years they ranged from 34 to 55 million PLN per annum (Tab. 3). The unit values of magnesium importation to Poland were consistent with tendencies on world metal markets, ranging in recent years between 3,400 and 3,600 USD/t (Tab. 4).

Tab. 3. Value of magnesium commodities trade in Poland — CN 8104 11, 19, 20, 30

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	4,449	6,772	6,653	15,563	27,967
Imports	53,711	40,548	52,199	70,499	75,507
Balance	**-49,262**	**-33,776**	**-45,546**	**-54,936**	**-47,540**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. The unit value of magnesium imports to Poland — CN 8104 11, 19

Year	2008	2009	2010	2011	2012
PLN/t	11,309	10,888	10,358	10,697	11,700
USD/t	4,834	3,514	3,442	3,647	3,592

Source: ***The Central Statistical Office (GUS)***

Consumption

In 2011-2012 the demand for ***magnesium metal*** in Poland amounted to 5.5 and 5.0 ktpy respectively (Tab. 1). The major traditional consumer used to be the aluminum industry that has utilised magnesium for the production of ***Al-Mg casting alloys***, i.e. the **Aluminum Konin — Impexmetal S.A.** and the **Nowoczesne Produkty Aluminiowe Skawina Ltd.**, both belonging to the **Impexmetal Co.**, as well as the **Kęty Group S.A.** The other key consumers have recently become the **Euromag Co.** in Kędzierzyn-Koźle operating the largest and the most modern foundry in Poland (a subsidiary of **Tar Heel Capital** Polish-American venture capital fund), **Finnveden Metal Structures** – plant in Bielsko Biała (a division of Swedish **FinnvedenBulten Group**), and **Polmag** in Kędzierzyn Koźle (planning expansion and the construction of large factory in Olszowa). The principal assortment offered by these plants have been various ***Mg*** and ***Mg-Al casts***, primarily for the automotive industry, electronics, the army, etc. The dwindled magnesium consumption in 2009 was a consequence of reduced demand for castings in the automotive industry caused by economic downturn. In 2010-2011 the car sales revived, and magnesium consumption increased. Last year as the demand for cars diminished, magnesium consumption was consequently lower.

MANGANESE

Overview

The primary source of **manganese** (**Mn**) is **manganese ore** of different types. The most important are ***oxide*** and ***silicate manganese ore***, which form huge deposits, but only in a few places in the world. **Manganese** is essential to iron and steel production, due to its sulfur-fixing, deoxidizing, and alloying properties.

Sources

Poland has no ***manganese ore*** deposits, and there are no prospects for their discovery.

Production

Currently ***ferromanganese*** (HC) production is held in blast furnace at the **"STALMAG" Ltd.** in **Ruda Śląska**. In 2008 production amounted to 8,500 t, but recorded in 2009 slowdown in Polish steelmaking industry, and in period 2010–2012 also economic problems of the sole ferromanganese producer in Poland, has caused further production decline to the level of only 800 tpy (Tab. 1). The domestic FeMn production volume in the last five years is many times lower in comparison to 2004 when production amounted to nearly 47,000 t. ***Ferrosilicomanganese*** production (from electric furnaces in **Łaziska Smelter**) in 2008 amounted to 25,100 t. Unfortunately, in the years of 2009–2012 economic problems of the producer forced him to dramatic reduction of output, which amounted to only 72 t, 112 t, 378 t and only 81 t, respectively (Tab. 1).

Tab. 1. Manganese commodities statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Manganese ores and concentrates CN 2602					
Imports	54.1	2.3	3.5	3.1	4.2
Exports	0.0	0.0	–	0.0	0.0
Consumption[a]	54.1	2.3	3.5	3.1	4.2
Ferromanganese CN 7202 11–19					
Production	8.5	1.7	0.8	0.8	0.8
Imports	36.1	30.9	31.4	44.1	30.9
Exports	9.0	2.3	2.6	1.6	2.0
Consumption[a]	35.6	30.3	29.6	43.3	29.7

Ferrosilicomanganese CN 7202 30					
Production	25.1	0.0[r]	0.1	0.4	0.1
Imports	50.8	73.0	56.8	65.5	60.6
Exports	28.7	18.3	7.4	1.7	3.7
Consumption[a]	47.2	54.7[r]	49.5	64.2	57.0
Manganese metal [t] CN 8111 00 11					
Imports	670.7	356.3	1,522.6	391.7	734.9
Exports	32.5	4.0	39.3	22.6	96.4
Consumption[a]	638.2	352.3	1,483.3	369.1	638.5
Manganese dioxide [t] CN 2820 10					
Imports	2,114.3	1,480.5	1,491.2	1,607.0	1,377.4
Exports	3.1	74.5	119.0	195.2	169.8
Consumption[a]	2,111.2	1,406.0	1,372.2	1,411.8	1,207.6
Potassium permanganate [t] CN 2841 61					
Imports	464.6	451.2	413.7	451.8	374.3
Exports	167.0	203.9	151.7	193.6	126.2
Consumption[a]	297.6	247.3	262.0	258.2	248.1

Source: ***The Central Statistical Office (GUS)***

Trade

Imports of ***ores*** and ***concentrates*** of ***manganese*** in 2008 amounted to 54,100 t, but in the years 2009–2012 they were stabilized at low level of 2,300-4,200 tpy, following the development of Mn ferroalloys production. The main imports sources in the last five years were Gabon, Brazil, Ukraine, France, and also Singapore as a trader (Tab. 2).

Tab. 2. Polish imports of manganese ores and concentrates, by country — CN 2602

'000 t

Year	2008	2009	2010	2011	2012
Imports	**54.1**	**2.3**	**3.5**	**3.1**	**4.2**
Brazil	34.9	0.0	0.1	0.0	–
France	9.3	0.4	0.2	0.1	0.2
Gabon	1.1	0.3	1.3	1.0	0.7
Germany	–	–	0.1	0.3	0.1
India	–	–	0.1	0.0	–
Morocco	–	–	–	0.0	0.0
Netherlands	0.0	0.0	0.0	0.0	0.0
Singapore	2.2	1.5	1.6	1.5	1.6
Slovakia	–	–	–	0.0	–
Ukraine	0.6	–	–	–	1.6

Source: ***The Central Statistical Office (GUS)***

The decrease of ***ferromanganese*** production from blast furnace has caused the increase of its imports (Tab. 1). Moreover, in the years 2008–2012 exports of ***ferromanganese*** and ***ferrosilicomanganese*** have been exceeding volume of domestic production (Tab. 1), what testifies to the weakness of domestic producers, which were unable to meet the market requirements. ***Manganese metal*** and ***manganese dioxide*** are available in Poland exclusively from imports. The main suppliers of ***manganese metal*** were China (together with Hong-Kong in 2010), the Netherlands, the Republic of South Africa and Germany (Tab. 3). In 2008 imports of ***manganese dioxide*** amounted to 2,114 t, but in the years 2009–2012 imports decreased and were at the stable level of 1,400–1,600 tpy (Tab. 4). The principal suppliers in recent years were Spain, Germany and other Europian Union countries, the US, and China (Tab. 4). The main supplier of ***potassium permanganate*** in the years 2008–2012 has been China, whereas deliveries from the US and few other countries were of minor importance (Tab. 5).

Tab. 3. Polish imports of manganese metal, by country — CN 8111 00 11

t Mn

Year	2008	2009	2010	2011	2012
Imports	**671**	**356**	**1,523**	**392**	**735**
Belgium	–	18	59	14	–
China	294	180	947	53	239
France	6	2	–	–	3
Germany	2	11	13	94	93
Hong Kong	–	–	100	–	–
India	81	–	0	–	–
Luxembourg	–	–	–	15	3
Netherlands	205	72	290	72	211
Mexico	–	–	–	–	9
South Africa, Republic of	83	68	68	70	75
Spain	–	1	21	45	26
Ukraine	–	–	–	–	65
United Kingdom	–	4	25	29	10
USA	0	0	0	0	0

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***manganese commodities*** has had in the years 2008–2012 a negative value (Tabs. 1, 6). In 2008 it amounted to 344 million PLN, in 2009 due to significantly lower imports of manganese commodities the trade balance improved, and reached almost 284 million PLN (Tab. 6). In the years 2010–2011 trade balance value had deepening tendency, and amounted to the record of 429 million PLN, but in 2012 due to lower prices on international markets the trade balance value improved and amounted to –361 million PLN (Tab. 6). The unit values of manganese commodities imports to Poland depend mostly on the volume of imports (Tabs. 6 and 1), particularly in the case of ores and concentrates.

Tab. 4. Polish imports of manganese dioxide, by country — CN 2820 10

t

Year	2008	2009	2010	2011	2012
Imports	**2,114**	**1,480**	**1,491**	**1,607**	**1,377**
Belgium	–	–	–	6	0
Brazil	77	66	–	–	–
China	18	30	13	29	21
France	7	–	–	–	–
Germany	42	15	33	0	0
Greece	20	–	–	20	30
India	25	50	–	–	75
Italy	9	9	12	4	21
Kazakhstan	–	2	–	–	–
Netherlands	67	24	10	–	1
Spain	1,702	1,188	1,269	1,369	1,008
USA	147	96	154	179	221

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Polish imports of potassium permanganate, by country — CN 2841 61

t

Year	2008	2009	2010	2011	2012
Imports	**465**	**451**	**414**	**452**	**374**
China	465	433	408	343	334
Czech Republic	0	0	–	–	–
Germany	0	0	0	0	0
Hungary	–	6	–	–	–
India	0	0	–	0	–
Netherlands	0	0	0	–	0
Spain	–	–	0	–	–
USA	0	11	5	109	40

Source: ***The Central Statistical Office (GUS)***

Consumption

Manganese ores and ***concentrates*** have been consumed in Poland for the production of ***blast-furnace ferromanganese*** at the **"Pokój" Steelworks**, and of ***ferrosilicomanganese*** in the electric furnaces at the **"Łaziska" Smelter** (Tab. 1). The relatively high demand for ***manganese dioxide*** is caused by the stable consumption by the battery making industry (the main plant: **Philips Matsushita Battery Poland S.A.** in **Gniezno**), and by the chemical industry. ***Potassium permanganate*** is traditionally used in the chemical and pharmaceutical industries.

A slight increase in the consumption of ***manganese metal*** has been offset by lower consumption of the remaining manganese commodities. The metal is used mainly in the

Tab. 6. Value of manganese commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Manganese ore and concentrates CN 2602					
Exports	73	65	–	58	2
Imports	64,739	4,538	7,150	6,324	7,406
Balance	**-64,666**	**-4,473**	**-7,150**	**-6,266**	**-7,404**
Ferromanganese CN 7202 11–19					
Exports	59,581	13,324	15,104	10,987	10,921
Imports	207,090	113,329	139,644	182,235	114,850
Balance	**-147,509**	**-100,005**	**-124,540**	**-171,248**	**-103,929**
Ferrosilicomanganese CN 7202 30					
Exports	127,181	55,536	27,590	7,112	14,426
Imports	243,775	224,247	230,965	245,173	229,249
Balance	**-116,594**	**-168,711**	**-203,375**	**-238,061**	**-214,823**
Manganese metal CN 8111 00 11					
Exports	382	48	375	260	1,037
Imports	5,564	3,095	13,668	4,162	6,968
Balance	**-5,182**	**-3,047**	**-13,293**	**-3,902**	**-5,931**
Manganese dioxide CN 2820 10					
Exports	10	745	1,682	2,977	2,246
Imports	9,112	9,709	10,351	10,911	10,508
Balance	**-9,102**	**-8,964**	**-8,669**	**-7,934**	**-8,262**
Potassium permanganate CN 2841 61					
Exports	1,172	1,950	1,331	2,397	1,334
Imports	2,490	3,594	2,975	3,625	3,363
Balance	**-1,318**	**-1,644**	**-1,644**	**-1,228**	**-2,029**

Source: ***The Central Statistical Office (GUS)***

non-ferrous metals industry as a constituent of aluminum, cobalt, magnesium, titanium, and ferronickel alloys, as well as in solders for aluminum and aluminum alloys, copper, bronze, and silver.

Companies involved in manganese commodities production in Poland, as of December 2012

- Huta "Łaziska" S.A. w Łaziskach Górnych ("Łaziska" Smelter Joint Stock Co. of Łaziska Górne), ul. Cieszyńska 23, 43–170 Łaziska Górne, tel. +48 32 2241500, fax +48 32 2241523, www.hlsili.pl — *ferrosilicomanganese from electric furnace.*
- STALMAG Sp. z o.o. w Rudzie Śląskiej ("STALMAG" Ltd. of Ruda Śląska) ul. Hutnicza 2, 41–709 Ruda Śląska, tel. +48 32 7712801, fax +48 32 7712800, www.stalmag.pl — *ferromanganese from blast furnace.*

MERCURY

Overview

Mercury (**Hg**) is a metal that has been known for over 4,000 years. It is recovered almost entirely from ***cinnabar*** and ***native mercury*** forming individual deposits. Recently, secondary mercury from recycling started to be important due to environmental reasons. Currently, **mercury** is consumed in the chlorine-caustic soda industry using mercury cell technology; for the production of discharge lamps laboratory instruments; in dentistry; and for the production of low melting alloys for fuses and thermometers. Due to the toxicity of mercury and the introduction of many substitutes, its economic value is diminishing.

Sources

There are no deposits of ***mercury ore*** in Poland. Some concentrations of mercury are observed in ***hard coal*** in the **Upper Silesian Coal Basin**, in some deposits of ***natural gas***, and in ***copper ore*** deposits in the **Fore-Sudetic Monocline**.

Production

Mercury is not recovered from primary sources, even though considerable amounts are emitted into the atmosphere in the course of ***hard coal*** combustion and the smelting of ***copper ore*** concentrates. Considerable amounts of mercury can be recovered from wastes containing this element, i. e.: spent batteries, but mainly from spent discharge lamps — fluorescent lamps, mercury discharge lamps, sodium discharge lamps, metal halide lamps and ultraviolet lamps. The average mercury content in discharge lamps previously produced is 40 mg Hg/unit and the newest products, according to European Union law regulations, may contain no more than 5 mg Hg/unit. From 2002, all producers and importers, which sell discharge lamps, excluding compact fluorescent lamps, are obliged to achieve the proper levels of their recovery and recycling — 40% until 2007. If these levels would not have been achieved, producer is obliged to pay the product fee. In Poland, there are several companies which dispose of the technology of mercury recovery from spent discharge lamps, i. e.: **Philips Lighting Poland** in **Piła**, **MAYA Ltd.** in **Warsaw**, **Abba-Ekomed** in **Toruń**, **Eko-Neutral-Elektron** in **Gorlice**, and **Utimer Ltd.** in **Warsaw**. In 2007, for the first time, output of secondary ***mercury*** was recorded by Central Statistical Office and amounted to 675 kg. In 2008 it increased to 1,332 kg while in the period 2009–2010 had been permanently decreasing, to 801 kg and 705 kg, respectively. In the years of 2011–2012 the output data of secondary mercury were not given by Central Statistical Office.

Trade

Domestic demand for ***mercury*** is satisfied mainly by variable imports (Tab. 1). The main suppliers to Poland were the Western European countries, and in the years 2008–2010 predominant were deliveries from the Netherlands, but in period 2011–2012 dominant supplier was Germany (Tab. 2). Exports in **CN** item **2805 40** "Mercury" was especially reported in the years 2008–2010 (Tab. 1), with Belgium, the Netherlands and India as the main buyers. It is not clear, what kind of commodity was exported under this item, because it had very low unit values 25–37 PLN/kg (8-12 USD/kg), while unit value of mercury imports in these years amounted to 328–673 PLN/kg (Tab. 4). In 2011, for the first time, the unit value of mercury exports was higher than it unit value of imports, what indicates, that the traded mercury had comparable quality. In 2011 receivers of mercury exports from Poland were India, China and the Netherlands. Trade balance in ***mercury*** in the years 2008-2009 has been constantly negative, changing between 4.0 and 4.8 million PLN/y, but in 2010 huge exports volume has caused that its value had exceeded value of imports, so the value of trade balance in mercury, for the first time in recent years, became positive (Tab. 3). In the period 2011–2012, trade balance in mercury was negative again, and changed between 4.6 and 3.0 million PLN/y.

Tab. 1. Mercury statistics in Poland — CN 2805 40

t Hg

Year	2008	2009	2010	2011	2012
Imports	14	11	5	40	13
Exports	18	47	106	7	–
Consumption[a]	–4	–36	–101	33	13

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of mercury, by country — CN 2805 40

t Hg

Year	2008	2009	2010	2011	2012
Imports	**14**	**11**	**5**	**40**	**13**
Germany	0	0	0	34	10
Netherlands	14	10	4	5	3
Others	0	1	1	1	0

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of mercury trade in Poland — CN 2805 40

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	585	1,204	3,957	1,094	–
Imports	4,591	6,010	3,228	5,665	3,002
Balance	**-4,007**	**-4,806**	**+129**	**-4,571**	**–3,002**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Unit values of mercury imports to Poland — CN 2805 40

Year	2008	2009	2010	2011	2012
PLN/kg	328	546	673	142	221
USD/kg	142	183	224	48	68

Source: ***The Central Statistical Office (GUS)***

Consumption

Until 2006, the apparent consumption of ***mercury*** in Poland has been on the same level, like a volume of imports (Tab. 1), while in the years 2006–2010 large volume of exports has caused that the mercury apparent consumption became negative. In the years 2011–2012 mercury trade became more regular, exports were reduced so apparent consumption amounted to 33 t in 2011 and dropped to 13 t in 2012 (Tab. 1). However, real consumption of mercury is estimated at a few, no more than a dozen tpy. There are no data available on the structure of ***mercury*** consumption in Poland. It is probably applied in the chlorine-caustic soda industry using mercury cell technology, for the production of discharge lamps, laboratory instruments, as well as for the production of low-melting alloys for fuses and thermometers.

MICA

Overview

Mica is the common name for a large group of rock-forming minerals that have a layered or platy texture. The most commercially important micas are ***flogopite*** and ***muscovite*** due to large sheets (minimum several hundred cm^2) utilized in electronics and electrotechnology as insulators. Mica sheets are transparent to opaque, resilient, reflective, refractive, dielectric, chemically inert, insulating and hydrophilic. Small monomineral ***mica flakes*** are used mainly to produce ***micanite*** and ***mica paper*** (electrical insulators); ***finescale mica***, and ***mica powder*** are used as a filler in many industries. In some countries **synthetic mica** is produced, mainly ***synthetic flogopite***.

Sources

There are no ***mica*** deposits in Poland of economic importance.

Production

Mica is not produced in Poland.

Trade

Domestic demand is entirely satisfied by imports, predominantly of ***mica powder*** (70–95%), which considerably increased from 913 tpy in 2008 to 1,908 tpy in 2011, with some decrease to 1,473 tpy in 2012 (Tab. 1). ***Mica powder*** accounted for most of the supplies (80-98%), whereas ***mica flakes*** and occasionally ***mica wastes*** were delivered in smaller amounts. India was the most important mica supplier to Poland, providing up to 50% of imports, until 2009. Since then the volume of deliveries from this country significantly dropped and majority of imported mica came from Germany (in fact there is no mica production in Germany and majority of imported mica came from processing plant at Aspang in Austria). Other important supplier became France (Tab. 1). The trade balance is consistently negative, despite some sales (re-exports) of mica powder to neighbouring countries. Recently, the trade deficit varied between 3.5 and 5.7 million PLN (Tab. 2).

The unit values of ***mica*** imports to Poland followed the fluctuations of international mica quotations. In the years 2008–2012 these values fluctuated between 990 and 1730 USD/t depending on share of cheaper mica from India (***mica powder*** 282-566 USD/t), as well as more expensive mica from Germany (***mica powder*** 572-853 USD/t) and France (***mica powder*** 731-3249 USD/t) in imports structure (Tab. 3).

Tab. 1. Mica statistics in Poland — CN 2525

t

Year	2008	2009	2010	2011	2012
Imports	**913**	**1,189**	**1,147**	**1,908**	**1,473**
Austria	–	–	–	1	25
Belgium	2	3	1	–	46
China	1	6	20	11	37
Czech Republic	46	–	0	3	49
France	66	89	200	377	192
Germany	208	358	575	1,255	919
India	313	530	180	124	122
Madagascar	20	20	–	–	–
Netherlands	176	65	71	43	12
United Kingdom	33	38	22	22	20
USA	15	19	2	3	3
Other	33	61	74	69	48
Exports	**21**[1,2]	**12**[1]	**42**[3]	**21**[1,4,5]	**30**[1,4,5]
Consumption[a]	**892**	**1,177**	**1,105**	**1,887**	**1,443**

[1] mica powder to Ukraine
[2] mica powder to Lithuania
[3] predominantly mica powder to Russia
[4] mica flakes to Belarus

[5] mica powder to Germany
Source: ***The Central Statistical Office (GUS)**,*

Tab. 2. Value of mica trade in Poland — CN 2525

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	113	129	263	271	156
Imports	3,674	3,686	4,775	5,967	5,806
Balance	**-3,561**	**-3,557**	**-4,512**	**-5,696**	**-5,650**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of mica imports to Poland — CN 2525

Year	2008	2009	2010	2011	2012
PLN/t	4,024	3,100	4,164	3,128	3,941
USD/t	1,727	991	1,360	1,066	1,208

Source: ***The Central Statistical Office (GUS)***

Consumption

In last five years the apparent consumption of mica in Poland ranged from 892 to 1,887 tpy (Tab. 1). ***Mica***, which was imported by **"Solvadis Polska" Ltd.**, **"Continental Trade" Ltd.**, **"Izo-Erg" S.A.**, **"Mikanit" Co.**, **"Franspol" Co.**, **"Sinkoplex" Co.**, **"Surtex" Ltd.,** and **"Techmat" Co.,** is utilised mainly in electrotechnology for the production of electroinsulating materials (***micanite***, ***micafoil***, ***mica paper***, etc.) and also in the production of building materials (as substitute of asbestos) and paints. In the future, growth of utilization of mica product is possible in plastic and rubber industries.

MINERAL WAXES

Overview

Ozokerite, once incorrectly called **"fossil wax",** is the product of the natural differentiation of ***petroleum***, containing considerable concentrations of saturated hydrocarbons, with admixtures of liquid and gaseous hydrocarbon constituents. Most ozokerite is processed into **ceresine**, which is used to make candles, wax paper, etc. **Mineral waxes**, which are extracted from peat, lignite, or sapropel coal (***peat wax***, ***Montana wax*** and ***sapropel wax***, respectively) by using organic solvents at a temperature below 100°C, has similar applications.

Sources

There are no ***ozokerite*** deposits in Poland. However, there are some possibilities for the ***Montana wax*** production from ***lignite***, e.g. from **Turów** lignite deposit.

Production

There is no production of ***ozokerite***, as well as of ***peat wax***, ***Montana wax***, and ***sapropel wax*** in Poland.

Trade

Germany is the main supplier of ***raw Montana wax*** to Poland. In recent years, it was also imported from Italy and the Netherlands. Total imports of ***raw Montana wax*** and ***other mineral waxes*** to Poland commonly do not exceed 100 tpy, but since 2009 they have dropped to only a few tpy (Tab. 1). Processed mineral waxes are also traded, at 100-200 tpy. Trade balance of ***raw Montana wax*** is traditionally negative (Tab. 2), what is influenced also by its very high unit values (Tab. 3).

Tab. 1. Crude ozokerite, Montana wax, and peat wax statistics in Poland — CN 2712 90 11

t

Year	2008	2009	2010	2011	2012
Imports = Consumption[a]	**33**	**3**	**3**	**0**	**6**
Germany	28	3	1	0	0
Netherlands	-	-	-	-	6
Italy	5	0	2	-	-

*Source: **The Central Statistical Office (GUS)***

Tab. 2. Value of crude ozokerite, Montana wax, and peat wax trade in Poland — CN 2712 90 11

'000 PLN

Year	2008	2009	2010	2011	2012
Imports = **Balance**	**-198**	**-50**	**-39**	**-1**	**-69**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Average unit values of crude ozokerite, Montana wax, and peat wax imports to Poland — CN 2712 90 11

Year	2008	2009	2010	2011	2012
PLN/t	6,033	15,514	13,389	11,019	12,325
USD/t	2,490	4,937	4,307	3,817	3,793

Source: ***The Central Statistical Office (GUS)***

Consumption

Ozokerite and ***mineral waxes*** are mainly used to make candles, floor paste, wax paper, and insulating materials.

MOLYBDENUM

Overview

The basic carrier of **molybdenum** (**Mo**) is ***molybdenite*** (***MoS_2***), in practice the only primary source of this metal. Less than 1/3 of the world supply of molybdenite comes from individual deposits. The remainder is obtained primarily as a co-product from the processing of porphyry-type ***copper ores*** (approx. 2/3 of the supply), while small amounts are recovered from secondary sources (used ***catalytic convertors***).

Molybdenum is a valuable additive in steel refining, used to produce stainless steel and cast steel, and also non-ferrous alloys. Molybdenum is used as a metallic matrix in alloys with copper, silver, and other metals, as an additive in alloys of tantalum, titanium, and vanadium, and for obtaining magnetically soft heat-resistant and high-temperature alloys (super alloys). It is also used as an alloy matrix in non-reactive solders for metal and ceramics.

Sources

Poland has one porphyry-type deposit of ***molybdenum ore*** with ***tungsten***, and ***copper***, located near **Myszków**. The resources of the deposit amounted to 550.8 Mt of ore containing 295,000 t ***Mo*** (as of 31 December 2012). The deposit has a form of stockwerk with sulfides-oxides veins, connected with granitoid magmatism of Variscian age. The deposit is currently undeveloped.

Small amounts of molybdenum occur in the ***copper ore*** deposits of the **Fore-Sudetic Monocline**. The estimated resources amount to 71,290 t of Mo, including 61,690 t of Mo in developed deposits (as of 31 December 2012).

Production

In 2012, the output of copper ores from the **KGHM "Polska Miedź" S.A.** mines contained 1,380 t of Mo. In the course of processing, approx. 44% of the Mo goes to ***copper concentrate*** (120–350 ppm of Mo). However, due to the lack of economically viable recovery methods, the molybdenum is left in smelter waste materials.

Trade

The entire demand for ***molybdenum commodities*** is satisfied by very variable imports of ***concentrates***, ***molybdenum oxides*** and ***molybdenum powder*** from Western European countries, China, the Czech Republic and Hungary (in case of Mo oxides), and in 2011 from Thailand (Tab. 1). However, the most important molybdenum commodity imported to Poland is ***ferromolybdenum*** (Tab. 2). Its imports in recent years decreased from 1,535 t in 2008 to only 421 t in 2011 as a result of lower demand from Polish economy, but in 2012 increased to 1,039 t. In the last five years the dominant suppliers were Western European countries, Chile, Republic of Korea, China, and deliveries from Russia, Iran and Armenia were of minor importance (Tab. 2). Incidental exports of some molybdenum commodities have also been noted. Especially high volume of re-exports was recorded in 2008 and in 2010 for ***molybdenum ores*** and ***concentrates***, in 2008 for ***molybdenum oxides*** and for ***molybdenum metal***, and in 2011 for ***molybdenum powder*** (Tabs. 1 and 2). Moreover, since 2010 there were recorded extremely high re-exports of ***ferromolybdenum***, a few times higher then imports, resulting in negative apparent consumption level (Tab. 2). Exports were directed mainly to the Czech Republic, the Netherlands, Belgium, Hungary, Ukraine and Slovakia. The recipients of ***molybdenum ores*** and ***concentrates*** re-exports from Poland were the following: in 2008 the Czech Republic, in 2010 Germany, in 2011 Turkey and France, and in 2012 Turkey, Estonia and Spain. The re-exports of ***Mo oxides*** in 2008 were directed to Estonia and United Kingdom, in 2009 to the Netherlands, while and in 2010 to Czech Republic and Germany (Tab. 2), whereas the exports of ***molybdenum powder*** in 2011 to Russia and in 2012 to the Czech Republic.

Tab. 1. Molybdenum commodities statistics in Poland

t Mo

Year	2008	2009	2010	2011	2012
Molybdenum ores and concentrates[1] CN 2613					
Imports	**56.1**	**0.2**	**1.0**	**34.5**	**1.2**
Austria	0.0	–	–	–	–
China	18.0	–	–	0.0	–
France	1.0	0.2	1.0	1.3	1.2
Germany	–	–	–	2.7	–
Hong Kong	–	–	–	5.0	–
Japan	–	0.0	0.0	0.0	–
Netherlands	36.9	–	–	–	–
Thailand	–	–	–	20.0	–
USA	0.2	–	–	–	–
Uzbekistan	–	–	–	5.5	–
Exports	**18.2**	–	**16.0**	**0.4**	**0.8**
Consumption[a]	**37.9**	**0.2**	**-15.0**	**34.1**	**0.4**
Molybdenum oxides CN 2825 70					
Imports	**72.6**	**82.8**	**209.0**	**196.4**	**240.9**
Czech Republic	42.2	27.0	24.6	23.5	15.2
France	–	–	–	–	1.8
Germany	10.2	22.8	5.8	27.0	1.4
Hungary	–	4.0	88.0	51.6	42.5
Kirgistan	–	15.4	–	–	–

Latvia	2.0	1.7	–	–	–
Netherlands	5.4	6.0	77.7	80.0	162.0
Ukraine	2.3	6.0	12.9	14.3	12.5
United Kingdom	2.4	–	–	–	–
USA	8.1	0.0	0.0	0.0	5.4
Exports	**17.1**	**1.5**	**12.0**	**7.0**	–
Estonia	2.0	–	–	–	–
Czech Republic	–	–	2.5	7.0	–
Germany	–	–	9.5	–	–
Netherlands	–	1.5	–	–	–
United Kingdom	15.1	–	–	–	–
Consumption[a]	**55.5**	**81.3**	**197.0**	**189.4**	**240.9**
Molybdenum metal CN 8102 94					
Imports	**64.5**	**1.0**	**2.9**	**0.0**	**0.2**
Armenia	33.0	–	–	–	–
Belgium	3.0	–	–	–	–
China	24.5	0.1	–	–	0.2
Germany	4.0	0.0	–	–	–
Spain	–	–	–	0.0	–
Uzbekistan	–	0.9	2.9	–	–
Exports	**10.0**	–	–	–	–
Consumption[a]	**54.5**	**1.0**	**2.9**	**0.0**	**0.2**
Molybdenum powder CN 8102 10					
Imports	**0.8**	**0.6**	**0.2**	**0.7**	**1.5**
Belgium	–	–	0.1	–	–
China	–	–	–	0.5	0.7
Germany	0.5	0.1	0.0	0.1	0.5
Netherlands	0.0	–	0.0	–	–
United Kingdom	0.3	0.4	0.0	0.0	0.0
USA	0.0	0.0	0.0	0.0	0.3
Exports	**–**	–	–	**3.1**	**0.2**
Czech Republic	–	–	–	–	0.2
Russia	–	–	–	3.1	–
Consumption[a]	**0.8**	**0.6**	**0.2**	**-2.4**	**1.3**

[1] gross weight

*Source: **The Central Statistical Office (GUS)***

Tab. 2. Ferromolybdenum statistics in Poland — CN 7202 70

t

Year	2008	2009	2010	2011	2012
Imports	**1,535**	**751**	**638**	**421**	**1,039**
Armenia	75	108	68	21	10
Austria	106	42	18	7	–
Belgium	300	195	187	136	157
Brazil	21	–	5	–	–
Chile	350	58	48	12	66
China	286	0	18	20	13
Czech Republic	26	4	–	–	4
France	5	2	3	1	3
Germany	66	22	28	13	25
India	–	2	1	9	3
Iran	8	5	7	5	2
Kazakhstan	–	8	–	–	24
Korea, Republic of	35	7	62	127	97
Laos	–	7	–	–	–
Lithuania	–	–	–	–	24
Luxembourg	–	–	–	4	–
Netherlands	102	9	41	47	525
Romania	–	–	2	–	1
Russia	94	232	47	1	50
Slovakia	–	2	–	–	–
Slovenia	–	–	4	–	–
South Africa, Republic of	2	–	–	–	–
Spain	–	–	8	–	–
Sweden	8	3	7	7	4
United Kingdom	51	33	84	11	30
USA	–	7	–	–	–
Uzbekistan	–	5	–	–	–
Exports	**160**	**212**	**1,547**	**3,412**	**3,151**
Consumption[a]	**1,375**	**539**	**-909**	**-2,991**	**-2,112**

Source: ***The Central Statistical Office (GUS)***

The trade balance of ***molybdenum commodities*** has been negative in recent years, particularly for ***ferromolybdenum*** (Tab. 3). Since 2010 high volume of re-exports of ***ferromolybdenum*** caused the positive value in its trade balance (Tab. 3). The unit values of molybdenum commodities imports to Poland depend mostly on the volume of imports and market price (Tab. 4).

Tab. 3. Value of molybdenum commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Molybdenum ores and concentrates CN 2613					
Exports	1,787	–	237	4	1
Imports	6,358	6	18	1,858	21
Balance	**-4,571**	**-6**	**+219**	**-1,854**	**-20**
Molybdenum oxides CN 2825 70					
Exports	1,196	44	928	513	–
Imports	6,265	2,888	9,976	11,630	12,124
Balance	**-5,069**	**-2,844**	**-9,048**	**-11,117**	**-12,124**
Molybdenum metal CN 8102 94					
Exports	1,893	–	–	–	–
Imports	11,134	154	322	0	48
Balance	**-9,241**	**-154**	**-322**	**-0**	**-48**
Molybdenum powder CN 8102 10					
Exports	–	–	–	1,285	46
Imports	206	218	83	151	472
Balance	**-206**	**-218**	**-83**	**1,134**	**-426**
Ferromolybdenum CN 7202 70					
Exports	19,462	15,488	113,650	277,461	239,610
Imports	172,625	43,288	49,991	31,271	68,501
Balance	**-153,163**	**-27,800**	**+63,659**	**+246,190**	**+171,109**

*Source: **The Central Statistical Office (GUS)***

Tab. 4. Unit values of molybdenum commodities imports to Poland

Year	2008	2009	2010	2011	2012
Molybdenum ores and concentrates CN 2613					
PLN/t	113,333	30,000	18,262	53,894	16,725
USD/t	49,217	10,299	5,808	17,854	5,159
Molybdenum oxides CN 2825 70					
PLN/t	86,261	34,876	47,735	59,213	50,336
USD/t	37,790	11,223	16,069	20,731	15,415
Molybdenum metal CN 8102 94					
PLN/t	172,620	149,701	112,890	182,000	246,964
USD/t	76,728	50,153	38,918	63,000	77,388

Molybdenum powder CN 8102 10					
PLN/t	257,500	363,333	404,390	220,675	312,458
USD/t	102,819	123,823	132,434	72,904	95,359
Ferromolybdenum CN 7202 70					
PLN/t	112,459	57,640	78,310	74,286	65,286
USD/t	48,744	18,667	26,134	25,454	20,185

Source: ***The Central Statistical Office (GUS)***

Consumption

The ***molybdenum powder*** and some amounts of ***molybdenum trioxide*** MoO_3 and ***metallic molybdenum*** are consumed by the **"Polam-Warszawa" Joint Stock Co.**, which produces mainly thin wires, rods, and bar ends. In 2008, production of ***molybdenum products*** amounted to 43,848 kg but in the years 2009–2011 has been consequently decreasing, amounting to 28,073 kg, 6,058 kg, 2,964 kg, respectively. In 2012 it increased to 5,345 kg.

Either ***natural molybdenite*** of high purity or ***synthetic molybdenite*** is consumed to produce ***molybdenum greases***, whereas ***ferromolybdenum*** is used in the steel and cast iron industry for stainless steel, spring steel, superalloys, heat resistant elements, etc.

NICKEL

Overview

The principal sources of **nickel** (**Ni**) are deposits of ***latheritic*** and ***silicate ores*** (processed mainly into **ferronickel** and **nickel oxide**), as well as deposits of ***nickel-copper sulfide ores*** (processed into **nickel sulfide concentrates**, **nickel matte**, and **nickel metal**), and other types of ore, in which nickel occurs as an accompanying element. In addition, there are extensive deep-sea resources of nickel in manganese crusts and nodules covering large areas of the ocean floor.

The majority of the **primary nickel** production is utilized for stainless steel and alloy steel manufacturing. It is also applied in the production of nonferrous alloys and superalloys, e.g. with chromium, copper, iron, aluminum, boron, magnesium, silver or gold, and electroplating. The future prospects for nickel demand are connected with the production of electrical vehicles powered by advanced nickel-metal hybrid batteries (***NiMH***).

Sources

Deposits of ***nickel silicate ore*** have been recognized in Lower Silesia. There is an independent deposit of **Szklary**, extraction of which was halted in 1983. Its resources, i.e. 14.64 Mt of ore graded at 0.8% Ni, since then have remained unchanged. Nickel occurs as an accompanying element also in the ***magnesite*** **Grochów** deposit (no economic value).

Since 2008, the Szklary deposit has been re-explored by Australian-based **Northern Mining Limited** (**NMI**) which entered into a heads of agreement with Polish copper giant **KGHM Polska Miedź**. The Szklary Project has an initial Inferred Resource to JORC reporting standards of 16.8 Mt with 0.6% Ni for 94,000 t contained nickel (including 3.2 Mt with 0.9% Ni). **NMI** believes that the location of its concession areas to the **KGHM** concession, combined with locating a reasonably priced source of sulphuric acid (**KGHM** a possible source) will provide a possibility to heap leaching application. Additionally, potential exists to increase the size of the Szklary resources through further study of the historic workings and determining their effect.

Up to date, the principal sources of ***nickel*** in Poland have been deposits of ***copper ore*** in the **Fore-Sudetic Monocline**, where it accompanies copper. The average content of nickel in the ore has amounted to 50 ppm, while in the shale-type of ore it has ranged from 200 to 280 ppm (occasionally peaking up to 521 ppm). At year-end of 2012 the approximate nickel resources were 65,360 t, including around 49,150 t in deposits currently operated, i.e. **Lubin-Małomice**, **Rudna**, and **Głogów Głęboki Przemysłowy**.

Production

In 2012 the nickel content in copper ore run-off-mine was 840 tons. The principal nickel commodity has been ***nickel sulfate***, recovered as a byproduct of metallurgical processing of ***copper concentrate*** at the smelters operated by **KGHM Polska Miedź S.A.**, i.e. **Głogów I** and **II** — ca. 2,000 t in 2012, and **Legnica** — 624 tons. The total output of ***nickel sulfate*** that ranged between 2.1 and 2.6 ktpy in the years 2008-2012, showing a growing tendency (Tab. 1). In recent time the **KGHM Ecoren S.A.** — a division of the **KGHM Polska Miedź** — has developed a hydrometallurgical technology for the by-product nickel sulfate purification, with ***nickel hydroxide***, and possibly — ***cobalt sulfate*** — as the final products. According to official records of the **Central Statistical Office** (**GUS**), some small amounts of goods made of ***nickel and nickel alloys***, i.e. sheets, bars, sections, wire etc., have been also manufactured (recently in the range 6-11 tpy).

Trade

The majority of ***nickel commodities*** consumed domestically has been imported in quite large quantities (Tabs. 1–3). The prime example has been ***nickel metal*** (1.2–3.1 ktpy). These deliveries have been basically sourced from Russia, Germany, the Netherlands, Norway, and the United Kingdom (Tab. 2). ***Nickel metal*** and especially ***nickel alloys*** has been distributed in Poland by subsidiaries of foreign companies, e.g. **Bibus Metals** (the Swiss representative of the US-based **Special Metals Corporation**), **Italinox** (Germany), **Jacquet Metals** (French-based). Other nickel commodities, i.e. ***powder***, and ***compounds*** (***sulfate***, ***chloride***, Tab. 3), recently have been brought from Belgium, Italy, Germany, Austria, and France. In the years 2008-2009 the importation of ***wastes and scrap of nickel metal*** were also substantial. The majority of these materials (3.0-4.0 ktpy) originated from Germany. Since 2010 these deliveries have been significantly reduced, with Germany remaining almost exclusive supplier (over 99%). The principal nickel commodity exported from Poland has been ***nickel sulfate***, manufactured by the **KGHM Polska Miedź S.A.** Its main and most regular recipient were Germany, while in 2012 Philipines emerged as the major foreign customer (Tab. 4). ***Nickel metal*** have been also exported in varying quantities (120-880 tpy). The sales of ***nickel wastes*** and ***scrap***, predominantly to Germany, were reduced from around 1,200 tpy in 2009-2010 to ca. 750-690 tons in the last two years. Poland has been a net importer of ***nickel*** commodities, therefore the overall trade balance has been negative (Tab. 5). The deficit in the trade of nickel commodities has been mitigated by revenues from ***nickel sulfate*** exports, which in recent years have ranged between 27 and 29 million PLN (Tab. 5). Negative balances in the trade of ***nickel waste*** and ***scrap***, which in 2008 amounted to around -15 million PLN, in the following years became positive. Their levels decreased from maximum ca +50 million PLN in 2010 to +3 million PLN last year. In 2008 and 2009 the unit cost of ***nickel metal*** importation decreased substantially, reflecting the downward trend of the LME nickel prices and unprecedented world recession (Tab. 6). The following two years brought their growth as the international nickel quotations improved, and 2012 – the drop again.

Tab. 1. Nickel commodities statistics in Poland

t

Year	2008	2009	2010	2011	2012
Nickel oxide sinter CN 7501 20					
Imports	–	1,611.4	0.2	7.3	0.4
Exports	–	1,552.1	–	–	–
Consumption[a]	–	59.3	0.2	7.3	0.4
Nickel metal CN 7502 10					
Imports	3,124.6	1,200.3	1,989.5	2,592.7	2,878.1
Exports	261.2	120.6	671.0	249.3	883.0
Consumption[a]	2,863.4	1,079.7	1,318.5	2,343.4	1,995.1
Nickel alloys CN 7502 20					
Production	24.0	9.0	NA	NA	NA
Imports	200.9	181.5	1,463.0	67.3	232.0
Exports	7.4	0.0	1,206.8	0.3	0.1
Consumption[a]	217.5	181.5	256.2	67.0	231.9
Wastes and scraps of nickel metal and nickel alloys CN 7503					
Imports	3,682.3	3,068.7	862.9	608.6	320.5
Exports	643.5	1,183.8	1,250.4	747.1	687.6
Consumption[a]	3,189.8	1,884.9	-387.5	-138.5	-367.6
Nickel powder and flake CN 7504					
Imports	111.3	94.7	89.4	114.1	132.7
Exports	6.7	7.2	10.3	8.9	7.7
Consumption[a]	104.6	87.5	79.1	105.2	125.0
Nickel sulfate CN 2833 24					
Production	2,182.0	2,123.0	2,378.0	2,481.0	2,600.0
Imports	162.9	122.7	328.5	159.5	223.5
Exports	630.8	2,080.6	2,742.0	2,419.6	2,668.5
Consumption[a]	1,714.1	165.1	-35.5	220.9	155.0
Nickel chloride CN 2827 35					
Imports	48.9	41.3	92.4	99.3	90.4
Exports	14.3	15.1	53.1	57.4	59.9
Consumption[a]	34.6	26.2	39.3	41.9	30.5

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of nickel, by country — CN 7502 10

t Ni

Year	2008	2009	2010	2011	2012
Imports	**3,125**	**1,200**	**1,990**	**2,593**	**2,878**
Australia	–	12	–	–	–
Belgium	5	4	40	13	–
Brazil	–	25	10	14	21
Canada	–	103	2	12	95
Czech Republic	–	2	18	10	59
Estonia	–	–	24	–	–
Finland	1	19	7	14	5
France	40	22	30	3	9
Germany	222	320	323	810	642
Indonesia	12	–	–	–	–
Italy	36	59	125	77	36
Luxembourg	–	116	8	265	97
Netherlands	616	121	501	443	374
Norway	190	154	243	207	345
Russia	1,580	195	391	540	968
Slovakia	18	–	–	–	–
Slovenia	–	–	72	–	–
Spain	22	18	69	–	1
South Africa	–	–	6	–	–
Switzerland	93	–	–	21	–
United Kingdom	290	30	121	164	226

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Polish imports of nickel compounds[1], by country

t

Year	2008	2009	2010	2011	2012
Imports	**212**	**164**	**421**	**259**	**314**
Austria	10	79	142	3	22
Belgium	15	–	53	90	97
Czech Republic	–	–	39	–	–
Finland	5	–	2	13	35
France	105	26	40	24	19
Germany	63	50	81	57	73
Italy	12	9	64	67	68
Netherlands	2	–	–	–	–
Taiwan	–	–	–	1	–
United Kingdom	–	–	–	4	–

[1] nickel sulfate — **CN 2833 24**, nickel chloride — **CN 2827 35**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Polish exports of nickel sulfate, by country — CN 2833 24

t

Year	2008	2009	2010	2011	2012
Exports	**631**	**2,081**	**2,742**	**2,420**	**2,669**
Belarus	2	4	7	1	3
Belgium	–	47	527	1,223	373
Czech Republic	392	33	16	1	2
Estonia	1	–	–	–	–
Finland	–	1,716	1,350	–	1
Germany	207	276	400	763	945
Hungary	–	1	1	8	6
India	–	–	322	396	–
Lithuania	2	1	2	2	2
Netherlands	–	–	–	–	15
Philipines	–	–	–	–	1,253
Russia	–	2	28	–	5
Romania	–	–	1	–	–
Serbia	20	–	–	–	2
Slovakia	–	–	–	3	17
Slovenia	1	–	0	–	2
Ukraine	6	1	42	23	43
United States	–	–	46	–	–

Source: ***The Central Statistical Office*** *(GUS)*

Tab. 5. Value of nickel commodities trade in Poland

‘000 PLN

Year	2008	2009	2010	2011	2012
Nickel oxide sinter CN 7501 20					
Exports	0	77,302	0	0	0
Imports	0	81,022	15	64	96
Balance	**0**	**-3,720**	**-15**	**-64**	**-96**
Nickel metal CN 7502 10					
Exports	13,191	5,338	46,945	17,114	52,188
Imports	163,543	54,099	121,734	170,698	170,622
Balance	**-163,733**	**-48,761**	**-74,789**	**-153,584**	**-118,434**
Nickel alloys CN 7502 20					
Exports	773	3	78,938	28	44
Imports	13,566	15,682	95,409	5,244	22,007
Balance	**-12,793**	**-15,679**	**-16,471**	**-5,216**	**-21,963**

Wastes and scraps of nickel metal and nickel alloys CN 7503					
Exports	2,910	52,226	65,346	26,644	9,437
Imports	17,800	30,798	15,866	18,403	6,379
Balance	**-14,890**	**+21,428**	**+49,480**	**+8,241**	**+3,058**
Nickel powder CN 7504					
Exports	653	690	936	845	677
Imports	7,540	7,673	9,902	14,103	16,578
Balance	**-6,887**	**-6,983**	**-8,966**	**-13,258**	**-15,901**
Nickel compounds CN 2833 24, 2827 35					
Exports	7,706	18,505	35,715	32,639	31,981
Imports	3,543	1,955	6,637	4,739	4,846
Balance	**+4,163**	**+16,550**	**+29,078**	**+27,900**	**+27,135**

Source: ***The Central Statistical Office (GUS)***

Tab. 6. The unit values of nickel imports to Poland — CN 7502 10

Year	2008	2009	2010	2011	2012
PLN/t	52,341	45,082	61,188	65,830	59,285
USD/t	22,410	14,694	20,337	22,533	18,115

Source: ***The Central Statistical Office (GUS)***

Consumption

Over the years 2008-2012 the domestic consumption of nickel metal ranged between 1.1 and 2.9 ktpy. It has been dominated by ***stainless*** and ***alloy steels***. Another important end-uses have included: the production of ***non-ferrous metals alloys*** (e.g.: ***copper-nickel*** and ***nickel-copper***), ***high temperature superalloys***, ***casting alloys***, ***electroplating***, as well as ***vegetable fat hardening***. The largest domestic consumer of nickel in various forms (including scrap of stainless steel and high-nickel alloys) has been the **Arcelor Mittal Poland Huta Warszawa** — the major producer of wide assortment of ***special steels*** (***stainless***, ***bearing***, ***tool***, ***spring***) and ***alloy steel Ni-Cr-Mo***. Relatively small amounts of ***nickel*** have been utilized for rolled products (a few dozen tons per year) at the **Non-Ferous Metals Mill Gliwice-Łabędy Ltd.** of Gliwice (***strips*** and ***sheets*** made of ***high-nickel brass***), the **Dziedzice Metals Mill** of Czechowice-Dziedzice (***cupro-nickel*** and ***alpaca strips***, as well as ***disks*** made of ***Cu-Ni***, ***Cu-Al-Ni***, ***Cu-Ni-Zn alloys***), **Hutmen S.A.** of Wrocław (***strips*** and ***coin disks*** made of ***nickel brass***, ***alpaca***, ***cupronickel***, and ***aluminium bronze***, as well as ***nickeline pipes*** to ***heat exchangers***). Some small amounts of ***nickel metal*** and ***stainless steel scrap*** with min. 9% Ni have been utilized by the **Huta Stali Jakościowych S.A.** of Stalowa Wola – a member of the Polish **COGNOR Capital Group** – for the production of various grades of steel (***structural***, ***tool***, ***stainless***, and ***heat-resisting***). The list of nickel consumers in Poland have also included: **Ferrostal Łabędy** of Gliwice, **ISD Huta Częstochowa** of Częstochowa, **Batory Steelworks** of Chorzów and **IMN Gliwice** of Gliwice (***strips***, ***wire*** — including ***resistance wire Ni-Cr***).

Companies involved in primary nickel production in Poland as of December 2012

- KGHM "Polska Miedź" S.A. w Lubinie (KGHM "Polska Miedź" Joint Stock Co.), ul. Skłodowskiej-Curie 48, 59–301 Lubin, tel. +48 76 7478200, fax +48 76 7478500, www.kghm.pl — *nickel sulfate*.

NIOBIUM (COLUMBIUM)

Overview

The main sources of **niobium** (**Nb**), also called **columbium** (**Cb**), are ***pyrochlore concentrates*** produced from carbonatite deposits. Additionally, concentrates of ***niobite*** (***columbite***) and ***niobite-tantalite*** are obtained from deposits of placer or vein type. These concentrates are used to produce **niobium pentoxide**, the main commodity for **niobium metal** and high quality **ferroniobium**, whereas pyrochlore is used only for ferroniobium production. Secondary sources — scrap and niobium-bearing waste materials, including ***niobium-bearing tin slag*** — are of less importance.

Niobium is a highly-valued additive for special steels and superalloys, providing them with better strength and corrosion resistance. Due to its important applications in the aerospace industry, armaments, and energy, it is considered a strategic material.

Sources

There are no deposits of ***niobium minerals*** in Poland.

Production

There is no production of ***niobium minerals*** or ***niobium commodities*** in Poland.

Trade

Domestic demand for ***raw niobium***, ***niobium powders***, and ***niobium products*** is met entirely by imports, ranging from 9 to 69 kgpy in the last years (Tab. 1). Although this trade is reported under a common item with ***rhenium***, niobium goods are the majority of this volume. The majority has been delivered from China, the US, Germany, United Kingdom and Switzerland. Until 2011 small and irregular re-exports were reported, and in 2008 the sole receiver of 6 kg was the United Kingdom, but in 2010 less than 1 kg were directed to Germany (Tab. 1). Since 2011 all the reported exports consists of rhenium, production of which has started in **KGHM "Polska Miedź" S.A.** (see: **RHENIUM**).

The most important ***niobium commodity*** imported to Poland is ***ferroniobium***. Variable level of deliveries, not exceeding 400 tpy, mainly from Brazil, the Netherlands, Belgium, France, and Canada, have been reported in the last years (Tab. 1). In the years 2008–2012 there were recorded re-exports to Spain, the Netherlands, Germany, Ukraine, Czech Republic, and Slovakia.

The balance of ***niobium commodities*** trade reflects the type and quality of material traded. The value has been negative in period 2009–2010, but in 2008 large value of re-exported niobium caused that the trade balance became positive. Since 2011, when

Tab. 1. Niobium commodities statistics in Poland

Year	2008	2009	2010	2011	2012
Niobium and rhenium [kg] **CN 8112 92 31, 8112 99 30**					
Imports	18	38	34	69	9
Exports	6	–	0	64[1]	4,963[1]
Consumption[a]	12	38	34	5	-4,934
Ferroniobium [t] **CN 7202 93**					
Imports	226	244	392	243	379
Exports	28	48	125	3	11
Consumption[a]	198	196	267	240	368

[1] *exports of rhenium*

Source: ***The Central Statistical Office (GUS)***

exports of ***rhenium*** produced in Poland has started, the trade balance was permanently positive (Tab. 2). Trade balance in ***ferroniobium*** is consistently negative (Tab. 2). Unfortunately, in 2010 following the increase in importation, the trade deficit deepened, in spite of record volume of exports. The unit values of niobium commodities imports to Poland depend on imports volume and prices on international markets (Tab. 3).

Tab. 2. Value of trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Niobium and rhenium **CN 8112 92 31, 8112 99 30**					
Exports	102	–	0	54[1]	58,284[1]
Imports	28	47	33	29	29
Balance	**+74**	**-47**	**-33**	**+25**	**+58,255**
Ferroniobium **CN 7202 93**					
Exports	2,003	2,712	7,661	287	977
Imports	14,013	17,637	28,724	17,982	27,326
Balance	**-12,010**	**-14,925**	**-21,063**	**-17,695**	**-26,349**

[1] *exports of rhenium*

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of niobium commodities imports to Poland

Year	2008	2009	2010	2011	2012
Niobium and rhenium CN 8112 92 31, 8112 99 30					
PLN/kg	1,555	1,237	978	421	3,225
USD/kg	648	383	331	142	978
Ferroniobium CN 7202 93					
PLN/t	62,004	72,283	73,332	73,958	72,182
USD/t	26,255	24,530	24,492	25,364	21,988

Source: ***The Central Statistical Office** (GUS)*

Consumption

Niobium is consumed almost exclusively as ***ferroniobium*** by the steel industry for the production of stainless and heat-resisting steels, and other high-grade special steels.

NITROGEN

Overview

Nitrogen (**N**) is one of the basic elements critical for life on the Earth in its present forms. The **nitrogen compounds** used as **fertilizers** are commercially the most important. **Ammonia NH_3**, obtained from atmospheric nitrogen and hydrogen coming from natural gas, is the basic material for the production of **nitrogen fertilizers**. It is also one of the most important raw materials for all modern chemistry, including for the crucial compound **nitric acid HNO_3**. Both these important compounds are used in the production of synthetic fibers for the textile industry, plastics, explosives, and enormous number of chemical compounds. **Elemental nitrogen**, obtained from atmospheric air or from natural gases, is also widely used, mainly as a protective (inert) gas, or as liquid nitrogen for freezing food products, kriotherapeutical operations, structural investigations carried out in low temperatures, etc.

Sources

Atmospheric air and nitrified natural gas are the sources of ***elemental nitrogen***. Atmospheric nitrogen and hydrogen from natural gas are the basis for ***ammonia*** production. Ammonia, in turn, is used to produce ***nitric acid***. The last two compounds, i.e. ammonia and nitric acid, are the basis for the production of ***nitrogen fertilizers***.

Production

Poland is an important producer of ***nitric acid***, ***ammonia***, and ***nitrogen fertilizers***, as well as ***elemental nitrogen*** and other nitrogen compounds.

Domestic production of ***elemental nitrogen*** recently rose from 1.0–1.3 billion m^3py to 1.6-2.0 billion m^3py (Tab. 1), and in practice satisfies the demand of the Polish industry. Supplementary imports were increasing up to 44,600 t in 2009, with significant reduction since 2010. In recent years, nitrogen exports were also developed, reaching up to 79,700 t in 2012. ***Nitrogen***, ***compressed*** and ***liquid***, is obtained in commercial gas plants (see: **GASES, COMMERCIAL**), in the **“Puławy”, “Tarnów”,** and **“Kędzierzyn” Nitrogen Plants**, as well as in the natural gas denitriding plant of **PGNiG S.A.** (**POGC**) in **Odolanów**. Mixtures of nitrogen and carbonic acid, hydrogen, phosphine, etc. are also produced.

Ammonia is produced in the **“Puławy”, “Kędzierzyn”, “Anwil”, “Tarnów”,** “**Chorzów”**, and the **“Police” Chemical Plant**. Total production was reduced by almost 20% in the years 2009-2010, with recovery to previous levels since 2011 (Tab. 2). These plants, except for the **“Police” Chemical Plant**, produce ***nitric acid*** from ammonia. Its production in the last years was also stable 2.2–2.3 Mtpy (Tab. 3).

Tab. 1. Gaseous nitrogen statistics in Poland — CN 2804 30

'000 t

Year	2008	2009	2010	2011	2012
Production [**Mm^3**]	1,255.8	1,047.2	984.5	2,021.4	1,596.2
Imports	41.7	44.6	16.2	2.0	0.8
Exports	6.3	28.7	52.8	63.4	79.7

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Anhydrous ammonia statistics in Poland — CN 2814

'000 t NH_3

Year	2008	2009	2010	2011	2012
Production	2,416.7	1,958.2	2,059.7	2,326.6	2,526.2
— *N content*	*1,994.7*	*1,697.4*	*1,700.8*	*1,917.6*	*2,026.1*
Imports	46.5	85.1	97.9	35.4	12.5
Exports	239.9	40.8	71.9	112.2	157.0
Consumption[a]	2,223.3	2,002.5	2,085.7	2,249.8	2,381.7

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Nitric acid statistics in Poland — CN 2808

'000 t HNO_3

Year	2008	2009	2010	2011	2012
Production	2,267.4	2,139.4	2,209.4	2,168.1	2,322.6
Imports	27.8	24.1	19.0	16.6	14.4
Exports	16.9	14.2	18.8	14.0	14.6
Consumption[a]	2,278.3	2,149.3	2,209.6	2,170.7	2,322.4

Source: ***The Central Statistical Office (GUS)***

Most of the ***ammonia*** and ***nitric acid*** is used for the production of ***nitrogen*** and ***multicomponent fertilizers***. ***Nitrogen fertilizers*** are produced mainly in plants: **"Puławy" Nitrogen Plants** (over 40% of domestic production volume regarding nitrogen content), **"Anwil" Nitrogen Plants**, **"Kędzierzyn" Nitrogen Plants**, **"Tarnów" Nitrogen Plants**, **"Police" Chemical Plant**, and **"Chorzów" Nitrogen Plants**. In 2012, Puławy, Tarnów, Kędzierzyn and Police plants were consolidated into **Grupa Azoty** holding group. The proportional shares of particular fertilizers in total Polish production in 2012 were as follows: ***urea*** (46% N) — 22%, ***ammonium sulfate*** (21% N) — 12%, ***ammonium nitrate*** (34% N) — 26%, ***nitro-chalk*** (approx. 28% N) — 27%, ***solution of ammonium nitrate*** and ***urea*** (30% N) — 12%. The share of other fertilizers (ammonia water, lime saltpeter, etc.) is insignificant. ***Ammonium nitrate*** is produced by all four large plants, ***urea*** and ***solution of ammonium nitrate*** by **"Puławy", "Kędzierzyn",** and **"Police",** ***nitro-chalk*** by **"Tarnów", "Anwil",** and **"Kędzierzyn",** ***ammonium sulfate*** by **"Puławy"** and **"Tarnów".**

Total domestic production of ***nitrogen fertilizers***, after notable reduction by over 10% in the years 2008-2009 to under 4.5 Mtpy due to lower exports, since 2010 started to recover up to almost 5.5 Mt in 2012, as a result of higher exports and growing domestic demand (Tab. 4).

Tab. 4. Nitrogen fertilizers statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Nitrogen fertilizers CN 3102					
Production	**4,820.8**	**4,472.4**	**4,709.0**	**4,986.8**	**5,454.5**
— containing N	1,549.1	1,466.2	1,491.7	1,609.9	1,741.7
• *urea*	*813.3*	*873.4*	*794.7*	*1,046.1*	*1,207.2*
• *ammonium sulfate*	*618.1*	*582.5*	*646.3*	*676.4*	*674.7*
• *ammonium nitrate*	*1,260.3*	*1,348.4*	*1,322.5*	*1,323.9*	*1,389.4*
• *nitro-chalk*	*1,447.3*	*1,260.9*	*1,474.1*	*1,358.0*	*1,487.3*
• *lime saltpeter*	*13.8*	*13.5*	*13.4*	*11.9*	*19.2*
Imports	**500.7**	**699.7**	**620.1**	**740.8**	**813.3**
Exports	**1,742.1**	**1,202.2**	**1,745.6**	**1,695.2**	**1,854.7**
Consumption[a]	**3,579.4**	**3,969.9**	**3,582.5**	**4,032.4**	**4,413.7**
Multicomponent fertilizers CN 3105					
Production	**2,077.3**	**1,138.5**	**1,941.8**	**2,016.2**	**1,894.1**
— containing N	165.5	79.6	145.8	156.8	138.8

Source: ***The Central Statistical Office (GUS)***

Multicomponent fertilizers of type ***NP***, ***NPK***, ***NPKMg***, and the like, are also carriers of nitrogen. They are produced mainly by the **"Police" Chemical Plant**, as well as the **"Fosfory" Phosphatic Fertilizers Plant** of **Gdańsk**, **"Siarkopol"** of **Tarnobrzeg**, **"Fosfan"** of **Szczecin**, and many smaller manufacturers. Their total production volume was reduced by ca. 10% in 2008 and collapsed in 2009, primarily in "Police" plant. In the last three years, their production was partly recovered to 1.9-2.0 Mtpy (Tab. 4). N_2 content in multicomponent fertilizers amounted to ca. 138,800 t in 2012 (only 7% of total N_2 supply, the remaining 93% from nitrogen fertilizers).

Trade

Exports and imports in ***elemental nitrogen*** and ***nitric acid*** in general do not exceed 50,000 tpy. ***Ammonia*** and ***nitrogen fertilizers*** are commonly exported from Poland in significant amounts. The level of ***ammonia*** exports were in general above 100,000 tpy, but in the years 2009-2010 they were significantly reduced. The main buyers are the Czech Republic, Slovakia, Sweden, and Germany (Tab. 5). On the contrary, imports of ***ammonia*** from Ukraine, Russia and Belarus were significant only in the years 2009-2010 (Tab. 2).

The most significant exports, however, are of ***nitrogen fertilizers***, reaching commonly 30–40% of production volume, except of 2009 (Tab. 4). They are sold not only in Europe, but also in Africa and America. In the last years they varied between 1.2–1.8 Mtpy, though in 2009 their amount was the lowest in the last ten years (Tab. 6).

Tab. 5. Polish exports of ammonia, by country — CN 2814

'000 t

Year	2008	2009	2010	2011	2012
Exports	**239.9**	**40.8**	**71.9**	**112.2**	**157.0**
Czech Republic	76.1	24.9	36.2	83.1	80.1
Denmark	1.6	1.1	0.0	0.3	0.6
Finland	-	-	-	8.0	-
France	-	-	-	8.0	-
Germany	59.1	3.3	2.0	1.2	20.2
Netherlands	-	-	-	-	9.0
Norway	-	-	-	-	8.0
Slovakia	10.5	5.5	26.2	5.1	15.0
Sweden	92.3	4.3	5.6	6.1	22.3
Others	0.3	1.7	1.9	0.4	1.8

Source: ***The Central Statistical Office*** *(GUS)*

Tab. 6. Polish exports of nitrogen fertilizers, by country — CN 3102

'000 t

Year	2008	2009	2010	2011	2012
Exports	**1,742.1**	**1,202.2**	**1,745.6**	**1,695.2**	**1,854.7**
Argentina	14.5	–	5.0	10.0	–
Austria	13.4	18.7	12.6	11.7	35.0
Belarus	–	–	–	5.5	16.2
Belgium	33.0	37.3	110.5	80.3	17.5
Brazil	176.7	201.9	173.5	154.8	145.2
Cameroon	8.0	9.9	3.9	10.3	5.0
Canada	–	–	0.1	9.8	38.0
Czech Republic	199.2	131.4	96.6	127.1	142.3
Denmark	139.7	96.3	179.4	92.2	97.9
Estonia	–	–	–	6.9	20.8
France	246.3	107.6	71.2	151.1	217.4
Germany	475.3	258.1	526.9	539.3	452.5
Hungary	5.3	23.2	16.2	8.2	6.3
Ireland	20.8	3.2	51.4	18.2	2.7
Italy	13.0	11.0	11.9	22.0	22.2
Ivory Coast	–	2.1	7.8	–	0.0
Latvia	20.6	6.9	14.1	15.8	11.2
Lithuania	30.5	40.1	51.4	57.2	70.6
Netherlands	7.0	4.7	15.5	12.2	14.3
Peru	–	–	–	–	19.8
Portugal	4.1	7.9	12.2	0.5	3.7
Slovakia	61.0	49.3	77.5	75.2	82.1

Spain	15.5	29.1	5.2	1.6	8.1
Sweden	40.0	8.4	87.4	70.3	61.9
Turkey	0.2	41.5	1.4	11.1	19.7
United Kingdom	104.3	11.0	107.0	169.5	249.5
USA	62.8	0.0	–	0.4	2.8
Others	50.9	102.6	106.9	34.0	92.0

Source: ***The Central Statistical Office (GUS)***

The main purchasers are Germany, the United Kingdom, France, Brazil, and the Czech Republic (Tab. 6). In the assortment structure of exports, ***solution of ammonium nitrate*** and ***urea***, ***nitro-chalk***, ***ammonium sulfate***, and ***urea*** dominate, with minor sales of other types. Significant amounts of fertilizers were also imported to Poland — up to over 800,000 t in 2012 (Tab. 4), coming mainly from Germany, Russia, Lithuania, and the Czech Republic.

The trade balance in ***ammonia*** is traditionally highly positive, only in the years 2009-2010 due to exports collapse started to be negative (Tab. 7). The trade balance in ***nitrogen fertilizers*** has been highly positive for years, sometimes even exceeding 1 billion PLN/y. Only in 2009 as a result of low exports volumes and lower prices it was reduced to under 300 million PLN (Tab. 7, 8).

Tab. 7. Value of ammonia and nitrogen fertilizers trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Ammonia CN 2814					
Exports	295,341	47,699	77,959	164,797	251,936
Imports	65,309	82,546	107,115	51,283	19,282
Balance	**+230,032**	**-34,847**	**-29,156**	**+113,514**	**+232,654**
Nitrogen fertilizers CN 3102					
Exports	1,569,411	828,739	1,162,161	1,616,522	1,873,807
Imports	455,882	529,889	455,082	717,043	850,104
Balance	**+1,113,529**	**+298,850**	**+707,079**	**+899,479**	**+1,023,703**

Source: ***The Central Statistical Office (GUS)***

Consumption

Elemental nitrogen is used mainly as an inert protective gas in the chemical industry and electronics, as well as a cooling agent (liquid nitrogen). ***Ammonia*** is used primarily for the production of nitric acid and nitrogen fertilizers. ***Nitric acid*** is utilized predominantly for nitrogen fertilizers, but also for the production of many chemical compounds and explosives.

Nitrogen fertilizers are the most common fertilizers used in Polish agriculture. Domestic consumption ranges between 3.6–4.4 Mtpy. Record level of 4.4 Mt was achieved in the last year (Tab. 4).

Tab. 8. Average unit values of ammonia and nitrogen fertilizers trade in Poland

Year	2008	2009	2010	2011	2012
Ammonia CN 2814					
Average exports unit values					
— PLN/t	1,231.2	1,168.2	1,084.4	1,468.3	1,604.5
— USD/t	529.7	366.9	358.7	488.8	490.9
Average imports unit values					
— PLN/t	1,403.5	970.5	1,094.5	1,448.3	1,541.8
— USD/t	587.9	314.4	361.1	503.1	484.6
Nitrogen fertilizers CN 3102					
Average exports unit values					
— PLN/t	900.9	689.3	665.8	953.6	1,010.3
— USD/t	388.3	215.4	221.7	325.1	308.5
Average imports unit values					
— PLN/t	910.4	757.3	733.9	968.0	1,045.2
— USD/t	377.9	233.9	247.5	327.0	318.9

Source: ***The Central Statistical Office (GUS)***

Main companies involved in nitrogen and nitrogen compounds production in Poland, as of December 2012

- Grupa Azoty Zakłady Azotowe Puławy S.A. w Puławach (Grupa Azoty Puławy Nitrogen Plants Joint Stock Co. of Puławy), Al. Tysiąclecia Państwa Polskiego 13, 24–110 Puławy, tel. +48 81 5652833, fax +48 81 5652856, www.zapulawy.pl — *elemental nitrogen, ammonia, nitric acid, nitrogen fertilizers* (*ammonium nitrate, urea, solution of ammonium nitrate and urea, ammonium sulfate*).
- Grupa Azoty S.A. Zakłady Azotowe w Tarnowie (Grupa Azoty Joint Stock Co. Nitrogen Plants in Tarnów), ul. Kwiatkowskiego 8, 33–101 Tarnów, tel. +48 14 6330781, fax +48 14 6330718, www.grupaazoty.com — *elemental nitrogen, ammonia, nitric acid, nitrogen fertilizers* (*nitro-chalk, ammonium nitrate, ammonium sulfate*).
- Grupa Azoty Zakłady Azotowe Kędzierzyn S.A. w Kędzierzynie-Koźlu (Grupa Azoty Kędzierzyn Nitrogen Plants Joint Stock Co. of Kędzierzyn-Koźle), 47–220 Kędzierzyn-Koźle, ul. Mostowa 30A, tel. +48 77 4812000, fax +48 77 4812999, www.grupaazoty.com — *elemental nitrogen, ammonia, nitric acid, nitrogen fertilizers* (*ammonium nitrate, nitro-chalk, solution of ammonium nitrate and urea, urea*).
- Anwil S.A. we Włocławku (Anwil Joint Stock Co. of Włocławek), ul. Toruńska 222, 87–805 Włocławek, tel. +48 54 2363091, fax +48 24 3677634, www.anwil.pl — *elemental nitrogen, ammonia, nitric acid, nitrogen fertilizers* (*ammonium nitrate, nitro-chalk*).
- Zakłady Azotowe Chorzów S.A. w Chorzowie (Chorzów Nitrogen Works Joint Stock Co. of Chorzów), ul. Narutowicza 15, 41–503 Chorzów, tel. +48 32 7362000, fax

+48 32 7362037, www.azoty-adipol.pl — *ammonia, nitric acid, potassium and calcium nitrates*.

- Grupa Azoty Zakłady Chemiczne Police S.A. w Policach (Grupa Azoty Police Chemical Plant Joint Stock Co. of Police), ul. Kuźnicka 1, 72–010 Police, tel. +48 91 3171717, fax +48 91 3173603, www.grupaazoty.com — *ammonia, urea, multicomponent fertilizers*.
- Gdańskie Zakłady Nawozów Fosforowych "Fosfory" Sp. z o.o. w Gdańsku ("Fosfory" Phosphatic Fertilizers Plant Ltd. of Gdańsk), ul. Kujawska 2, 80–550 Gdańsk, tel. +48 58 3438376, fax +48 58 3038555, www.fosfory.pl — *multicomponent fertilizers*.
- Zakłady Chemiczne Siarkopol Tarnobrzeg Sp. z o.o. w Tarnobrzegu (Siarkopol Tarnobrzeg Chemical Plants Ltd. of Tarnobrzeg), ul. Chemiczna 3, 39–400 Tarnobrzeg, tel. +48 15 8565801, fax +48 15 8229797, www.zchsiarkopol.pl — *multicomponent fertilizers.*
- Fosfan S.A. w Szczecinie (Fosfan Joint Stock Co. of Szczecin), ul. Nad Odrą 44/65, 71–820 Szczecin, tel. +48 91 4538394, fax +48 91 4538490, www.fosfan.pl — *multicomponent fertilizers.*
- PGNiG S.A. Oddział w Odolanowie (Polish Oil and Gas Company Joint Stock Co., Odolanów Unit), ul. Krotoszyńska 148, 63–430 Odolanów, tel. +48 62 7364441, fax +48 62 7365989, www. Odolanow.pgnig.pl — *elemental nitrogen liquid*.

For other plants producing *elemental gaseous nitrogen*, see **GASES, COMMERCIAL**.

OIL, CRUDE

Overview

Crude oil, together with natural gas, hard and brown coal, and lignite, is a basic fuel for the world's energy economy. Natural deposits are the only source of **crude oil**. Preliminary processing, i.e. desalination and deemulgation, are needed to lower a water content below 1%. Some types of crude oil require further stabilization by the separation of volatile fractions — ***methane***, ***ethane***, ***propane***, and ***butane*** — which serve both as fuels and as important raw materials for the chemical industry, and are extracted mainly from natural gas. Preliminary **purified crude oil** is the first commercial product, which can then be processed into various **petroleum products**, e.g. ***gasoline*** (***petrol***), ***diesel oil***, ***fuel oil***, ***kerosene***, and ***mazout*** (the remaining product used for further processing). These products are used directly or processed into further derivatives.

Currently, petroleum products are consumed mainly by the fuel and power industries (almost 90% of the total consumption). They are also used in the petrochemicals industry to produce many **synthetic products** (***fibers***, ***rubber***, ***paints*** and ***lacquers***, ***detergents***, ***drugs***, ***chemicals***, etc.).

Sources

Only three relatively large deposits of ***crude oil*** — called **BMB**, **Lubiatów** and **Grotów** — has been discovered in Poland in recent years (BMB in the 1990s, Lubiatów in 2004, Grotów in 2005), despite intensive exploration works were done. The prospects for the discovery of significant new crude oil deposits on land are limited. The reserves of 82 mostly small deposits recognized in the **Polish Lowland**, the **Carpathian Mountains**, and the **Carpathian Foredeep** were 20.1 Mt, including 7.8 Mt in the **BMB** deposit, 5.4 Mt in the **Lubiatów** deposit, 1.8 Mt in the **Grotów** deposit and 1.3 Mt in the **Cychry** deposit (as of 31 December 2012). Several dozen concessions for further exploration of certain promising areas in the Polish Lowland and the Carpathian Foredeep have been granted.

On the **Baltic Sea Shelf**, up till now two crude oil and accompanying gas deposits were recognized — **B3** (currently being operated) and **B8** (currently under development). Reserves of B3 and B8 deposits were 4.9 Mt, including 3.5 Mt in B8 (reserves recalculated in 2009), and 1.5 Mt in B3 deposit (as of 31 December 2012). At present, exploration works are carried on in the NE area of the Polish economic zone of the Baltic Sea. One of results is the confirmation of presence of a few potential structures.

Production

Crude oil production in Poland in the years 2008–2012 decreased by ca. 10% to 680,000 t (Tab. 1). Offshore production on the Baltic of shelf decreased by ca. 27%, and onshore production decreased by ca. 1%, respectively. The total supply met ca. 3% of the domestic demand for crude oil, and constituted only 1% of the total domestic supply of primary energy in 2012.

Tab. 1. Crude oil statistics in Poland — CN 2709

'000 t

Year	2008	2009	2010	2011	2012
Production	755	687	687	617	680
— *offshore production*	*259*	*183*	*186*	*149*	*188*
— *onshore production*[1]	*496*	*504*	*501*	*468*	*492*
Imports	20,918	20,098	22,688	23,792	24,630
Exports	247	226	211	292	211
Change in stocks	390	134	325	-52	-52
Consumption[a]	21,036	20,425	22,839	24,169	25,151

Source: ***The Central Statistical Office (GUS),*** [(1)] ***POGC***

The deposits located in the **Polish Lowland** supply ca. 90% of the onshore oil output. These are operated by the **Polish Oil and Gas Company Joint Stock Co.** (**POGC**) — **Zielona Góra Unit**. **POGC — Sanok Unit**, operates the deposits in the **Carpathians** (ca. 5% of the terrestrial production) and the **Carpathian Foredeep** (ca. 4%). According to the new strategy of POGC, onshore crude oil production should increase to ca. 1 Mtpy until 2015 due to development of new **Lubiatów** and **Grotów** deposits (in 2012 new **Lubiatów-Międzychód-Grotów – LMG** mine was commenced) and further development of **BMB** deposit. The **B3** deposit in the **Baltic Sea Shelf** is operated by the **LOTOS Petrobaltic Joint Stock Co.** (**LOTOS Capital Group**). It intends to expand production volume considerably, even up to 1.0 Mtpy in the next few years, by growth of output from **B3** deposit, as well as by development of output from **B8** deposit, and maybe other potential structures.

Trade

In the years 2008–2012, ***crude oil*** imports to Poland increased by 18% to ca. 24.6 Mt. In 2012 ca. 99% of deliveries came from Russia and Norway, the rest - from Iraq, Tunisia and Saudi Arabia etc. (Tab. 2). It should be mentioned that in the last year all the imports from Russia were realized through brokers from Cyprus, Bermuda, Virgin Islands, Germany, Switzerland, and the United Kingdom. All imported oil from Russia is delivered through the **"Przyjaźń"** pipeline (throughput 50 Mtpy to Płock). The remaining amounts are delivered by sea.

Tab. 2. Polish imports of crude oil, by country — CN 2709

'000 t

Year	2008	2009	2010	2011	2012
Imports	**20,918**	**20,098[r]**	**22,688**	**23,792**	**24,630**
Algeria	–	424	–	–	–
Azerbaijan	212	–	–	–	–
Belarus	109	372	0	160	–
Colombia	–	–	97	–	–
Denmark	–	0	85	–	–
Iran	–	–	–	124	–
Iraq	–	–	–	–	120
Kazakhstan	24	7	–	0	0
Norway	1,194	275	1,142	1,336	716
Saudi Arabia	–	–	–	–	59
South Africa, Republic of	–	131	–	–	–
Russia	19,287	18,574	20,761	21,086	23,618
Tunisia	–	–	–	–	103
United Kingdom	83	163	0	158	0
Unknown country[e]	–	143	600	920	–
Others	9	9	3	8	14

*Source: **The Central Statistical Office (GUS)***

The trade balance in ***crude oil*** is traditionally highly negative (Tab. 3). In the years 2008–2012 it rose rapidly, exceeding 63 billion PLN in 2012. It was a result of rising world oil prices, as well as increase of imports volumes. The only exception was 2009, when oil prices and imports volumes were reduced, and negative trade balance was temporarily reduced to ca. 26 billion PLN (Tab. 3, 4).

Tab. 3. Value of crude oil trade in Poland — CN 2709

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	445,000[e]	250,000[e]	340,000[e]	700,000[e]	566,690
Imports	34,540,151	26,092,513[r,e]	38,190,715[e]	54,939,232[e]	63,891,033
Balance	**-34,095,151[e]**	**-25,842,513[r,e]**	**-37,850,715[e]**	**-54,239,232[e]**	**-63,324,343**

*Source: **The Central Statistical Office (GUS)***

Tab. 4. Average unit values of crude oil imports to Poland — CN 2709

Year	2008	2009	2010	2011	2012
PLN/t	1,651.2	1,298.3[r,e]	1,683.3[r,e]	2,309.1[e]	2,682.9
USD/t	710.1	422.7[r,e]	555.6[r,e]	786.2[e]	822.5

*Source: **The Central Statistical Office (GUS)***

Consumption

Crude oil's share in the structure of domestic primary energy consumption amounts to 24%. All crude oil is processed to ***petroleum products***: ***fuels*** — gasoline (petrol), diesel oil, fuel oil, liquefied petroleum gas, etc., and ***non-fuels***: asphalts, motor-oils, lubricants, paraffin, kerosene, solvents, etc. As in other developed countries, over 80% of the Polish demand for ***petroleum products*** is met by domestic producers.

Crude oil is processed in 4 refineries, with a total capacity of ca. 27.4 Mtpy. The largest facilities are the **Płock Refinery** (capacity of 16.3 Mtpy) and the **Gdańsk Refinery** (actual capacities 10.5 Mtpy). The remaining smaller refineries, i.e. **Trzebinia** (0.5 Mtpy) and **Jedlicze** (0.1 Mtpy), supplement the production of basic fuels (i.e. gasoline, diesel oil, and fuel oil) with over 300 specialized petroleum products (so-called niche products). The fifth refinery in **Jasło** finished oil processing in 2009.

The shortage of ***petroleum products*** on the domestic market, especially liquid and gas fuels, is supplemented by imports. It is especially the case of ***diesel oil***. On the contrary, Poland is still the net exporter of ***fuel oil*** (Tab. 5).

Tab. 5. Principal petroleum products statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Gasoline (petrol)					
Production	4,081	4,271	4,210	3,904	4,009
Imports	665	492	415	530	437
Exports	327	369	463	518	678
Consumption[a]	4,419	4,394	4,162	3,916	3,768
Diesel oil					
Production	8,433	8,901	9,742	10,652	10,854
Imports	2,284	2,227	2,355	1,942	1,419
Exports	282	128	43	127	337
Consumption[a]	10,435	11,000	12,054	12,467	11,936
Fuel oil					
Production	4,145	3,818	4,354	4,212	4,546
Imports	75	93	102	77	73
Exports	1,165	1,059	1,633	2,054	2,310
Consumption[a]	3,055	2,852	2,823	2,235	2,309

Source: ***The Central Statistical Office (GUS)***

As a result of long process of Polish oil industry restructurisation, significant changes in the organisation and ownership structure of this branch occurred. In the end of 2009, two State Treasury companies were consolidated: **Logistic Operator of Liquid Fuels Ltd. (Operator Logistyczny Paliw Płynnych - OLPP**) and **"Przyjaźń" Oil Pipelines Management Enterprise Joint Stock Co.** (**PERN "Przyjaźń"**), and **PERN Capital Group** was established.

Now, two main companies are involved in crude oil processing and oil products manufacture in Poland. i.e. the **Polish Oil Company Joint Stock Co. — PKN ORLEN S.A.**

(refineries **Płock**, **Trzebinia**, and **Jedlicze**) and **Capital Group LOTOS Joint Stock Co. — GK Grupa LOTOS S.A.** (refinery **Gdańsk**, and **LOTOS Petrobaltic**).

Storage and pipeline transportation of crude oil through **"Przyjaźń"** pipeline (in the Polish part) and **"Pomorski"** pipeline (between Gdańsk and Płock), as well as pipeline transportation of petroleum products, is managed by the **PERN "Przyjaźń"** (100% State Treasury property). In the area of trans-shipment, transportation and storage of crude oil and petroleum products, a few companies were established in Poland. **PPS Port Północny Ltd.** is engaged in trans-shipment of oil and oil products in the **Liquid Fuels Basis** (100% **Naftoport Ltd.** – 67% PERN Capital Group) in the Północny Port in Gdańsk. It has capacities 34 Mtpy. Petroleum products stores in the Poland are managed by the **OLPP Ltd.** (previously: "Naftobazy" Ltd., now in 100% PERN Capital Group). Rail transportation is realized by: **GATX Rail Poland Sp. z o.o.** (former DEC Ltd., owned by GATX Corp. of US), **Orlen KolTrans Ltd.** (100% **PKN ORLEN**) and **LOTOS Kolej Ltd.** (100% **Grupa LOTOS**), and others. Petroleum products from Płock refinery are partly transported by pipelines to **OLPP** stores in Rejowiec, Nowa Wieś Wielka, Boronów, Koluszki, Emilianów, and Mościska, and to Underground Oil and Fuel Store PKN ORLEN in Góra. The remaining part of Płock refinery products, as well as products from other refineries, are transported by rail tanks of Orlen, Lotos or GATX, as well as by car tanks. Petroleum fuels distribution is provided by over 6,756 petrol stations. The largest part of them belongs to PKN ORLEN S.A. (ca. 1,767) and Group LOTOS S.A. (ca. 405). The rest is owned by private domestic and international companies, such as: **British Petroleum** (ca. 446), **Shell** (ca. 376), **Statoil** (ca. 356), **Lukoil** (ca. 115, it recently bought Polish petrol stations of ConocoPhillips — Jet brand), **Neste** (ca. 106), and others.

Recycling

The only petroleum products which can be recycled are ***lubricants***, which are recycled in the course of purification, distillation, and refining at the **Jedlicze Refinery** of recycling capacity ca. 80,000 tpy. The Jedlicze Refinery introduced a new recycling program of lubricants, with ca. 15 companies dealing with buying up of used lubricants, all over Poland. It also modernizes and enlarges existing installation of used lubricants processing, to achieve a capacity of ca. 140,000 tpy.

Companies involved in crude oil production in Poland as of December 2012

- Polskie Górnictwo Naftowe i Gazownictwo S.A. w Warszawie (Polish Oil and Gas Company Joint Stock Co. of Warsaw), ul. Krucza 6/14, 00–537 Warszawa, tel. +48 22 5835000, fax +48 22 6918273; www.pgnig.com.pl — *crude oil.*
- LOTOS Petrobaltic S.A. w Gdańsku (LOTOS Petrobaltic Joint Stock Co. of Gdańsk), ul. Stary Dwór 9, 80–958 Gdańsk, tel. +48 58 3013061–5, fax +48 58 3014311, www.lotos.pl — *crude oil.*

PEAT

Overview

Peat is a mineral of organic origin, usually formed in cold, anaerobic, and extremely moist conditions. In its natural state, it usually contains 86–95% water.

There are many classifications of **peat**, based on botanical, physical, mechanical, geomorphological, genetical, or mixed criteria. For economic purposes, however, only two types are important: **fuel peat** and **horticultural peat**, used in agriculture, gardening, pomiculture, and medicine, and also (to a small extent) in the chemical industry.

Only **peat products** for agriculture, pomiculture, gardening, etc. are traded commercially. Polish standards distinguish the following peat types: **gardening peat**, **peat substrate**, **mineral peat mixes**, and **agricultural peat**, offered in bales or bags.

Sources

There are over 50,000 known occurrences and deposits of ***peat*** in Poland (a surface area of approx. 1.2 million ha), the resources of which amount to 17,000 Mm^3. In 2012, only 271 of these — with resources of 78,980 Mt, including 28,490 Mt of available reserves (as of 31 December 2012) — were listed in the **Mineral Resources Datafile**. Over 93% of the known deposits are in the northern and central parts of the country. Small deposits, smaller than 100 ha in area, are the most common (over 90% of the total number of deposits).

Production

In comparison to peat resources, its production in Poland is very limited, partly due to environmental restrictions. In the years 2011–2012, 97 deposits were developed and 66 deposits were extracted. ***Raw peat*** mining output amounted to 1,220,700 m^3 (Tab. 1). The majority of the peat mines produce peat at the level of several thousand tpy, and only in a few of them it exceeds 50,000 tpy. The largest producers are: **"Wokas" Peat Mines Ltd.** of **Łosice** with 7 mines in Lubelskie, Podlaskie and Mazowieckie voivodeships (total output 200,000–250,000 m^3py), **"Karaska" Peat Plant** of **Łomianki** with one mine in Mazowieckie voivodeships (output 130,000–180,000 m^3py) and **"Hollas" Ltd.** of **Pasłęk** with four mines in Warmińsko-Mazurskie and Pomorskie voivodeship (total output 140,000–160,000 m^3py). The production of ***commercial peat*** commonly constitute 55–70% of mining output (Tab. 1).

Tab. 1. Statistics on peat and peat products in Poland — CN 2703

'000 t

Year		2008	2009	2010	2011	2012
Mining output	['000 m^3]	1,066.1	1,151.5	985.5	1,214.0	1,220.7
Production		632.0	620.0	671.6	746.0	758.8
Imports		180.0	164.4	211.7	204.9	183.9
Exports		52.9	51.7	44.4	34.9	41.7
Consumption[a]		759.1	732.7	838.9	916.0	901.0

Source: ***The Central Statistical Office (GUS)***

Trade

Agricultural and ***horticultural peat*** have been traditionally exported to various European countries. Exports are very dispersed, decreasing in the last year. In the years 2011–2012 the main customers were Italy, Germany, Ukraine, Belarus the Netherlands, and - lately United Kingdom and Lithuania (Tab. 2). Simultaneously, imports of ***peat products*** have been continuously increasing from Belarus, Lithuania, Latvia, Germany, Ukraine, and Estonia (Tab. 3).

Tab. 2. Polish exports of peat and peat products, by country — CN 2703

'000 t

Year	2008	2009	2010	2011	2012
Exports	**52.9**	**51.7**	**44.4**	**34.9**	**41.7**
Belarus	1.7	2.0	3.3	3.7	4.6
Croatia	2.1	1.6	0.1	0.1	0.1
Germany	6.8	1.5	1.8	5.6	5.9
Ireland	2.1	–	–	–	–
Italy	29.7	37.1	29.2	15.0	13.4
Lithuania	0.0	0.0	3.6	0.0	2.9
Malaysia	0.5	0.5	0.7	0.2	0.3
Moldova	0.2	0.1	0.2	0.2	0.5
Netherlands	1.2	–	1.1	4.4	0.0
Oman	0.0	0.1	0.1	0.1	0.1
Russia	0.0	0.2	0.0	0.0	0.5
Slovenia	2.3	3.4	1.1	0.0	–
Spain	–	0.1	–	–	–
Ukraine	6.0	5.0	2.8	5.3	3.3
United Kingdom	–	–	–	0.0	9.5
Others	0.3[r]	0.1[r]	0.4[r]	0.3	0.6

Source: ***The Central Statistical Office (GUS)***

Since 1999 the trade balance in ***peat*** and ***peat products*** has been negative. In recent years, this deficit was still deepening (Tab. 4), mainly due to rising imports volumes. Since 2006, exports unit values have been higher than imports unit values (Tab. 5).

Tab. 3. Polish imports of peat and peat products, by country — CN 2703

'000 t

Year	2008	2009	2010	2011	2012
Imports	**180.0**	**164.4**	**211.7**	**204.9**	**183.9**
Belarus	45.1	42.3	73.1	56.1	41.2
Czech Republic	0.9	0.7	0.5	0.0	0.0
Denmark	0.9	0.1	0.2	–	0.2
Estonia	7.3	3.0	3.6	4.3	3.2
Finland	0.1	0.0	0.0	–	0.1
Germany	23.6	21.1	25.0	28.3	21.7
Italy	0.1	1.3	–	2.0	–
Latvia	47.9	51.3	51.0	35.9	51.7
Lithuania	44.6	35.8	42.4	36.5	58.2
Netherlands	2.8	0.3	1.3	0.4	0.1
Russia	1.9	2.4	2.1	1.6	2.2
Ukraine	3.4	5.9	12.4	39.6	5.3
Others	1.4[r]	0.2[r]	0.1	0.2	0.0

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Value of peat and peat products trade in Poland — CN 2703

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	17,431	23,066	19,797	12,156	14,471
Imports	44,416	45,964	51,341	57,212	55,107
Balance	**-26,985**	**-22,898**	**-31,544**	**-45,056**	**-40,636**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Average unit values of peat and peat products trade in Poland — CN 2703

Year	2006	2007	2008	2009	2010
Exports unit values					
PLN/t	297.2	305.2	329.3	446.1	445.7
USD/t	94.9	109.8	137.8	142.2	148.0
Imports unit values					
PLN/t	262.3	257.1	246.7	279.6	242.5
USD/t	83.6	92.2	103.2	89.8	80.7

Source: ***The Central Statistical Office (GUS)***

Consumption

Low and transient peats with a moisture content of 60–70% are used to produce ***agricultural peat***, ***peat compost***, and ***peat flower-pots***. Low, high, and transient peats containing 40–50% of water are processed into ***horticultural peat***, ***peat substrate***, and

mineral peat mixes, sold in bales, bags, or bulk. Therapeutic peat grades should meet specific requirements: that is, they are documented and exploited for this purpose only. They are used to make ***peat bath***, ***therapeutic paste***, ***dressings***, and ***therapeutic preparations***, including the ***Tołpa preparation*** used in the treatment of cancer.

Principal companies involved in peat production in Poland as of December 2012

- "Hollas" Sp. z o.o. w Pasłęku ("Hollas" Ltd. of Pasłęk), ul. 3 Maja 30, 14–400 Pasłęk, tel. +48 55 2482000, fax +48 55 2482009, www.hollas.pl
- "Wokas" Kopalnie Torfu Sp. z o.o. w Łosicach ("Wokas" Peat Mines Ltd. of Łosice), ul. Błonie 5A, 08–200 Łosice, tel./fax: +48 83 3590555, www.wokas.pl
- "Torfex" Sp. z o.o. w Niedrzwicy ("Torfex" Ltd. of Niedrzwica), Niedrzwica 25, 19–500 Gołdap, tel./fax +48 87 6153945, www.torfex.pl
- Zakład Torfowy "Karaska" w Łomiankach ("Karaska" Peat Plant of Łomianki), ul. Partyzantów 35, 05–092 Łomianki, tel./fax +48 22 7512269, www.karaska.pl
- "Lasland" Sp. z o.o. w Gródach ("Lasland" Ltd. of Gródy), Gródy, 72–342 Cerkwica, tel. +48 91 3867776
- Zakład Produkcji Torfowej "Torf" Sp. z o.o. ("Torf" Ltd. Peat Production Plant), Nowy Chwalim, 78–460 Barwice, tel./fax +48 94 3736383, www.torf.home.pl
- "Bio-Produkty" Sp. z o.o. Athena ("Bio-Produkty" Ltd. Athena), ul. Piramowicza 16A, 71–157 Szczecin, tel. +48 91 3860117, www.athena.com.pl
- "Agromis" S.C. Przedsiębiorstwo Wielobranżowe ("Agromis" Multitrade Company civil partnership), Łochowice 36, 86–065 Łochowo; tel. +48 52 3202935, fax +48 52 3202936, www.agromis.pl
- "Atlas Planta" S.C. ("Atlas Planta" civil partnership), ul. Przemysłowa 8, 85–758 Bydgoszcz; tel./fax +48 52 3421902, www.atlas-planta.pl

PERLITE

Overview

Perlite is rhiolithic volcanic glass, whose volume increases considerably (even fifteen times) when roasted at 800–1,100°C. In this way **expanded perlite** is obtained (with a volume density of 55–500 kg/m^3), useful primarily as insulating material and light aggregate, and also as absorbent and filtering material. In the majority of its applications it can be replaced with ***vermiculite***, ***pumice***, ***diatomite***, or related materials.

Sources

Perlite deposits do not occur in Poland.

Production

Raw perlite is not produced in Poland. The total production level of ***expanded perlite*** is impossible to assess, because — according to the Central Statistical Office classification — it is recorded together with other porous minerals in one **PKWiU** item **23.99.19.20**. It is possible however to estimate the production level based on the data obtained from domestic manufacturers - in recent years it could reach 300,000-360,000 m^{3}py.

The largest supplier of ***expanded perlite***, which offers products for construction, filtration and agricultural, is **Perlipol S.C.** in **Bełchatów**, which bases on the raw material imported mainly from Hungary and Slovakia. In the plant, which was opened in 2005, there are three production lines for expanding perlite in operation, with total capacities ca. 300,000 m^{3}py. Due to increasing supply for building perlite, which makes recently about 90% of total company's supply, its production has grown to the level of 250,000 m^{3}py in 2011-2012, sold almost entirely on the domestic market. Besides the construction grades, the company offers perlite for horticulture and filtration applications.

The second largest manufacturer and Polish pioneer in the production of expanded perlite is the **"Zębiec" Mining and Metal Works** of **Starachowice,** which imported crude perlite from Hungary already since 1999. After modernization of the expanding installation and start of agroperlite manufacturing for horticultural applications, the company's production reached the level of 54,000–66,000 m^{3}py (i.e. ca. 5,400–6,600 tpy) with increase to almost 70,000 m^{3}py in last two years. Perlite is manufactured there in four grades of: **0** (max. bulk density of 120 g/m^3) and **I-III** (max. 100, 150, and 180 g/m^3). Almost 80% of its production is consumed in building applications, in smaller amounts in agiculture, horticulture and metallurgy as an insulation filler.

Since 2007 **PTH Certech** company in Niedomice near Tarnów has produced perlite for agriculture and horticulture application on the basis of raw perlite from the Lehotka deposit in central Slovakia. The production volume of the plant in recent years ranged from 3,300-4,000 m^{3}py, the while the level of raw materials imports 420-500 tpy. Also in 2007, the production line of expanded perlite for construction application, with the installed capacity of ca. 50,000 m^{3}py, was constructed by **Piotrowice II Ltd.** in Tarnobrzeg. The production on the basis of Hungarian raw material ranged between 20,000 to 30,000 m^{3}py in the years 2011-2012 depending on consumer demand, and in small amount was exported. In September 2012, the next modern plant of expanded perlite was opened in **Kazimierz Biskupi** near Konin by **Perlit A.F. Ltd.,** whose main shareholder is the Polish **Atlas Group**. The plant uses the Hungarian raw material, being launched with the participation of the Hungarian mining company capital. Its production reached 4,000 m^3 in the year of commissioning, but target production capacity is about 80,000 m^{3}py. Perlite produced there is mainly used for building applications, not only for internal purposes of Atlas Group. ***Expanded perlite*** based on Hungarian raw materials is also produced in the plant of **Knauf Jaworzno III Ltd.** Almost all final products are used for the plant's internal dry plasters production, but in small amount they are also exported to another Knauf's plant in Riga.

Trade

Imports of perlite (non-expanded) is recorded in the common CN position with vermiculite and chlorite, but it dominates quantitatively within CN 25301010 position. The importation of ***perlite*** has shown a strong growth in recent decade (Tab. 1). Development of domestic production of ***expanded perlite*** in **Zębiec**, **Perlipol**, **PTH Certech**, and **Piotrowice II**, as well as in newly opened **Perlit AF Ltd**. were the main reasons of growth in imports. Additionally, another Polish company **Perlit-Polska**, which previously imported expanded perlite from the Czech Republic, Hungary and Slovakia, recently purchased an expanding plant in Novy Jicin in the Czech Republic. The production plant with capacity of 100,000 m^{3}py supplies expanded perlite mainly for construction (80%) and horticulture applications. A part of expanded perlite manufactured there is sold on Polish markets.

In the last five years, imports of perlite rose to the level of 25,400 t in 2011, with small decrease in 2012 (Tab. 1). The majority of deliveries was coming from Hungary (83% of imports in 2012), for Zębiec, Knauf and Piotrowice II, and recently Perlit AF companies. Since 2010, the imports from Slovakia decreased significantly, and in 2012 fell to less then 3,300 t. i.e. only 13% of imports (Tab. 1). Some occasional re-exports of small amounts of perlite occurred (including ***expanded perlite***), as well as exports of this material from the plant of **Knauf Jaworzno III Ltd.** and **Zębiec** to Lithuania and Belarus. The trade balance in ***perlite*** was always negative and in the last years it was deepened as a result of the increasing importation volume, including the most expensive ***expanded perlite***, as well as rise of imported Slovakian and Hungarian perlite prices (Tab. 2).

Tab. 1. Perlite statistics in Poland — CN 2530 10 10

t

Year	2008	2009	2010	2011	2012
Imports	**20,030**	**21,568**	**24,542**	**25,476**	**24,914**
China	–	–	82	96	22
Czech Republic	154	33	38	27	28
Germany	364	242	379	498	354
Hungary	12,548	13,256	13,141	16,979	20,663
Italy	23	24	24	–	–
Netherlands	67	14	8	–	9
Slovakia	6,872	7,901	10,723	7,667	3,237
Turkey	–	84	–	88	154
United Kingdom	–	–	97	5	–
Others	–	14	50	116	128
Exports	**129**	**56**	**78**	**204**	**188**
Consumption[a]	**19,901**	**21,512**	**24,464**	**25,272**	**24,726**

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of perlite trade in Poland — CN 2530 10 10

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	425	163	138	289	295
Imports	4,685	6,156	7,288	7,518	8,078
Balance	**-4,260**	**-5,993**	**-7,150**	**-7,229**	**-7,783**

Source: ***The Central Statistical Office (GUS)***

The average unit values of perlite imports refer to all grades of raw material as crude as expanded. Recently, due to the commencement of expanded perlite in Poland they refers mainly to crude perlite. Sine 2008 the importation unit values has shown significant rising tendency, with the exception of a slight decrease in 2011 (Tab. 3).

Tab. 3. The unit values of perlite imports to Poland — CN 2530 10 10

Year	2008	2009	2010	2011	2012
PLN/t	234	285	297	295	324
USD/t	67	92	98	101	99

Source: ***The Central Statistical Office (GUS)***

Consumption

The major market for ***expanded perlite*** in Poland is the construction industry — for thermal and acoustic insulation products, and lightweight component of gypsum plasters, in metallurgy — for insulation casting powders, and insulation refractories (perlite bricks), in the food industry — as a filter aid. In a limited scale it is also utilised as horticultural aggregate.

Companies involved in perlite production in Poland as of December 2012

- P.P.H.U. "Perlipol" s.c., 97–400 Bełchatów, ul. Przemysłowa 4, tel. +48 44 6333398, fax +48 44 6332408, www.perlipol.pl — *expanded perlite*.
- Zakłady Górniczo-Metalowe "Zębiec" S.A. w Zębcu ("Zębiec" Mining and Metal Works Joint Stock Company in Zębiec), 27–200 Starachowice, tel. +48 41 2747045, fax +48 41 2746177, www.zebiec.com.pl — *expanded perlite*.
- P.T.H. Certech, 33–132 Niedomice, ul. Fabryczna 36, tel./fax +48 14 6458703, www.certech.com.pl — *expanded perlite.*
- Zakład Surowców Chemicznych i Mineralnych "Piotrowice II" (Chemical and Mineral Raw Materials Production Works "Piotrowice II" Ltd.), 39–400 Tarnobrzeg, ul. Zakładowa 1, tel. +48 15 6415804, fax +48 15 6415805, www.piotrowice.com.pl — *expanded perlite.*
- Knauf Jaworzno III Sp. z o.o. (Knauf Jaworzno III Ltd.), 43–603 Jaworzno, ul. Promienna 51, tel. +48 32 7549 900, fax +48 32 7549 902, www.knauf.pl — *expanded perlite.*
- Perlit AF Sp. z o.o., 62-530 Kazimierz Biskupi, Kamienica 47, tel.+48 601 826 615, fax +48 63 241 22 74 — *expanded perlite*

PHOSPHATES

Overview

Phosphorus (**P**) and its compounds are obtained mainly from deposits of phosphate, apatite, and guano. The **apatite** deposits are richest in phosphorus; they contain ***fluoric apatite***, which is barely soluble in ground water and not absorbed by plants. Concentrates with 33–40% P_2O_5 are processed into phosphate fertilizers, which contain phosphate in an easily soluble and consumable form. **Phosphate** deposits are most common and occur widely around the world. They contain ***carbonate*** and ***hydroxilic apatite*** soluble in ground water and absorbed by plants. The concentrates contain 30–38% P_2O_5. In well-developed countries, animal bones are processed into bone meal, a high quality ***calcium-phosphate fertilizer***.

Sources

Deposits of ***phosphate concretion***, averaging 14% P_2O_5, are recognized in the NE part of the **Świętokrzyskie Mountains**. The resources in the 10 known deposits amount to 42.4 Mt of ***phosphates*** (7.35 Mt P_2O_5), including 10.77 Mt (1.47 Mt P_2O_5) in the formerly-mined deposits at **Annopol** (1924–1970) and **Chałupki** (1936–1956). These resources have been determined on the basis of the economic criteria used in the 1950s, and until recently have remained unchanged. However, in the early 1980s, when the new criteria were introduced, the economic value of these deposits became negligible due to quality of phosphate rock and depth of deposits.

Production

Currently, there is no production of ***phosphates*** in Poland.

Trade

The demand for phosphorus-bearing raw materials is satisfied entirely by imports (Tab. 1), consisting primarily of ***phosphate concentrates*** (32–33% P_2O_5), mainly from Algeria, Egypt, Morocco, Tunisia, Syria and sometimes from other countries (Tab. 2). Crisis on the world fertilizers market, reported since the second half of 2008, was visible also on the domestic market. Imports of calcium phosphates for the production of ***phosphates fertilizers and multicomponent fertilizers,*** after significant reduction in 2008, in 2009 totally collapsed, down by 73% comparing to 2007 to only 459,000 t (Tab. 1). It was the lowest imports level since the early 1970s. In 2010, domestic demand for fertilizers revived, and as a consequence phosphates imports jumped back to 1.3 Mt. In 2011 imports increased again to 1.4 Mt, but it is still 0.3 Mt less than 2007. In 2012, imports were reduced again to 1.2 Mt. Small amounts of phosphates are re-exported, mainly to the Czech Republic and Germany. Moreover, ***elementary phosphorus*** (yellow) is imported in amounts of 9,000–15,000 tpy (Tab. 5), almost exclusively from Kazakhstan and China.

Tab. 1. Natural calcium phosphates statistics in Poland — CN 2510

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Imports	1,449	459	1,302	1,438	1,238
Exports	0	0	0	0	0
Consumption[a]	1,449	459	1,302	1,438	1,238
— *P_2O_5 content*[e]	*471*	*149*	*423*	*467*	*402*

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of natural calcium phosphates, by country — CN 2510

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Imports	**1,449**	**459**	**1,302**	**1,438**	**1,238**
Algeria	–	45	223	243	391
Egypt	46	–	6	173	336
France	0	0	–	–	7
Israel	85	31	14[r]	45	80
Jordan	71	–	–[r]	–	–
Morocco	642	29	292[r]	405	254
Netherlands	15	2	35[r]	3	3
Syria	147	162	321	292	67
Togo	15	–	–	116	75
Tunisia	427	189	410	160	25
Others	1[r]	1	1	1	0

Source: ***The Central Statistical Office (GUS)***

The balance of ***natural calcium phosphates*** trade has been constantly negative. Rapid threefold increase of unit values of imported phosphates in 2008 (Tab. 4), in spite of lower import volumes, resulted in deepening of negative trade balance to 868 million PLN (Tab. 3). In 2009 due to imports collapse and lower import unit values, negative trade balance was reduced to only 163 million PLN. In 2010 unit values were still decreasing, but due to imports volume growth deficit rose to 412 million PLN. In 2011 and 2012 imports unit values were still increasing what resulted in deficit deepening down to almost 700 million PLN (Tab. 3, 4).

Tab. 3. Value of natural calcium phosphates trade in Poland — CN 2510

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	103	6	41	399	108
Imports	867,969	163,181	411,764	684,027	699,020
Balance	**-867,866**	**-163,175**	**-411,723**	**-683,628**	**-698,912**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of natural calcium phosphates imported to Poland — CN 2510

Year	2008	2009	2010	2011	2012
PLN/t	599.1	355.6	316.3	475.7	564.7
USD/t	257.5	113.6	104.1	156.1	172.8

Source: ***The Central Statistical Office (GUS)***

Consumption

The consumption of imported ***phosphate*** has been determined by the demand from agriculture, as well as by the production capacities of the six domestic manufacturers of ***phosphate*** and ***multicomponent fertilizers***. Recently, after a period of increase of ***phosphate fertilizers***, ***phosphorus compounds*** production and consumption in the years 2000–2004, in 2005 strong reduction of their domestic production and consumption occurred, while production of multicomponent fertilizers was continuously growing. In the years 2006–2007, ***phosphate fertilizers*** were reconstructed, with increasing share of production being exported. In case of ***phosphoric acid*** decreasing tendency was reported until 2005, with radical change in 2006. Rapid growth of prices of all raw materials necessary for production of phosphate and multicomponent fertilizers, observed in 2008, resulted in drop of domestic agriculture demand for such fertilizers. This tendency was continued in 2009, in spite of the fact, that world ***calcium phosphates*** prices were distinctly lower than in 2008. So, in the years 2008–2009 sold production of ***phosphate fertilizers*** (over 99% to ***superphosphates***) decreased by 77%, while sales of ***multicomponent fertilizers*** by 68% (regarding P_2O_5 content). These facts influenced over 70% drop of demand and production of ***phosphoric acid*** (Tab. 5). In 2010 situation in domestic agriculture improved, fertilizers prices were reduced, while food prices rose in general. As a result, demand for fertilizers rose, so imports of phosphates also were increasing. In the years 2010-2011 ***phosphate fertilizers*** production rose by 150% (in P_2O_5 content), ***multicomponent fertilizers*** by 173% (in P_2O_5 content), and ***phosphoric acid*** by 130%. In 2012, demand and production of ***phosphoric acid*** and ***multicomponent fertilizers*** were reduced by 10-15%, while for ***phosphate fertilizers*** production went down by 3%, but demand rose by 15%, with lower exports volume (Tab. 5). Processing of ***apatite*** in **Wizów Chemical Plant** into ***phosphoric acid*** and ***sodium tripolyphosphate*** for food industry and household chemistry, was recently abandoned. The only chemical plant processing ***elementary phosphorus*** into ***phosphoric acid*** and ***phosphorus compounds*** (mainly ***sodium tripolyphosphate***), is the **"Alwernia" Chemical Plant**.

Tab. 5. Phosphorus commodities statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Elementary phosphorus CN 2804 70					
Imports	15	9	13	15	15
Exports	6	2	2	1	0
Consumption[a]	9	7	11	14	15
Phosphoric acid CN 2809 20					
Production *[P_2O_5]*	293	141	293	320	271
Imports	26	7	19	24	32
Exports	24	17	20	36	27
Consumption[a]	295	131	292	308	276
Phosphate fertilizers CN 3103					
Production, sold	120	50	104	115	110
— *P_2O_5 content*	*37*	*14*	*31*	*35*	*34*
Imports	3	10	16	3	3
Exports	43	17	49	48	33
Consumption[a]	80	43	71	70	80
Multicomponent fertilizers CN 3105					
Production, sold	1,691	1,189	1,746	1,849	1,722
— *P_2O_5 content*	*304*	*135*	*329*	*368*	*317*

Source: ***The Central Statistical Office (GUS)***

The processing of phosphates causes many ecological problems, due to ***phospho-gypsum*** waste material storage. These wastes, properly processed, could be a source of ***gypsum*** (see: **GYPSUM AND ANHYDRITE**). The phosphate and apatite imported to Poland contain some amounts of ***fluorine***, ***uranium***, and ***rare earth elements***, which should be recovered or neutralized; otherwise, they considerably contaminate the environment. In the last years, some research works related to recovery of rare earth elements from phos pho-gypsum and neutralisation of the remaining wastes, were carried on. Gases generated during phosphoric acid and phosphate fertilizers production contain fluorine, being harmful to atmosphere. Up till now, installations for its recovery and production of fluorine compounds were commenced only in three plants. In **"Siarkopol" Tarnobrzeg Chemical Plant** ***cryolite*** is produced (see: **FLUORITE**), in **Luvena** (former **Luboń Chemical Works**) — ***hydrogen fluoride***, while in **Police Chemical Works** — ***sodium fluosilicate***.

Main companies involved in phosphoric acid and phosphate fertilizers production in Poland as of December 2012

- Zakłady Chemiczne Police S.A. (Police Chemical Plant Joint Stock Co. of Police), ul. Kuźnicka 1, 72–010 Police; tel. +48 91 3171717, 3174296, fax +48 91 3173603; www.zchpolice.pl — *phosphoric acid, multicomponent fertilizers NPS, NPKS, NPK-Mg, NPKMgS, NPKNaS, PK, PKMgS, NP.*
- Fosfory Sp. z o.o. Gdańskie Zakłady Nawozów Fosforowych (Fosfory Phosphate Fertilizers Plant Ltd. of Gdańsk), ul. Kujawska 2, 80–550 Gdańsk; tel./fax. +48 58 3073892, fax. +48 58 3073791; www.fosfory.com.pl — *phosphoric acid, superphosphates, multicomponent fertilizers PK, NPK.*
- Zakłady Chemiczne Luvena S.A. (Luvena Chemical Plant Joint Stock Co. of Luboń), ul. Romana Maya 1, 62–030 Luboń; tel. +48 61 8130251, 8130313, fax +48 61 8130212; www.luvena.pl — *superphosphates, multicomponent fertilizers NP, NPK.*
- Zakłady Chemiczne Siarkopol Tarnobrzeg Sp. z o.o. w Tarnobrzegu (Siarkopol Tarnobrzeg Chemical Plants Ltd. of Tarnobrzeg), ul. Zakładowa 50, 39–402 Tarnobrzeg 4, tel. +48 15 8555710, fax. +48 15 8229797, www.zchsiarkopol.pl — *superphosphates, NPK multicomponent fertilizers, synthetic cryolite.*
- Fosfan S.A. w Szczecinie (Fosfan Joint Stock Co. of Szczecin); ul. Nad Odrą 44/65, 71–820 Szczecin; tel. +48 91 4538394, fax +48 91 4538490; www.fosfan.com.pl — *superphosphates, NPK multicomponent fertilizers.*
- Zakłady Chemiczne Alwernia S.A. (Alwernia Chemical Plant Joint Stock Co.); ul. Olszewskiego 25, 32–566 Alwernia; tel. +48 12 2589100, fax +48 12 2832188; www.alwernia.com.pl — *phosphoric acid, sodium tripolyphosphate, other phosphorus compounds.*

PLATINUM GROUP METALS

Overview

Platinum, along with **palladium**, **rhodium**, **iridium**, **ruthenium**, and **osmium**, belongs to a family of noble metals that form adjacent triads: ***light platinum metals*** (ruthenium, rhodium, palladium) 44–49, and ***heavy platinum metals*** (osmium, iridium, platinum) 76–78. For centuries, ***platinum*** obtained from placer deposits was used in jewellry, as well as for crucibles and sometimes for coinage. Since the beginning of the 20th century, industrial applications of **platinum** and other platinum group metals were developed, especially as chemical catalysts. In the last 30 years, rapid development of autocatalysts was reported, where a majority of these groups of metals is currently used.

The most of **platinum group metals** supply comes from primary sources, i.e. principally from the deposits of ***sulphide ores*** and ***Cu-Ni ores***. Concentrate of platinum group metals is obtained from ores, which is processed in multistage complicated process by a few refineries with a use of hydrometallurgical methods. Considerable and still increasing amounts of these metals are recovered from secondary sources, e.g. from **platinum-** and **palladium-bearing scrap** (e.g. spent catalysts).

Sources

In Poland, the only economic source of ***platinum group metals*** is the ***copper ore*** of the **Fore-Sudetic Monocline** deposits. ***Platinum group metals*** concentrations occur mainly in the bottom of the copper-bearing shale series, with the highest amounts in the western part of **Lubin** deposit and eastern part of **Polkowice** deposit (up to 1,000 ppm Pt-metals). ***Platinum group metals*** form their own minerals, or occur as admixtures in ***gold minerals***, or in non-metallic compounds.

The secondary sources of ***platinum group metals*** in Poland are: spent catalytic gauzes from nitrogen plants, as well as other scrap and wastes from plants, which produce platinum group metals-bearing products and compounds.

Production

In the course of ***copper ore*** processing at the **KGHM Polska Miedź S.A.**, ***platinum metals*** are collected in ***copper concentrates***, then transferred into the ***anode sludge*** which remains after the electrolytic refining of ***copper***. The ***anode sludge*** is processed at the **Precious Metals Plant** of the **Głogów Copper Smelter** (Boliden technology). The waste sludge after the electrolytic refining of ***silver*** and the precipitation of ***gold*** is processed into ***palladium-platinum sludge*** containing 22–36% Pt and 12–22% Pd. The level of sludge production stabilized at 90–100 kgpy. The Pt-Pd sludge is sold mainly to the **State Mint** of **Warsaw**, where ***platinum group metals*** are obtained by refining. Minor quantities are sold to the **POCH Co.** of **Gliwice**. Sporadically, some amounts of sludge are also exported. ***Platinum*** is also recovered from waste solutions coming from the **Precious Metals Plant** in **Głogów** by some reduction method introduced in the **Non-ferrous Metals Institute**, **Legnica Branch**. ***Platinum concentrate*** with 30% Pt content is a product there.

Refined platinum group metals are manufactured in Poland mainly by the **Mennica-Metale Szlachetne Ltd.** of **Warsaw** (daughter company of the **State Mint** of **Warsaw**). It uses both ***Pd-Pt sludge*** from KGHM, and ***platinum group metals scrap*** and ***wastes***. The latter ones are purchased from industrial users of products containing these metals (especially spent catalytic gauzes from nitrogen plants), as well as imported. ***Platinum*** production from sludge in the **Mennica-Metale Szlachetne Ltd.** of **Warsaw** is estimated at 25–30 kgpy, while ***palladium production*** 15–20 kgpy. Probably production of ***platinum group metals*** (***platinum***, ***palladium***, ***rodium***, etc.) from secondary sources is much higher. ***Refined platinum*** obtained from waste solutions, as well as ***refined platinum*** and ***palladium*** from scraps are manufactured by **Innovator Ltd.** of **Gliwice** (daughter company of the **Non-ferrous Metals Institute** of **Gliwice**), at the level of under 20 kgpy. Total domestic production of ***platinum group metals*** (***metals and powders***) recently varied between 100-300 kgpy, coming mostly from scrap. However, official production data for 2011 - 7,569 kg - are ambiguous (Tab. 1).

The Mennica-Metale Szlachetne Ltd. of **Warsaw**, as well as the **POCH Co.** of **Gliwice** and **Innovator Ltd.** of **Gliwice** produce numerous ***platinum group metals compounds***, e.g. ***platinum chloride acid***, ***palladium chloride acid***, ***rhodium chloride acid***, ***compounds of the platinum***, and ***palladium chloride groups***, ***palladium***, ***platinum*** and ***rhodium nitrates***, ***palladium chloride***, ***rhodium sulphate***.

Trade

Trade of ***platinum group metals*** and their ***semiproducts*** are very variable, both in exports and in imports. The largest and the most stable is the trade of ***platinum semiproducts*** and ***palladium semiproducts***. ***Metallic platinum group metals*** trade was very variable, sometimes above 100 kgpy or even 1,000 kgpy, and in 2011 even almost 100,000 kg (Tab. 1). Trade of other ***rhodium, iridium, osmium***, and ***rhutenium semiproducts*** is insignificant, commonly not exceeding a few kgpy. The official trade of ***platinum group metals*** and their ***semiproducts*** is reported almost entirely with Western and Central European countries, as well as the US. It is probable that some amounts of these metals come to Poland from Eastern Europe unofficially (smuggling).

Tab. 1. Platinum-group metals statistics in Poland

kg

Year	2008	2009	2010	2011	2012
Platinum group metals — metal and powder					
Production	**381**	**95**	**156**	**7,569**	**265**
Imports	**126**	**45**	**37**	**41**	**675**
• *Platinum* **CN 7110 11**	*5*	*5*	*4*	*3*	*616*

•	*Palladium*	**CN 7110 21**	*117*	*37*	*28*	*33*	*48*
•	*Rhodium*	**CN 7110 31**	*4*	*3*	*5*	*3*	*10*
•	*Iridium, osmium and rhutenium*	**CN 7110 41**	*0*	*0*	*0*	*2*	*1*
	Germany		119	30	25	33	11
	Slovakia		–	–	–	–	580
	United Kingdom		4	5	5	3	42
	USA		3	1	0	3	42
	Others		–	9	7	2	0
	Exports		**18**	**12**	**810**	**97438**	**753**
•	*Platinum*	**CN 7110 11**	*13*	*1*	*11*	*64482*	*753*
•	*Palladium*	**CN 7110 21**	*1*	*1*	*796*	*32948*	*93*
•	*Rhodium*	**CN 7110 31**	*4*	*10*	*3*	*8*	*3*
•	*Iridium, osmium and rhutenium*	**CN 7110 41**	–	*0*	–	–	–
	Austria		–	1	–	–	–
	Czech Republic		–	–	25	45	510
	Germany		18	7	782	47	0
	United Kingdom		–	4	3	97346	243
	Consumption[a]		**489**	**128**	**-617**	**-89,828**	**187**
Platinum group metals — semiproducts							
	Imports		**668**	**4,770**	**2,590**	**2,092**	**618**
•	*Platinum*	**CN 7110 19**	*456*	*2,173*	*720*	*782*	*433*
•	*Palladium*	**CN 7110 29**	*165*	*1,957*	*456*	*87*	*171*
•	*Rhodium*	**CN 7110 39**	*36*	*163*	*1,289*	*1,072*	*14*
•	*Iridium, osmium and rhutenium*	**CN 7110 49**	*1*	*477*	*125*	*151*	*0*
	Austria		1	–	–	213	5
	Czech Republic		20	5	7	19	10
	Denmark		138	34	19	12	6
	France		27	1,762	325	18	37
	Germany		368	2,563	439	528	329
	Ireland		–	–	–	752	18
	Italy		3	8	101	24	0
	Japan		24	–	–	–	–
	Netherlands		12	1	–	2	2
	United Kingdom		49	385	1,682	518	199
	USA		14	3	6	4	8
	Others		12	9	11	2	4
	Exports		**7,257**	**29,575**	**282**	**1,112**	**301**
•	*Platinum*	**CN 7110 19**	*7,255*	*29,537*	*276*	*1,007*	*264*
•	*Palladium*	**CN 7110 29**	*2*	*37*	*4*	*100*	*37*

• *Rhodium*	**CN 7110 39**	–	*1*	*2*	*5*	*0*
• *Iridium, osmium and rhutenium*	**CN 7110 49**	–	–	–	*0*	*0*
Belarus		369	–	–	–	–
China		–	34	–	–	–
Czech Rep.		–	33	10	57	9
Germany		28	112	250	965	165
Kazakhstan		3,235	–	–	–	–
Netherlands		44	45	18	–	29
Romania		3,522	–	–	–	–
United Kingdom		55	29,350	2	8	0
USA		–	–	–	80	97
Others		4	1	2	2	1

Source: ***The Central Statistical Office (GUS)***

Total trade balance of ***platinum group metals*** and their ***semiproducts*** was commonly negative, with total deficit of a few million PLN/y. However, in 2009-2011 it was exceptionally highly positive for semiproducts, while in 2011-2012 - for metals (Tab. 2). The average unit values of ***platinum group metals*** and their ***semiproducts*** trade are very variable as a result of fluctuations of this trade, so they are not presented.

Tab. 2. Value of platinum group metals trade in Poland

'000 PLN

Year		2008	2009	2010	2011	2012
Platinum group metals — metal and powder						
Exports		2,308	1,399	1,705	34,357	116,200
• *Platinum*	**CN 7110 11**	*1,532*	*54*	*407*	*26,860*	*109,265*
• *Palladium*	**CN 7110 21**	*3*	*3*	*591*	*5,682*	*6,250*
• *Rhodium*	**CN 7110 31**	*773*	*1,339*	*707*	*1,815*	*685*
• *Iridium, osmium and rhutenium*	**CN 7110 41**	–	*3*	–	–	–
Imports		2,328	1,401	1,434	1,292	109,864
• *Platinum*	**CN 7110 11**	*355*	*293*	*395*	*500*	*103,960*
• *Palladium*	**CN 7110 21**	*250*	*604*	*467*	*330*	*4,557*
• *Rhodium*	**CN 7110 31**	*1,703*	*489*	*545*	*460*	*1,287*
• *Iridium, osmium and rhutenium*	**CN 7110 41**	*20*	*15*	*27*	*2*	*60*
Balance		**-20**	**-2**	**-271**	**+33,065**	**+6,336**
Platinum group metals — semiproducts						
Exports		14,004	35,799	43,200	173,527	43,906
• *Platinum*	**CN 7110 19**	*13,998*	*34,754*	*42,838*	*166,132*	*41,452*
• *Palladium*	**CN 7110 29**	*6*	*888*	*95*	*6,457*	*2,395*

•	*Rhodium*	**CN 7110 39**	–	*157*	*267*	*934*	*58*
•	*Iridium, osmium and rhutenium*	**CN 7110 49**	–	–	–	*4*	*1*
	Imports		20,652	21,143	32,486	28,318	50,015
•	*Platinum*	**CN 7110 19**	*13,496*	*14,240*	*22,678*	*21,350*	*37,225*
•	*Palladium*	**CN 7110 29**	*7,007*	*6,416*	*9,160*	*6,171*	*12,007*
•	*Rhodium*	**CN 7110 39**	*70*	*44*	*354*	*388*	*393*
•	*Iridium, osmium and rhutenium*	**CN 7110 49**	*79*	*443*	*294*	*409*	*390*
	Balance		**-6,648**	**+14,656**	**+10,714**	**+145,209**	**-6,109**

Source: ***The Central Statistical Office (GUS)***

Consumption

The main uses of ***platinum group metals*** in Poland are industrial applications such as manufacture of: catalytic gauzes, liquid metals for chinaware and crystal decoration, glass fiber bushings, crucibles, electrodes and other laboratory apparatus, rolled and drawn products. All these products are manufactured by the **Mennica-Metale Szlachetne Ltd.** of **Warsaw**, while ***chemical compounds*** also in the **POCH Co.** of **Gliwice** and the **Innovator Ltd.** of **Gliwice**.

Production of catalytic gauzes (***PtRh10***, ***PdAu20***, and ***PdAu10 alloys***) used by domestic nitrogen plants is currently the most important industrial application of ***platinum group metals*** in Poland. Liquid metals for decoration are sold to domestic chinaware and ceramic tiles plants, as well as to crystal glassworks. Glass fiber bushings (***PtRh10*** and ***PdRh20 alloys***) are sold to glass fibre plants. In the glass industry, special platinum-rhodium linings are used in some specialized glass furnaces. Production of crucibles, electrodes and other laboratory equipment with a use of ***PtIr2 alloy*** is very traditional use of platinum. Chemical compounds of platinum group metals, produced by the **Mennica-Metale Szlachetne Ltd.** of **Warsaw**, as well as by the **POCH Co.** of **Gliwice** find use as catalysts in various chemical processes. Rolled products (e.g. foil) and drawn products (e.g. wires) are manufactures from ***PtIr2***, ***PtRh10***, ***PtRh30***, ***PdIr10***, and ***AuPd20 alloys***. Rolled products are used in electronics (thermoelements, contacts), while thermocouple wires — in laboratories. In recent years, production of autocatalysts was commenced in Poland. **Lindo-Gobex Ltd.** of **Gorzów Wielkopolski** started to produce catalysts for some both domestic and foreign automotive plants, as well as spare parts in used cars. Total industrial consumption of ***platinum group metals*** in Poland amounts probably a few hundred kgpy.

Platinum and — in minor amounts — ***palladium*** are used in jewellry for years. This is mostly ***platinum 950*** (with admixture of silver or copper), but also ***Au700Pt50Ag-38Cu162*** and ***Pt250Au80Ag670 alloys***, as well as ***palladium 950*** (with admixture of silver or copper). For these purposes, mostly jewelry scraps are used, with some quantities of imported material. It is difficult to estimate the level of ***platinum*** and ***palladium*** consumption in Poland.

Companies involved in platinum group metals production in Poland, as of December 2012

- KGHM Polska Miedź S.A. w Lubinie (KGHM Polska Miedź Joint Stock Co. of Lubin); ul. Marii Skłodowskiej-Curie 48, 59–301 Lubin; tel. +48 76 8478200, fax +48 76 7478500, www.kghm.pl — *palladium-platinum sludge*.
- Mennica-Metale Szlachetne Sp. z o.o. w Warszawie (Mennica-Metale Szlachetne Ltd. of Warsaw), 00–958 Warszawa, ul. Pereca 21, tel. +48 22 6564101, fax +48 22 6564111, www.mennica-metale.com.pl — *platinum group metals and compounds*.
- Innovator Sp. z o.o. w Gliwicach (Innovator Ltd. of Gliwice), 44–101 Gliwice, ul. Sowińskiego 5, tel. +48 32 2380245, fax +48 32 2380202, www.innovator.com.pl — *platinum group metals and compounds*.
- POCH S.A. w Gliwicach (POCH Joint Stock Co. of Gliwice), 44–101 Gliwice, ul. Sowińskiego 11, tel. +48 32 2392000, fax +48 32 2392370, www.poch.com.pl — *platinum group metals compounds.*

POTASH

Overview

Potassium-magnesium chlorides and ***sulfates*** (rare, but of higher value) are the main source of **potassium** and **potassium compounds**. Almost 90% of **potassium** and **potassium-magnesium salts** is extracted from natural deposits of ***chlorides*** or ***sulfates***, while the rest is obtained from deposits of ***potassium saltpeter*** KNO_3 and from ***brines of salty lakes*** and ***mineralized waters***. Potassium salts are used in their original state (rarely), or, after dressing and chemical processing, as mixed fertilizers, which are critical for the development of agriculture (95% of consumption). Other potassium compounds and **metallic potassium** are utilized to a lesser degree.

Sources

In Poland, deposits of ***K-Mg salts*** of the ***polyhalite type*** occur near Puck Bay north of Gdańsk. There are four recognized deposits (**Chłapowo**, **Mieroszyno**, **Swarzewo**, and **Zdrada**), the total resources of which amount to 597 Mt (as of 31 December 2012) of polyhalite, containing 7.7–13.7% K_2O (51 Mt K_2O). ***Chloride type K-Mg salts*** (***carnalite***) are known in the **Kłodawa** ***salt dome***. The mineral occurs here as an accompanying mineral is ***kieserite carnalitite***, containing 8.5% K_2O and 8.1% MgO. The resources amount to 73 Mt (as of 31 December 2012) of ***carnalite salt*** (6 Mt K_2O).

Production

Kieserite carnalitite was extracted in the 1980s, as a byproduct of ***salt*** in the **"Kłodawa"** mine. It was used as a fertilizer and as salt for balneological curative treatment. Due to the mining conditions and low quality, it was irregularly extracted at the level of under 1,000 tpy (last time in 2000).

Trade

The demand for potassium commodities is satisfied by importing various grades of K and K-Mg salts, mainly ***potassium chloride*** (96% of total imports in 2012) from Belarus, Russia and Germany. ***Potassium sulphate*** comes primarily from Germany and Belgium. The level of imports in the years 2005-2008 varied between 0.8 and 1.1 Mtpy, but in 2009 - due to collapse of demand for fertilizers in Poland - dropped to only ca. 0.2 Mt, while in 2010 imports volume revived to 0.8 Mt and stabilized at this level in the following two years (Tabs. 1, 2). Detailed information on the quality of imported ***chloride salts*** is not available, but it is known that these were mainly ***dust*** and ***standard grades***, with low contents of usable constituents (mostly 40–60% K_2O). Minor amounts of ***potassium***

salts are re-exported to Western Europe, only in 2009 re-exports constituted ca. 9% of imports (Tab. 1).

Tab. 1. Potash salt statistics in Poland — CN 3104

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Production[1]	6.0	2.4	5.4[r]	0.0	0.0
Imports	843.9	208.2	822.7	799.5	816.1
Exports	8.9	19.2	10.0	9.7	3.8
Consumption[a]	841.0	191.4	818.1[r]	789.8	812.3

[1] only synthetic chloride and sulfate

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of potash salt, by country — CN 3104

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Imports	**843.9**	**208.2**	**822.7**	**799.5**	**816.1**
Belarus	381.5	107.1	8.0	7.4	5.6
Belgium	3.9	3.9	388.3	398.5	367.9
Germany	134.7	29.5	86.6	130.4	133.6
Israel	1.0	0.7	1.1	1.0	0.8
Lithuania	0.3	3.0	5.2	3.6	1.3
Russia	312.2	45.4	299.4	240.4	279.2
Spain	0.0	0.0	4.1	0.0	13.7
United Kingdom	2.9	16.3	27.1	14.1	9.5
Others	7.4	2.3	2.9[r]	4.1	4.5

Source: ***The Central Statistical Office (GUS)***

The balance of ***potash salts*** trade is constantly negative. In 2008, due to rapid growth of import unit values, deficit in trade balance deepened to -1,088 million PLN, in spite of lower volume of imports. In 2009 it improved to -282 million PLN due to collapse of imports, though imports unit values - in PLN/t terms - rose by 17%. In 2009 imports unit values sharply rose, but due to imports volumes collapse, deficit improved to -282 million PLN. In 2010 situation reversed: unit values decreased by 30%, but due to imports volume rise, deficit jumped to -862 million PLN. In the years 2011–2012 imports unit values increased by over 30%, what resulted in deepening of deficit to -1,132 million PLN (Tab. 3, 4).

Tab. 3. Value of trade in potash salt in Poland — CN 3104

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	12,582	36,508	12,107	13,468	7,457
Imports	1,101,203	318,491	873,697	1,018,866	1,139,817
Balance	**-1,088,621**	**-281,983**	**-861,590**	**-1,005,398**	**-1,132,360**

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Average unit values of potash salt imports to Poland — CN 3104

Year	2008	2009	2010	2011	2012
PLN/t	1,304.9	1,530.0	1,062.0	1,274.4	1,396.6
USD/t	572.5	513.8	355.6	434.8	426.0

Source: ***The Central Statistical Office (GUS)***

Consumption

The level of ***potash salts*** consumption in Poland is dependent on domestic agriculture demand. Due to high prices and worsening of economic situation of the domestic agriculture in 2009, demand for potash salts dropped by ca. 77%. Lower potash salt imports unit values since 2010 and improvement of domestic agriculture resulted in demand recovery (Tab. 1).

It is estimated that at present production of ***multicomponent NPK fertilizers***, mainly at the **"Police" Chemical Plant**, commonly consumed 60–70% of the total imports of potash salts (Tab. 5). The rest is used directly as fertilizers, as well as in the chemical industry for potassium compounds production. Only in 2009 almost all imported potash salts were consumed for the production of multicomponent fertilizers (maybe also some stocks were also consumed).

Tab. 5. Production of multicomponent fertilizers in Poland — CN 3105

'000 t

Year	2008	2009	2010	2011	2012
Multicomponent fertilizers	**2,077.3**	**1,138.5**	**1,941.8**	**2,016.2**	**1,894.1**
• *potash content (K_2O)*	*307.8*	*188.6*	*326.3*	*330.4*	*346.6*

Source: ***The Central Statistical Office (GUS)***

Irrespective of the level of demand, ***K*** and ***K-Mg chloride salts*** will need to be imported, because the Polish deposits of ***K-Mg salts*** are of the ***polyhalite type***, suitable only for the production of ***K*** and ***K-Mg sulfate***.

Companies involved in K-Mg salts production[1] in Poland as of December 2012

- Zakłady Chemiczne "Police" S.A. ("Police" Chemical Plant Joint Stock Co. of Police), ul. Kuźnicka 1, 72–010 Police; tel. +48 91 3171717, 3174296, fax +48 91 3173603; www.zchpolice.pl — *multicomponent fertilizers NPS, NPKS, NPKMg, NPKMgS, NPKNaS, PK, PKMgS, NP.*
- Gdańskie Zakłady Nawozów Fosforowych "Fosfory" Sp. z o.o. ("Fosfory" Phosphate Fertilizers Plant Ltd. of Gdańsk), ul. Kujawska 2, 80–550 Gdańsk; tel./fax. +48 58 3438376, fax +48 58 3038555; www.fosfory.com.pl — *multicomponent fertilizers PK, NPK.*
- "Luvena" S.A. ("Luvena" Joint Stock Co.), ul. Romana Maya 1, 62–030 Luboń; tel. +48 61 8900100, fax +48 61 8900400; www.luvena.pl — *multicomponent fertilizers NP, NPK.*

[1] only production of multicomponent salts on the basis of imported potassium salts

- Zakłady Chemiczne “Siarkopol” Tarnobrzeg Sp. z o.o. w Tarnobrzegu (“Siarkopol” Tarnobrzeg Chemical Plants Ltd. of Tarnobrzeg), ul. Zakładowa 50, 39–402 Tarnobrzeg 4, tel. +48 15 8555710, fax. +48 15 8229797, www.zchsiarkopol.pl — *NPK multicomponent fertilizers.*
- “Fosfan” S.A. w Szczecinie (“Fosfan” Joint Stock Co. of Szczecin); ul. Nad Odrą 44/65, 71–820 Szczecin; tel. +48 91 4538394, fax +48 91 4538490; www.fosfan.com.pl — *NPK multicomponent fertilizers.*

PUMICE AND RELATED MATERIALS

Overview

Pumice is very porous pyroclastic rock built of magmatic glaze. It occurs in many varieties, the finest of which are suitable for **cosmetic pumice** and **abrasive pumice stone**. Other pyroclastic rock types — compact **volcanic tuff** (called ***trass***, ***pozzolan***), **volcanic ash**, **lapilli**, and **scoria** — have a similar genesis and properties. These are widely used as active additives for cement, lime, and hydraulic binding materials, and also as natural light aggregates (e.g. ***tuffoporite***).

Sources

There are no ***pumice*** deposits in Poland. Nevertheless, in Lower Silesia and close to Krzeszowice near Cracow there are known large occurrences of ***tuff*** and ***volcanic ash***. The ***tuff*** deposit of ***Filipowice type*** has been recognized in **Kowalska Góra** near **Krzeszowice**, with reserves estimated at 18.3 Mt. Moreover, a new deposit containing 11.3 Mt of ***tuff*** and 14.9 Mt of ***melaphyre*** was recognized in **Włodzicka Góra** near **Nowa Ruda** (Lower Silesia).

Production

There is no ***pumice*** production in Poland. However, some substitutes there are manufactured, i.e. synthetic ***quartz pumice*** (made from ***foam glass***) and ***polyurethane pumice*** use mainly in the cosmetics sector. Moreover foam glass is excellent insulator and material for filters. In the past in Poland was also produced so-called ***smelter pumice*** (***foam slag***) used as aggregates for lightweight concrete. According to the official statistics, production of the ***synthetic pumice*** taken together with ***tuff*** and other ***natural abrasive materials*** decreased from 52,000 tpy in 2008 to 36,000 tpy in 2012. The largest domestic producers of the synthetic pumice are **"GL-PUMEKS", "Pumice System",** and **"MILMOR"** companies.

Trade

Demand for natural ***pumice*** is satisfied basically by imports and the use of substitutes. In the years 2008–2011 the total supplies of pumice decreased from ca. 5,600 tpy to 2,900 tpy, and afterwards they grew to 4,100 t in 2012 (Tab. 1). Pumice was imported primarily from Iceland and Turkey, although supplies from the second direction considerably dropped. Some very small amounts of pumice have been re-exported in many directions, predominantly to the US. The balance of ***pumice*** trade was negative in 2008, whereas, in the following four years its positive value increased to above 4.0 million PLN (Tab. 2). Improvement of deficit in pumice trade in Poland, in spite of lack of domestic production is unclear, particularly regarding that only ca. 2–4% of annual supplies has been exported. It is mainly caused by very high unit values of the exports (products from pumice or synthetic pumice were probably exported).

Tab. 1. Pumice statistics in Poland — CN 2513 10

t

Year	2008	2009	2010	2011	2012
Imports	**5,646**	**4,370**	**3,887**	**2,891**	**4,054**
Germany	40	8	9	13	8
Greece	81	86	23	2	–
Iceland	2,801	2,851	2,530	2,304	3,084
Turkey	2,345	1,217	1,090	388	706
USA	277	174	208	151	228
Others	102	34	27	33	28
Exports	**141**	**95**	**138**	**123**	**159**
Consumption[a]	**5,505**	**4,275**	**3,749**	**2,768**	**3,895**

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of pumice trade in Poland — CN 2513 10

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	3,273	3,748	4,946	3,998	6,332
Imports	3,113	2,528	2,090	1,782	2,139
Balance	**-160**	**+1,220**	**+2,856**	**+2,216**	**+4,193**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. The unit value of pumice imports to Poland — CN 2513 10

Year	2008	2009	2010	2011	2012
PLN/t	551	579	538	616	528
USD/t	234	184	174	213	163

Source: ***The Central Statistical Office (GUS)***

The average imports unit values are the consequence of diversified prices of pumice grades being purchased (Tab. 3). In the years 2008–2012 they ranged from 163 to 234 USD/t, mainly depending on share of deliveries from Iceland (68–89 USD/t) and Turkey (184–204 USD/t).

Consumption

Imported ***pumice*** is consumed almost entirely by the cosmetics and abrasive materials industries. In the domestic market is available also pumice for washing jeans clothes, for water filtration, and pumice powder for polishing denture. ***Pumice aggregates*** imported from Iceland are used for thermal insulation in heating systems. Domestically produced ***foam glass*** is used for cosmetics. ***Smelter pumice*** (***foam slag***) from domestic smelters was utilized as a light aggregate, e.g. for light concrete products. The ***tuff from Filipowice*** was basically applied as the dimension stone, and in a very small quantities — as poor quality light aggregate for the concrete manufacturing (***tuffoporite***) and for the production of dark bottle glass.

QUARTZ, QUARTZITE AND QUARTZ-SCHIST

Overview

Quartz, **quartzite** and **quartz-schist** are silica raw materials comprising quartz as a primary mineral. Depending on contents of SiO_2 and impurities (e.g. Fe_2O_3, Al_2O_3, TiO_2) they are used in the production of ***silicon metal*** and ***ferrosilicon*** (**quartz** and **quartzites**), ***siliceous refractory materials*** (**quartzite** and **quartz-schists**), and also in the ceramics, glass-making, and chemical industries (mainly **quartz**).

Quartz, the crystalline form of silica SiO_2, is one of the most widespread rock minerals. It is extracted primarily from various types of quartz veins. The unique form of the quartz is large crystals, known in Poland as **quartz crystal** or **mountain crystals**. Due to its piezoelectric properties, quartz crystal is one of the basic raw materials for the electronics. It is also used in the optics and production of jewellery. However, **synthetic quartz crystal** now predominates in the electronics, where it is known as **piezoelectric quartz**. This is obtained by using natural quartz crystal of lower grade (***lascas***) as crystallization nuclei for ***cultured quartz crystals*** in pressure reactors.

Quartzite is usually understood as thermally metamorphosed quartz rocks. However, the commercial term **industrial** (**refractory**) **quartzite** refers to all rocks rich in SiO_2 (>97%), suitable for the production of ***siliceous refractory materials*** and ***ferrosilicon***. The significance of the first application of quartzite is continually declining, due to the decreasing use of ***siliceous refractory materials***. On the other hand, ***ferrosilicon*** production has recently become the main use of industrial quartzite around the world, and in Poland as well. So, demand for quartzite is strictly dependent on demand for ferrosilicon used in steel production.

Quartz-schist is a rare metamorphic rock. **Quartz-schist** from Jegłowa deposit (Lower Silesia) for over 150 years has been utilized as natural refractory material, previously as shaped lining elements, but now as a powder for mortars and mixes.

Sources

Quartz crystal occurs in the fissures of granite massifs (e.g. in Strzegom) and in the ***quartz-schist*** deposit in **Jegłowa** (Lower Silesia). It is picked up by collectors and used for jewellery purposes.

Quartz of commercial importance occurs in veins in magmatic and metamorphic rocks in Lower Silesia. Currently, 7 deposits are recognized, with total resources of 6,564,000 t (as of 31 December 2012). Three of these are developed (**Stanisław**, **Taczalin**, **Krasków**), while the other four deposits were extracted irregularly in the past. There are also prospects for discovery of new deposits with possible reserves of around 4 Mt.

The deposits of ***industrial*** (***refractory***) ***quartzite*** known in Poland are of average or low overall quality, but of high refractoriness. They occur in the Świętokrzyskie Mountains, in the vicinity of Łagów (the **Góra Skała** and **Wojtkowa Góra I** and **II** deposits), and near Starachowice (the **Doły Biskupie-Godów** deposit). Their total resources are 4,438,000 t[1]. Moreover, in 14 abandoned deposits of ***high quality quartzite*** of the ***Bolesławiec type*** (Lower Silesia region) there were resources of 2,442,000 t left (as of 31 December 2012).

The ***quartz-schist*** reserves in **Jegłowa** deposit near Strzelin amounted to 5,897,000 t (as of 31 December 2012).

Production

Domestic production of ***quartz*** and ***quartzite products*** varied between 26,000 tpy and 80,000 tpy in the last five years (Tab. 1).

Tab. 1. Quartz, quartzite and quartz-schist statistics in Poland — CN 2506

'000 t

Year		2008	2009	2010	2011	2012
Mining output		**631.1**	**637.5**	**1,223.4**	**1,654.4**	**1,085.2**
• *quartz*		–	–	–	–	–
• *quartzite*[1]		*624.0*	*634.0*	*1,221.0*	*1,614.0*	*1,057.0*
• *quartz-schist*		*7.1*	*3.5*	*2.4*	*40.4*	*28.2*
Production		**79.8**	**26.1**	**40.5**	**53.3**	**59.1**
• *quartz*		*6.5*	*5.0*	*5.6*	*6.1*	*5.3*
• *quartzite*		*72.5*	*20.4*	*34.2*	*46.5*	*53.2*
• *quartz-schist*		*0.8*	*0.7*	*0.7*	*0.7*	*0.6*
Imports		**100.4**	**22.3**	**104.2**	**148.5**	**147.5**
• *quartz*		*9.9*	*8.0*	*8.4*	*3.8*	*3.3*
• *quartzite*		*90.5*	*14.3*	*95.8*	*144.7*	*144.2*
Belgium	q	0.2	0.2	0.2	0.4	0.3
Germany	q	18.8	1.5	1.8	2.0	2.7
Italy	q	0.6	0.8	0.1	0.0	0.3
Norway	q	6.7	5.1	6.0	1.4	–
Ukraine	qt	73.1	14.1	95.6	144.2	144.1
Others	q,qt	1.0	0.6	0.5	0.5	0.3
Exports		**0.3**	**0.1**	**7.7**	**41.8**	**34.6**
• *quartz*		*0.3*	*0.1*	*0.1*	*0.0*	*0.2*
• *quartzite*		–	–	*7.6*	41.7	*34.4*
Slovakia	qt	–	–	7.6	41.7	34.4
Ukraine	q	0.1	–	0.0	0.0	0.0
Others	q,qt	0.2	0.1	0.1	0.1	0.0
Consumption[a]		**179.9**	**48.3**	**137.0**	**160.0**	**172.0**

Legend: **q** — quartz, **qt** — quartzite

[1] from Bukowa Góra deposit

Source: ***The Central Statistical Office (GUS)***, ***Mineral Deposits Datafile***, ***producers' data***

[1] Since 2008 **Bukowa Góra**, which previously was classified as industrial quartzite deposit, started to be classified in the group of crushed and dimension stones deposits due to the fact that majority of extracted raw material is used for crushed aggregates production. The deposit comprises ca. 13.3 million t of quartzite (as of 31 December 2012).

Quartz products were produced in the amounts of 5,000-7,000 tpy in the recent years. The ***quartz*** production reported by the Central Statistical Office concerned ***quartz flour***, manufactured by the **Strzeblowskie Kopalnie Surowców Mineralnych Ltd.** on the basis of quartz sand from **"Osiecznica" Mine and Processing Plant Ltd.** Another producer of ***quartz flours,*** obtained by the millnig of quartz sand, is **Grudzeń Las Ltd.** The company has manufactured in the recent years ca. 5,000 tpy of flours, containing 98.5–99.1 %, SiO_2 and 0.06–0.1% Fe_2O_3.

Since 2008 there has been no mining output of quartz from any deposit in Poland. The output of quartz in both **Taczalin** and **Stanisław** mines as well as the production of quartz products in **Mikołajowice** plant, belonging to **"PeBeKa" S.A.** of **Lubin** (KGHM Group), was ceased in 2005 (Tab. 1). The plant produced ***quartz breakstone*** and ***key aggregate*** (fractions over 8 mm) for ***ferrosilicon*** production, ***quartz grits*** (fractions 0.4–5 mm and 5–20 mm) for chinaware, refractories and construction products (resinous floors, special concrete, dry mortars), and ***quartz flour*** (fractions <0.4 mm) for chinaware, enamel, paint & varnish and chemical industries. Three years later production and output from another quartz deposit, in **Kraskόw**, was terminated. Mine was operating by **PEZM "Magma" Ltd.** of **Świdnica,** which delivered ***quartz breakstone*** and ***key aggregate*** for ***ferrosilicon*** production (ca. 25% of total production), as well as ***grits*** for chinaware and construction products (dry mortars, resinous floors).

Raw quartzite materials are produced on the basis of ***quartzite sandstone*** from **Bukowa Góra** deposit. **"Bukowa Góra" Quartzite Mine and Processing Plant** in **Łączna**[2], which were taken over by German company **PCC SE** in September 2009, produces ***industrial quartzite*** in various grades (KpSi99, KpSi98 and KpSi97) and fractions (40-100 mm and 100-300 mm), as well as increasing amounts of ***quartzite crushed aggregates*** and ***quartzite sand*** (500–1,600 ktpy). Production of industrial quartzite, which is dependent on condition of steel industry, fluctuated from ca. 20,000 tpy to 73,000 tpy (Tab. 1). It was a result of the changes in volume of production in **Łaziska** smelter, as well as a temporary cease of exports to Slovakian ferrosilicon producer — **Oravske Ferozliatinarske Zavody**, and growing imports of quartzite from Ukraine.

The producer of ***quartz-schist products*** was **Quartz System Kopalnie Ltd**., which exploited ***quartz-schist*** deposit in Jegłowa. The previous owner, **PPHU "Kwarcyt" Danuta Kwiatkowska,** sold the mine in October 2010. Since then, the output level considerably increased, from a few tpy to 30–40,000 tpy. The majority of the output was utilized as split tiles, while production of ***refractory silica mortars*** and ***mixes***, as well as ***foundry mix "kwarcoplast"*** consumed only ca. 600–800 tpy raw material (Tab. 1).

Trade

The demand for the best quality ***quartz*** and ***quartzite*** grades is satisfied by imports. Level of supplies usually ranged from 100,000 tpy to 150,000 tpy, with the exception of the drop to barely 20,000 tpy in 2009 (Tab. 1). The deliveries of ***raw quartz material***, especially ***quartz flours,*** considerably decreased from ca. 10,000 tpy in 2008 to ca. 3,000 tpy in 2012. The decline was caused by cease of production of the ***quartz flours*** in the Norwegian plant in **Lillesand**[3] (**Sibelco Group**), which was the most important sup-

[2] There was a change of the company's name into **PCC Silicium S.A.** in January 2011

[3] The production of the **quartz flours,** on the basis on the quartz recovered from leucogranite in flotation process of feldspar, has not been carried on since June 2011.

plier of such raw material to Poland (Tab. 1). On the other hand, there was growth of imports of the more expensive ***quartz flours*** from Germany. Moreover, smaller amounts of the ***raw quartz material*** came from Italy and Belgium (Tab. 1). Exports of mainly ***coarse grades*** did not exceed a few hundreds tpy. Due to the lack of refractory quartzite of the highest quality on the domestic market, some quantities (10,000–150,000 tpy) have been traditionally imported, predominantly from Ukraine (**Owrucz** mine). Additionally, in 2008 some deliveries of quartzite (ca. 17,000 t) from Germany were also reported. The majority of deliveries were used in ferrosilicon production, competing with domestic raw materials. Exports of ***industrial quartzite*** to Slovakia were reported in the amount of 7,000–42,000 tpy since 2010 (Tab. 1). ***Quartz-schist*** is not traded internationally.

The volume of trade of ***quartz crystal*** is difficult to determine, as there is no separate item for it in the Central Statistical Office statistics. Therefore, it is very probable that imported quartz crystal is included under the headings of ***piezoelectric quartz*** (**CN 7104 10**), ***quartzite*** (**CN 2506 21**) or ***quartz*** (**CN 2506 10**). The total amounts of deliveries didn't exceed 2 tpy. Supplies primarily of synthetic quartz crystal (***cultured***) came from China (12–968 kg/y), Germany (0–1546 kg/y), Japan (220–500 kg/y), the US (0–207 kg/y) and additionally from Israel (100-869 kg/y) in the years 2011-2012.

The trade balance in ***quartz and quartzite products*** has been consistently negative and the total trade deficit ranged from 5 to 8 million PLN (Tab. 2). The unit values of ***quartz products*** (primarily ***quartz flours***) varied in a wide range from 100 to over 800 USD/t, depending on grades. The unit values of ***quartz flours*** of Norwegian origin changed between 90 and 110 USD/t in the years 2008–2011, while the prices of the ***quartz flours*** from Germany were more than two times higher (172–261 USD/t in the years 2008–2012) (Tab. 3). The unit values of ***industrial quartzite*** imports from Ukraine ranged from 10 to 16 USD/t. The average unit values of ***industrial quartzite*** exports to Slovakia, reported exclusively in the years 2010–2012, were considerably higher and reached 20–30 USD/t (Tab. 3). The unit values of ***piezoelectric quartz*** (***natural*** and ***synthetic***) imports from China, Germany, Japan, the US, and other countries were very high, changing in wide range from 6,000 to 335,000 USD/t.

Tab. 2. Value of quartz and quartzite trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Quartz CN 2506 10					
Exports	162	182	101	113	61
Imports	4,034	4,953	3,528	3,062	3,149
Balance	**-3,872**	**-4,771**	**-3,427**	**-2,949**	**-3,088**
Quartzite CN 2506 20					
Exports	–	–	511	3,779	3,242
Imports	3,353	764	3,439	5,911	7,995
Balance	**-3,353**	**-764**	**-3,439**	**-2,132**	**-4,753**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. The average unit values of quartz and quartzite products trade in Poland

Year	2008	2009	2010	2011	2012
Quartz CN 2506 10					
Average imports unit values[1]					
— PLN/t	513.7	537.5	579.8	765.9	675.5
— USD/t	217.6	172.0	192.6	260.7	205.0
Average exports unit values					
— PLN/t	626.9	1,473.7	885.1	2,485.8	328.8
— USD/t	269.2	471.7	284.7	822.9	100.8
Quartzite CN 2506 20					
Average imports unit values[2]					
— PLN/t	38.1	31.1	31.9	42.6	53.7
— USD/t	16.1	11.2	10.4	14.2	16.4
Average exports unit values					
— PLN/t	–	–	67.4	90.5	94.2
— USD/t	–	–	22.8	30.2	28.6

[1] solely from Germany [2] solely from Ukraine

Source: ***The Central Statistical Office (GUS)***

Consumption

Total domestic consumption of ***quartz*** and ***quartzite products*** generally fluctuated in relation to demand of the largest consumer between 137,000 and 180,000 tpy, with the exception of drop to 48,000 t in 2009 (Tab. 1) The largest domestic consumer remains **Łaziska Smelter**, which strictly determines the level of demand. Consumption of quartz and quartzite products highly depends on competition from alternative raw materials of domestic and foreign origin (German and Norwegian quartz flour, Ukrainian quartzite).

Quartz is used for the manufacture of a few various ***quartz products***, which have different uses. The highest quality varieties are used for ***quartz flour*** production, which is a component for chinaware production, but being also utilized in enamels, paints and varnishes, and in chemical industry. Owing to considerable decrease in the volume of domestic chinaware production demand for ***quartz flours*** dropped to below 10,000 tpy. ***Quartz grits*** commodities find application in chinaware and refractory industries and recently also are used for resinous floors, special concrete and dry mortars production. ***Quartz breakstone*** and ***key aggregate*** obtained from lower quality quartz are utilized mainly for the production of ***ferrosilicon*** and related ferroalloys (substituting for industrial quartzite in those applications). ***Quartz flour*** produced by the **Strzeblowskie Kopalnie Surowców Mineralnych Ltd.** is utilized as a component in ceramics, foundry, paint and varnish industries and besides in production of plasters, mortars, abrasives, and in many other applications.

Industrial quartzite from Bukowa Góra and from Ukraine and also smaller amounts of ***quartz stone*** are utilized in **Łaziska Smelter** in the production of ***ferrosilicon***. Recently, the demand for these commodities fluctuated between 100,000 and 120,000 tpy, with the exception of drop to 20,000 t in 2009. Reduction of the industrial quartzite consumption was a result of a difficult situation on the world market of steel, high prices of electric energy, and in a consequence shutting down of the Łaziska Smelter for nine months in 2009. Recently principal raw material utilized in the production of ***ferrosilicon*** is quartzite from Ukraine.

Industrial quartzite was also used in **Chrzanów Refractory Plant**[4] for the production of ***siliceous refractories*** (***shaped products***, ***mixes***, ***mortars***) applied for lining coke ovens, open-hearth furnaces, induction furnaces, glass-furnaces, etc. The decline in demand from some metallurgical plants (e.g. open-hearth furnace technology) has resulted in the collapse of siliceous refractories production, down by over 90% to only 7,000–12,000 tpy in the recent years. As a result, consumption of industrial quartzite for siliceous refractories production currently does not exceed a few thousands tpy, including primarily domestic quartzite from Bukowa Góra, and the smaller amounts of quartzite from Ukraine. The increase of demand for industrial quartzite is observed temporarily as a result of repairing of coke oven batteries. ***Industrial quartzite***, manufactured by the domestic producer are also utilised in electronics and renewable energy sector.

Quartz-schist mixes and ***mortars***, manufactured previously by **PPHU "Kwarcyt" Danuta Kwiatkowska** and now by **Quartz System Kopalnie Ltd**., find application in the refractories and foundries.

Quartz crystal was used by the **"Cemat 70" Electronic Materials Research and Development Center**[5], and until 2009 by **Thomson Displays** in **Piaseczno** (a manufacturer of TV kinescopes), among others.

Companies involved in quartz, quartzite and quartz-schist production in Poland, as of December 2012

- Strzeblowskie Kopalnie Surowców Mineralnych Sp. z o.o. w Sobótce ("Strzeblów Mineral Mines" Ltd. of Sobótka), 55–051 Sobótka, ul. Torowa 1, tel. +48 71 3904211, fax +48 71 3904224 www.sksm.pl — *quartz flours*.
- Kopalnia i Zakład Wzbogacania Kwarcytu "Bukowa Góra" S.A. w Łącznej ("Bukowa Góra" Quartzite Mine and Processing Plant of Łączna), 26–140 Łączna, tel. +48 41 2548223, fax +48 41 2548330, www.bukowagora.com.pl — *industrial (refractory) quartzite, crushed quartzite aggregates*.
- Quartz System Kopalnie Sp. z o.o. w Jegłowej (Quartz System Kopalnie Ltd. of Jegłowa), 57-130 Przeworno, tel./fax. +48 74 810 23 26, www.quartzstone.pl — *quartz-schist powder, silica mortats, split tiles, garden stone*.

[4] At the beginning of 2011 **Chrzanowskie Zakłady Materiałów Ogniotrwałych S.A**. were incorporated into **Mostostal Energomontaż S.A.** from Cracow. Both companies, belonging to **Ropczyce S.A**., were sold to **Mostostal Rzeszów S.A.** in July 2011. Since then **Ropczyce S.A** has been renting a plant in Chrzanów and has been carrying on production of aluminosiliceous and siliceous refractories in the newly formed division.

[5] The production in **Cemat 70 S.A.** was terminated in December 2010, while in January 2011 it was resumed by newly formed **Cemat Ceramika Ltd.**

RARE EARTH ELEMENTS

Overview

The **rare earth elements** (**REE**), or **"lanthanides"** are a group of 14 chemically similar elements with atomic numbers between 57 (**lanthanum**) and 71 (**lutetium**), except for the synthetic element **promethium** (atomic number 61). Although not a lanthanide, **yttrium** (atomic number 39) is often included in the rare earth elements, because it invariably occurs along with them in nature, and has similar chemical properties (see: **YTTRIUM**). The **rare earth elements** and **yttrium** are essential constituents in more than 100 minerals; however, only a few of them occur in sufficient concentration to warrant their use as ore. ***Monazite*** from beach-sand deposits and ***bastnaesite*** from veins and disseminations in complexes of carbonate-silicate rocks are the principal mineral sources of rare earth elements. ***Apatite*** and multiple-oxide minerals, such as ***euxenite*** and ***loparite***, are also commercial sources. Recently it became mandatory to indicate the RE elements predominating in particular minerals by adding the appropriate abbreviation, e.g. ***monazite*** (***Ce***), ***monazite*** (***Nd***), ***fergussonite*** (***Y***), etc.

Due to their similar geochemical properties, the RE elements usually occur in the form of pleiads, with one of them predominant. A technology to separate them from **mischmetal** (a mixture of rare earth elements in metallic form) and obtain high purity compounds was developed after the Second World War.

The RE elements and their compounds are used in the most advanced branches of industry, e.g. for the production of special glass types, lasers, control rods in nuclear reactors, modern ceramic elements, ceramic glazes, superconductors, ferrites, and permanent magnets. They are also used as catalysts in many chemical and petrochemical processes, and in the production of luminophores, and also as additives for various types of alloys (e.g. **cerium**, **erbium**, **neodymium**, and **praseodymium** in metallic form).

Sources

RE minerals are known in Lower Silesia. In the vicinity of **Szklarska Poręba** lenses containing up to 0.5% REO occur, the resources of which amount to 305 t REO (anticipated resources of 1,500 t). Near **Bogatynia** there are ***phosphates of rare earth elements*** containing 1.55% REO (anticipated resources of 150 t). In both cases the rare earth minerals accompany thorium minerals.

On the other hand, there are huge stocks of secondary sources, e.g. ***phospho-gypsum*** after the processing of ***apatites*** imported from the **Chibiński massif** deposits (Kola peninsula, Russia). Dumps of phospho-gypsum at the **Wizów Chemical Plant** contain 8,280 t REE, in an average concentration of 0.69% REE, calculated for dry product (mainly ***yttrium***, ***europium***, and ***yttrium lanthanide***). These parameters are comparable to those which are specific for natural deposits of REE recognized elsewhere. Examinations and tests of phospho-gypsum from Wizów have proved that the recovery of these rare earths may be economically feasible. For several years now, as raw apatites have been replaced by concentrates free from significant admixtures of REE, the contents of these elements in the processing wastes currently generated are very low.

Production

Rare earth elements are not recovered in Poland from the existing sources, and Polish industry does not produce ***rare earth commodities***.

Trade

The total Polish demand for ***rare earth elements*** and their compounds is satisfied by imports (Tab. 1), mainly from China, Western European countries, the US and — in 2008 — from Estonia. In period 2008–2012 structure of imports was dominated by cerium compounds and rare earth metals compounds (Tab. 1). The level of purchase has followed the demand of the electronics industry, where RE elements are used in many applications. In 2009 imports of ***rare earth commodities*** to Poland were lower by more than 70% in comparison to 2008 reflecting the lower demand from Polish economy. In 2010 domestic demand significantly increased and imports were more than three times grater, but in next two years imports decreased again, by ca. 60% (Tab. 1). The trade balance (Tab. 2) of ***rare earth commodities*** has been consistently negative, depending on the imports volume, the quality of imported raw materials and the producers' price (Tabs. 1, 2). The same reasons were influencing the unit values of rare earth elements imports to Poland, escpecially for 2010 and 2011, when unstable deliveries from China – the World leading supplier – to international markets caused the sharp prices incerase (Tab. 3).

Consumption

Rare earths elements in the form of oxides and other compounds are used in the glass-making industry, for optical instruments, in electronics, petrochemicals, ceramics, and for the production of special alloys. Their importance in modern technologies is increasing, beginning with the production of cast iron and continuing to advanced electronics. In spite of the very small amounts, the consumption of rare earth elements is important for the technical development of domestic industry.

Tab. 1. Polish imports of rare earths, by country

t

Year	2008	2009	2010	2011	2012
Rare earth metals[1]					
CN 2805 30					
Imports	**0.6**	**2.4**	**7.9**	**0.0**	**1.7**
Austria	0.6	–	0.2	–	0
China	0.0	0.4	0.1	0.0	0.2
Czech Republic	–	–	–	–	0.9
Germany	0.0	1.5	6.1	0.0	0.0
Netherlands	–	–	0.4	–	–
Sweden	–	–	–	–	0.5
Spain	–	0.4	0.7	–	–
United Kingdom	0.0	0.0	0.4	0.0	0.0
USA	0.0	0.0	–	0.0	0.0
Rare earth metal compounds other than cerium compounds					
CN 2846 90					
Imports	**57.6**	**15.6**	**47.5**	**21.0**	**12.4**
Austria	1.0	3.0	2.0	0.0	0.0
Belgium	0.0	0.0	–	1.0	–
China	23.3	6.0	34.3	8.1	11.5
Czech Republic	–	–	0.0	0.0	0.0
Estonia	20.0	–	–	–	–
Finland	–	–	–	7.0	–
France	0.4	0.4	0.3	0.5	0.0
Germany	0.1	0.1	0.0	2.6	0.2
Lithuania	–	0.5	–	1.0	–
Netherlands	12.7	5.5	7.2	0.5	0.0
Switzerland	–	–	–	0.0	0.0
Taiwan	0.0	0.0	–	0.0	0.0
Ukraine	–	–	–	0.3	–
United Kingdom	0.0	0.0	3.6	0.0	0.6
USA	0.0	0.0	0.0	0.0	0.0
Cerium compounds					
CN 2846 10					
Imports	**147.8**	**41.0**	**135.4**	**85.5**	**64.9**
Austria	5.0	3.2	3.8	2.0	4.1
Belgium	0.6	–	0.0	0.0	0.0
Bulgaria	–	–	–	0.5	0.3
China	44.6	11.3	99.4	39.2	35.9
Czech Republic	0.3	1.4	0.3	2.2	0.0
Denmark	–	–	–	–	0.9
France	77.0	9.4	10.3	0.8	5.3
Germany	9.0	6.7	8.0	8.3	14.9
Italy	–	–	–	2.0	–
Korea, Republic of	3.0	–	–	–	–
Lithuania	–	–	5.0	3.0	0.0
Netherlands	0.0	–	–	8.0	0.0
Ukraine	–	–	–	17.3	–
United Kingdom	4.3	6.3	7.2	2.0	3.3
USA	4.0	2.7	1.3	0.1	0.2

[1] together with scandium and yttrium

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of rare earth commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Rare earth metals[1] **CN 2805 30**					
Exports	76	–	16	0	14
Imports	74	106	157	71	117
Balance	**+2**	**-106**	**-147**	**-71**	**-103**
Rare earth metal compounds other then cerium compounds **CN 2846 90**					
Exports	2,127	17	881	16,541	1,111
Imports	4,053	1,004	7,122	6,449	4,461
Balance	**-1,926**	**-987**	**-6,241**	**+10,092**	**-3,350**
Cerium compounds **CN 2846 10**					
Exports	128	70	1,471	9,614	87
Imports	9,054	1,611	8,851	8,113	7,198
Balance	**-8,926**	**-1,541**	**-7,380**	**+1,501**	**-7,111**

[1] together with scandium and yttrium

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of rare earth commodities imports to Poland

Year	2008	2009	2010	2011	2012
Rare earth metals[1] **CN 2805 30**					
PLN/t	123,333	44,287	19,754	1,064,075	18,313
USD/t	50,140	14,516	6,645	359,478	5,570
Rare earth metal compounds other then cerium compounds **CN 2846 90**					
PLN/t	61,258	64,333	150,070	306,778	360,234
USD/t	25,861	21,209	49,750	104,387	110,252
Cerium compounds **CN 2846 10**					
PLN/t	70,365	39,296	65,380	96,168	110,898
USD/t	29,773	12,793	21,569	33,023	33,119

[1] together with scandium and yttrium

Source: ***The Central Statistical Office (GUS)***

RHENIUM

Overview

The main source of **rhenium** (**Re**) is ***molybdenite*** from porphyry deposits of Mo and Cu-Mo ores. Some concentrates contain up to 18.8 kg Re per ton of MoS_2. Rhenium can also be recovered in the form of **ammonium perrhenate** NH_4ReO_4 from ***dust*** generated in course of ***Cu*** and ***Zn-Pb concentrates*** metallurgical processing. **Rhenium metal** is obtained from **rhenium powder** by sintering at a temperature of 1,200°C.

Rhenium has been traditionally utilized in the petroleum industry as Pt-Re catalyst (to obtain high-octane hydrocarbons used in the production of lead-free gasoline), and in the production of high-temperature superalloys applied in jet engines, space rockets, and gas turbines.

The major commercial products containing rhenium are **ammonium perrhenate** (min. 69.2% Re), **rhenium metal**, and **metal powder** (99.99% Re).

Sources

Rhenium is an element associated with ***copper ore*** in the **Fore-Sudetic Monocline** deposits. Its content averages 0.6 ppm Re; however the richest in Re is the shale-type ore — 1.1 ppm, while in sandstone-type it approaches 0.4 ppm, and in limestone-type one — 0.5 ppm. In course of the ore beneficiation Re content is increasing to 5–20 ppm in copper concentrate. Total rhenium reserves in copper ore deposits have not been estimated.

Production

Until 2010 the only rhenium commodity produced in Poland has been ***ammonium perrhenate*** (69.2% Re). Since the autumn of 2007 it has been recovered from acid waste water of copper extraction circuit by **KGHM Ecoren S.A.** at the **Hydrometallurgical Division** in the **Głogów II copper smelter**. At the end of 2009 the new plant for the ***ammonium perrhenate*** recovery from metallurgical sewage (up to 18,000 m^3 per year) was commisisioned in the **Głogów I smelter**. The production of crystalline ***ammonium perrhenate*** (99.99% NH_4ReO_4) has varied from 3.5 to 5.0 tpy. In April 2010 the new installation for ***ammonium perrhenate*** processing on pure ***rhenium metal*** (99.95% Re) was commissioned at the **Legnica Smelter**. Of 5 tons of rhenium perrhenate up to 3.5 tpy of Re can be recovered. **Ecoren** has become the only metallic rhenium producer from own sources in Europe, and has ranked the third in the world.

Trade

Since 2006 Poland has exported ***ammonium perrhenate*** to the international market. The sales have been conducted by the **KGHM Ecoren** trade agency — **Traxys Belgium**

NV/S.A. The group of recipients has included: the US (**Ultamet**, **Engelhard**), Japan (**Sumitomo Metal Mining**), the United Kingdom (**Rolls Royce**, **Johnson Matthey**), and Austria (**Plansee**). There are no individual data on volume and value of trade for ***rhenium commodities***. In the CN nomenclature they are listed together with niobium in a common position (see: **NIOBIUM**).

Consumption

The main consumer of ***ammonium perrhenate*** has been the petrochemical industry (for the production of catalysts), which utilises approximately 200 kg per annum NH_4ReO_4. Other rhenium commodities are probably not consumed in Poland.

Companies involved in rhenium commodities production in Poland as of December 2012

- KGHM Ecoren S.A. w Lubinie (KGHM Ecoren Joint Stock Co.), ul. Skłodowskiej Curie 45A, 59–301 Lubin, tel. +48 76 7468970, fax +48 76 7468971, www.ecoren.pl — *ammonium perrhenate, metallic rhenium*.

ROCK-SMELTING COMMODITIES

Overview

Rock-smelting commodities consist primarily of various types of ***basalt***, ***diabase***, ***amphibolite***, ***andesite***, etc. Two basic kinds of products are obtained through smelting of these rocks: **rock-casting commodities** and **rock wool** (the basic heat-insulation material). **Cast rock products**, particularly of ***basalt***, have a high compression strength (490–590 MPa), similar to that of cast iron, and even better resistance to abrasion, and to atmospheric and chemical influences. **Rock wool** is produced by melting rocks at a temperature below 1,400°C, in furnaces similar to glass furnaces, with ***chromite*** added as crystallization nuclei, and then casting in steel or sand molds. Rock wool can be also made of industrial waste materials, such as ***foundry slag*** (**slag wool**).

Sources

Only some Lower Silesian ***basalts*** have been used for the production of rock-smelting commodities. ***Nepheline basalt*** (a basalt variety) from the **Mikołajowice** deposit is the best rock for the production of rock-casting commodities. The ***basalts*** from the **Bukowa Góra**, **Sulików**, and — in minor quantities — **Księginki I** and **Mikołajowice** deposits have been used in the production of ***rock wool***. Despite numerous advantageous properties, basalt is not an optimal raw material for rock wool production, due to its high crystallization ability. Thus another rocks — ***diabase*** from the **Słupiec-Dębówka** deposit and ***gabbro*** from **Braszowice** deposit — has also began to be used for this purpose, constituting currently ca. 50% of total amount of rocks used for this purpose.

Production

Cast basalt products are currently manufactured at the **Basalt Melting Enterprise Ltd.** of **Starachowice** and **"Kalenborn Delma" Ltd.** (previously: **"Delma Bazalt" Ltd.**) of **Strzegom**. World leading producer of molten basalt products — German company **Kalenborn Kalprotect** — has shares in both companies for a few years. Molten basalt is cast into molds for lining tiles, railway loading platforms, troughs and pipes for stowing pipelines, elbows, shaped elements, etc. The production of rock-casting commodities was 8,000–10,000 tpy in recent years (detailed information unavailable).

Rock wool (mainly made of basalt or diabase) is currently produced in Poland by Danish company **Rockwool** at the **Cigacice** and **Małkinia** plants, by Finnish company **Partek Paroc** (**Paroc Polska Ltd.** subsidiary) in **Trzemeszno** plant, by Spanish **Uralita Group** (**URSA Polska** subsidiary) in **Dąbrowa Górnicza** plant, and by Austrian group **Isoroc** (**Isoroc Polska** subsidiary) in **Nidzica** plant. ***Glass wool*** is manufactured entirely by **Saint Gobain Con-**

struction Products Polska Ltd. in **Gliwice** plant. All these plants were modernized and enlarged in recent years. Enlargement of production capacities, as well as quick growth of domestic demand, resulted in eightfold increase of production in the period of 1995–2007, up to 461,900 t in 2007. In the next two years, production was reduced by 28%, primarily due to reduction of its exports, but since 2010 it rose again by 35% to 451,200 t in 2012 (Tab. 1).

Tab. 1. Rock wool statistics in Poland — CN 6806 10

'000 t

Year	2008	2009	2010	2011	2012
Production	381.4	334.1	395.9	449.0	451.2
Imports	24.9	17.6	33.6	35.6	33.4
Exports	164.6	120.6	163.5	194.8	185.0
Consumption[a]	241.7	231.1	266.0	289.8	299.6

Source: ***The Central Statistical Office (GUS)***

Trade

The volume of foreign exports in ***rock wool*** was continually increasing until 2008. After two years in decreasing tendency, since 2010 it started to incraese again, to record 194,800 t in 2011, with some reduction in 2012 (Tab. 1). Exports of Polish rock wool are directed mainly to the Germany, Ukraine, Belarus, Lithuania, Latvia, Estonia and Russia. Imports in ***rock wool*** are a few times smaller, not exceeding 40,000 tpy. The main suppliers are Germany, the Czech Republic and Slovakia. The balance of ***rock wool*** trade is positive in recent years (Tab. 2). Rock wool of the highest quality, more expensive, is mainly imported, while standard quality rock wool is exported, though such tendency has been recently changing (Tab. 3). Recently, exports volume climbed to almost 50% of domestic production volume, with reduction to 41-43% in recent years. As a result, positive trade balance rose up to 637 million PLN in 2012 (Tab. 2).

Tab. 2. Value of rock wool trade in Poland — CN 6806 10

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	424,467	430,281	506,753	681,945	768,519
Imports	87,538	82,179	153,018	144,223	131,117
Balance	**+336,929**	**+348,102**	**+353,735**	**+537,722**	**+637,402**

Source: ***The Central Statistical Office (GUS)***

Consumption

Rock-casting commodities are used mainly in underground hard coal and ore mines (in stowing pipelines), chemical plants (acid and wear resistant linings), municipal sewage systems, and bulk material reloading stations.

Rock wool is utilized primarily for the production of insulating plates, pipeline mats, and lagging; the density of the materials varies usually from 45 to 180 kg/m^3, and the thickness from 2 to 12 cm. Some of these products are hydrophobized. Small amounts of rock wool are added to bituminous pavement mixes and asbestos-cement products to

Tab. 3. Average unit values of rock wool trade in Poland — CN 6806 10

Year	2008	2009	2010	2011	2012
Average exports unit values					
PLN/t	2,578.4	3,567.2	3,098.9	3,501.3	4,153.4
USD/t	1,097.5	1,154.5	1,026.0	1,190.5	1,270.1
Average imports unit values					
PLN/t	3,513.0	4,674.3	4,557.4	4,053.5	3,931.1
USD/t	1,468.9	1,532.2	1,520.2	1,372.9	1,204.4

Source: ***The Central Statistical Office (GUS)***

replace asbestos. Special grades of rock wool are used as insulating refractory materials.

The per capita consumption of ***rock wool*** in Poland, after slight reduction in the years 2001–2002, in the following five years climbed to 7.0 kgpy in 2007, with reduction to 6.1 kgpy in 2009 and recovery back to record almost 8.0 kgpy in 2012. It is worth mentioning that per capita consumption amounts to 10–15 kgpy in Western Europe, and over 20 kgpy in Scandinavia. Continuously rising energy prices on domestic market, still more stringent requirements regarding thermal insulation of new dwellings, enforcement of so-called “Thermo-modernization projects strengthening Act” in 1998, as well as the almost unlimited availability of domestic raw materials for the production of rock wool, should still stimulate growth of the domestic rock wool consumption again.

Principal companies involved in rock-smelting commodities production in Poland, as of 31 December 2012

- Przedsiębiorstwo Topienia Bazaltu Sp. z o.o. w Starachowicach (Basalt Melting Enterprise of Starachowice), ul. Piłsudskiego 68, 27–200 Starachowice, tel. +48 41 2745351, fax +48 41 2746150, www.bazalt.com.pl — *cast basalt.*
- “Kalenborn Delma” Sp. z o.o. w Strzegomiu (“Kalenborn Delma” Ltd. of Strzegom), ul. Olszowa 60, 58–150 Strzegom, tel. +48 74 8555400, fax +48 74 8555401, www.kalenborndelma.pl — *cast basalt.*
- “Rockwool Polska” sp. z o.o w Cigacicach (“Rockwool Polska” Ltd. of Cigacice), ul. Kwiatowa 14, 66–131 Cigacice, tel. +48 68 3850250, fax +48 68 3850234, www.rockwool.pl — *rock wool.*
- “Paroc Polska” Sp. z o.o. w Trzemesznie (“Paroc Polska” Ltd. of Trzemeszno), ul. Gnieźnieńska 4, 62–240 Trzemeszno, tel. +48 61 4682190, fax +48 61 4682304, www.paroc.pl — *rock wool.*
- “URSA Polska” Sp. z o.o. w Dąbrowie Górniczej (“URSA Polska” Ltd. of Dąbrowa Górnicza), ul. Armii Krajowej 12, 42–520 Dąbrowa Górnicza, tel. +48 32 2680101, fax +48 32 2640791, www.ursa.pl — *rock wool.*
- “Isoroc Polska” Sp. z o.o. w Nidzicy (“Izolacja” Joint Stock Co. of Nidzica), ul. Leśna 30, 13–100 Nidzica, tel. +48 89 6250300, fax +48 89 6250302, www.isoroc.pl — *rock wool.*
- “Saint Gobain Construction Products Polska” Sp. z o.o. w Gliwicach (“Saint Gobain Construction Products Polska” Ltd. of Gliwice), ul. Okrężna 16, 44–100 Gliwice, tel. +48 32 3396300, fax +48 32 3396444, www.isover.pl — *glass wool.*

RUBIDIUM

Overview

In nature, **rubidium** (**Rb**) mainly occurs dispersed in lithium minerals (***lepidolite***), cesium minerals (***pollucite***), ***carnalite salts***, ***salty seawaters***, and ***geothermal waters***. It is recovered mainly from ***alcarb*** (waste remaining after the processing of ***lithium concentrates***), and as a by-product of cesium production from ***pollucite*** and ***brines***.

Metallic rubidium is used in the production of photocells, and **rubidium compounds** for the building of thermionic converters (heat-electricity converters) and in electronics. The introduction of **rubidium oxide** Rb_2O into glass considerably increases its hardness, but lowers its softening point. The high price of rubidium and its compounds is the primary factor limiting consumption, particularly when there exist many substitutes (mainly in the production of light-sensitive instruments): cesium, germanium, tellurium, selenium, silicon, and others.

Sources

There are no ***rubidium-bearing*** deposits in Poland.

Production

There is no ***rubidium*** production in Poland.

Trade

Domestic demand for ***rubidium*** is satisfied by imports, mainly of highly processed products, but there are no data available.

Consumption

There are no data available on the structure of ***rubidium*** consumption in Poland.

SALT

Overview

Salt (**sodium chloride NaCl**) is one of the basic minerals, in use for 5,000 years. Bedded deposits and salt-domes of ***rock salt***, containing principally ***halite*** NaCl, are the main source of salt. It is also obtained from the evaporation of ***salty water***, ***sea water***, and ***natural*** or ***artificial brine***, as well as ***salty mine water***. For centuries, it has been consumed directly by both people and animals. Since the 19th century, sodium chloride has also been of fundamental importance in the production of ***calcined soda***, ***caustic soda***, and ***chlorine*** — the most widely applied inorganic compounds in modern industry.

Sources

Poland has large deposits of ***rock salt***, with total resources of 84,953 Mt (as of 31 December 2012). Only about 17.8% of the domestic resources are in deposits currently being operated. The most important are the deposits of the ***Zechstein formation***, which occur as ***salt-domes*** in the Kujawy region and the vicinity of Poznań (where the **Góra**, **Mogilno I**, **Mogilno II**, and **Kłodawa** deposits are under extraction), or in bedded form in the **Pomerania** region (e.g. **Mechelinki** deposit, where **Underground Cavity Natural Gas Storage Kosakowo** started to be constructed) and in the **Fore-Sudetic Monocline** (the **Kazimierzów** (**Sieroszowice**) deposit is under operation, where salt is a co-product of ***copper ore***). The ***Miocene salt formation*** of the **Carpathian Foredeep** is of minor significance. There are mines of only historical importance in **Wieliczka**, **Bochnia**, and **Kraków-Barycz**. The largest Miocene deposits are **Wojnicz** near Tarnów and **Rybnik-Żory-Orzesze** (Upper Silesia), but they are not planned to develop.

Another source of NaCl is ***salty water*** from ***hard coal*** mines in the **Upper Silesian Coal Basin** and from the **Rudna copper ore** mine near Lubin. This water has thus far been utilized to a very small extent. Discharging it damages the environment, however, and is only a burden on the mines' budgets.

Production

Until 2007 the production of ***salt*** has been increasing tendency, up to over 4.0 Mtpy. In the years 2007-2008, ***rock salt*** mining output was reduced by a half to ca. 0.6 Mt, in 2009-2011 it rose back to 1.2 Mtpy, while in 2012 decreased again to 0.8 Mt. On the contrary, ***salt brine*** output was distinctly reduced in the years 2008-2010, while in the years 2011-2012 it rose up to 2.7 Mtpy. As a result, total salt production in 2011 rose to 3.9 Mt, though in 2012 decreased to 3.5 Mt (Tab. 1). In ***salt*** production structure, share of ***rock salt*** decreased to 22%, with ***brine*** constituting the rest from mining output.

Tab. 1. Salt statistics in Poland — CN 2501

'000 t NaCl

Year	2008	2009	2010	2011	2012
Total production	3,401.3	3,532.1	3,699.9	3,887.2	3,524.7
— *rock-salt*	*618.1*	*998.7*	*1,235.5*	*1,253.9*	*792.5*
— *brine*	*2,783.2*	*2,533.4*	*2,464.4*	*2,633.3*	2,732.2
Imports	357.3	483.3	887.1	1,043.4	454.9
Exports	368.7	510.5	565.3	521.6	396.0
Consumption[a]	3,389.9	3,504.9	4,021.7	4,409.0	3,583.6

Source: ***The Central Statistical Office (GUS)***

Domestic supply of ***salt*** in 97% originates from rock salt deposits. The other sources are: mine waters desalination in hard coal mines and closed historic salt mines, but also — small amounts — salty water springs (e.g. Ciechocinek spa).

Rock salt production comes mainly from the underground **"Kłodawa" Salt Mine**. In this mine, after simple processing, ***rock salt*** (97.5% NaCl) for industrial and human consumption use is produced, at the level of 850,000–900,000 tpy in 2004–2006, but in 2007–2008 it was reduced to 448,000 t, in 2009–2010 it recovered to 823,000 t in 2010, and in 2011–2012 it was reduced to 566,000 t in 2012. Second rock salt producer is the underground **"Sieroszowice-Polkowice" Copper Mine** operated by **KGHM "Polska Miedź" S.A.**, which extracts salt from **Sieroszowice** deposit. Its production, after achievement of 392,000 t in 2006 and deep reduction to 110,000 t in 2007, in 2008–2012 increased to 524,000 t in 2012. Marginal amounts of ***rock salt*** for direct use are also supplied by the underground **"Wieliczka" Salt Mine**.

Brine obtained by leaching of rock salt deposits is the main primary source of salt in Poland. Its share in total domestic production varied between 67–72%, except of the years 2007–2008, when it rose even to 82%, while in 2012 it rose to 78%. The dominant producer — **Inowrocław Salt Mines Solino S.A.** (**GK PKN ORLEN S.A.** group) reduced brine output from ca. 2.5 Mtpy to ca. 1.9 Mt in 2012. It has two well mines: **Mogilno I** and **Góra**. Moreover, in extracted salt cavities in Góra deposit, **Underground Storage of Oil and Fuels** (**USOF**) was formed. Finally, USOF will have total capacity of ca. 5 Mm^3 in 10 cavities. The exploitation of the **Mogilno II** deposit, carried on by **Polish Oil and Gas Company Joint Stock Co.** of **Warsaw** through its subsidiary — **Investgas S.A.**, have the purpose of preparation of cavities of **UCNGS Mogilno**. Their output depends on intensity of such works, e.g. in the years 2011 and 2012 it was 745,000 t and 868,000 t salt in brine, respectively. In 2010 **Investgas S.A.** started to construct leaching of **Mechelinki** deposit (north of Gdańsk) and construction of **Underground Cavity Natural Gas Storage Kosakowo.** 595,000 t of salt in brine was leached in 2012, but it was not used in industry, being directed to Puck Bay (Baltic Sea). Finally, this storage will consist of 10 caverns, each with capacity of 250 million m^3 of gas.

The **Wieliczka-Bochnia** salt deposits, in southern Poland near Cracow, have been extracted for about 1,000 years, but now they have only historical importance. In the oldest Polish shaft mines — **Wieliczka** and **Bochnia** — tourist and rehabilitation parts were extracted. In Wieliczka mine, for purposes of protection of museum part of mine, salty waters are collected and up to 20,000 tpy of ***evaporated salt*** is produced.

In addition to individual rock salt deposits, ***mineralized underground waters*** from hard coal mines in the **Upper Silesian Coal Basin** are also a source of sodium chloride. Their discharge into surface water is responsible for ecological disaster in the upper Vistula and upper Odra river valleys. The pilot plant **"Dębieńsko" Underground Water Desalination Plant** was constructed in 1975 to utilize salty water and produce ***evaporated salt*** (production capacity of 45,000 tpy). In the years 1994–1995, the second **"Dębieńsko II"** plant (capacity 110,000 tpy) was commenced. Since 1999, they were included in **"Dębieńsko" Desalination Plant Ltd.** (belonging to **Kompania Węglowa S.A.**), and its ***evaporated salt*** production amounts to 75,000– 92,000 tpy.

Evaporated salt is produced from salt brine in saltplants. The largest of these is evaporation plant in Janikowo (**Soda Polska Ciech Sp. z o.o.** — former **JZS "Janikosoda"**), which delivers ca. 600,000 tpy of ***evaporated vacuum salt*** containing 99.8% NaCl. The **"Wieliczka"** and **"Dębieńsko"** plants are of minor importance. ***Precipitated salt*** is recovered from post-production solutions in the plants, which process salt brine into chemical products other than evaporated salt. The largest installation of this type occurs at the **"Anwil" Nitrogen Plants** of **Włocławek**. The total supply of evaporated and precipitated salt, after achievement of record amount of 953,000 t in 2004, was reduced to 763,000 t in 2009 and 2010, 768,000 t in 2011 and 724,000 t in 2012 (including salt for human consumption: 279,000 t in 2009, 227,000 in 2010, 301,000 t in 2011 and 256,000 t in 2012).

Trade

Poland usually exported both ***rock salt*** and ***evaporated salt***. The export level after 2002 has increased to almost 0.5 Mtpy in 2005–2006. In the years 2007–2008, due to weak winter, two largest recipients — the Czech Republic and Germany — reduced their purchases, what resulted in 25% decrease of total exports (Tab. 2), while their total share decreased from 90% to 76% of total exports. On the contrary, as a result of heavy winter, in the years 2009–2010 exports were above 0.5 Mtpy, with over 83% combined share of the Czech Republic, Germany and Slovakia. In the years 2011–2012 exports decreased to ca. 0.4 Mtpy, while Slovakia became important customer. Due to the same reasons, imports of salt from Ukraine and Belarus for road maintenance were reduced by over 40% in the years 2007-2008, while in 2009, and especially in 2010-2011 imports (from Belarus, Ukraine and Germany) rose to over 1,040,000 t. In 2012, imports were reduced by over half, especially from Ukraine (Tab. 3). Poland was traditional net exporter of salt, but in 2006 and since 2010 it - probably temporarily - became net salt importer.

Tab. 2. Polish exports of salt and pure sodium chloride, by country — CN 2501

'000t

Year	2008	2009	2010	2011	2012
Exports	**369**	**510**	**565**	**522**	**396**
Austria	1	7	13	4	2
Belgium	23	22	23	22	17
Czech Republic	186	235	236	218	156

Finland	3	3	5	4	1
France	8	9	8	6	5
Germany	93	142	174	189	94
Hungary	4	5	5	5	5
Latvia	2	2	2	2	3
Lithuania	7	7	9	10	10
Netherlands	10	2	1	1	0
Norway	1	1	1	1	1
Romania	3	3	3	1	1
Slovakia	11	54	63	38	78
Sweden	11	12	13	13	12
Others	6	6	9	8	11

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Polish imports of salt and pure sodium chloride, by country — CN 2501

‘000t

Year	2008	2009	2010	2011	2012
Imports	**357**	**483**	**887**	**1,043**	**455**
Belarus	122	228	382	434	217
Egypt	–	–	7	17	0
Germany	88	96	126	165	137
Slovakia	4	5	6	6	6
Ukraine	140	151	361	419	90
Others	3	3	5	2	5

Source: ***The Central Statistical Office (GUS)***

The balance of ***salt*** and ***pure sodium chloride*** trade is continually positive, except of 2011. In 2011 high imports (two times higher than exports) resulted in minimal trade deficit. In 2012 trade balance returned to positive value of over 31 million PLN (Tab. 4). Positive trade balance was possible also due to higher exports unit values in comparison to imports unit values (Tab. 5).

Tab. 4. Value of salt and pure sodium chloride trade in Poland — CN 2501

‘000 PLN

Year	2008	2009	2010	2011	2012
Exports	81,833	122,683	133,328	139,517	113,172
Imports	45,555	60,619	99,618	139,789	81,616
Balance	**+36,278**	**+62,064**	**+33,710**	**-272**	**+31,556**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Average unit values of salt and pure sodium chloride trade in Poland — CN 2501

Year	2008	2009	2010	2011	2012
Imports unit values					
PLN/t	127.5	125.4	112.3	134.0	179.4
USD/t	51.6	40.8	37.7	45.2	55.1
Exports unit values					
PLN/t	222.0	240.3	235.8	267.5	285.8
USD/t	93.3	78.2	78.9	91.0	87.3

Source: ***The Central Statistical Office (GUS)***

Consumption

The main consumers of ***salt brine*** are soda works and other chemical plants. In 2012, ca. 26% of salt brine was used for ***evaporated salt*** manufacture, ca. 64% for ***calcined soda*** production, and the remaining 10% in other chemical compounds, including ***chlorine*** and ***caustic soda***.

The largest amounts of salt-brine are consumed by the **Soda Polska Ciech Ltd.** in Janikowo soda plant (former **"Janikosoda" Soda Works**, ca. 1,500,000 tpy of NaCl, used in the production of ***calcined soda*** and ***evaporated salt***), and in Inowrocław soda plant (former **"Soda Mątwy" Works**, ca. 900,000 tpy of NaCl, mainly for the production of ***calcined soda***). Smaller amounts of salt-brine are consumed by the **"Organika-Zachem" Chemical Works** in **Bydgoszcz** (approx. 100,000 tpy, used in the production of ***chlorine***, ***caustic soda***, and ***chemical compounds***) and other chemical plants.

Rock salt and ***evaporated salt*** are directly consumed mainly by humans and animals. In addition, significant amounts are used in the production of ***chlorine*** and ***caustic soda*** (**"Anwil" Nitrogen Plants** of **Włocławek**, **PCC Rokita S.A.** in **Brzeg Dolny**, **Nitrogen Works of Tarnów S.A.** in **Tarnów**). Other applications include plastics, refrigeration engineering, textiles, and agriculture, as well as the food industry and forestry. In the years 2004–2006, and again in 2009–2011, due to long and heavy winters in Poland, rock salt was used primarily for road maintenance.

Companies involved in salt production in Poland as of December 2012

- Inowrocławskie Kopalnie Soli Solino S.A. (Solino Inowrocław Salt Mines Joint Stock Co. of Inowrocław), ul. Św. Ducha 26a, 88–100 Inowrocław, tel. +48 52 3545800, fax +48 52 3575837, www.solino.pl — *salt brine.*
- Polski Górnictwo Naftowe i Gazownictwo S.A. (Polish Oil and Gas Company Joint Stock Co. of Warsaw), ul. Krucza 6/14, 00–537 Warszawa, tel. +48 22 5835000, fax +48 22 5835856, www.pgnig.pl — *salt brine.*
- Kopalnia Soli Kłodawa S.A. (Kłodawa Salt Mine Joint Stock Co. of Kłodawa), Al. 1000-lecia 2, 62–650 Kłodawa, tel. +48 63 2733200, fax +48 63 2731560, www.sol-klodawa. com.pl — *rock salt.*
- Kopalnia Soli "Wieliczka" ("Wieliczka" Salt Mine of Wieliczka), Park Kingi 1, 32–020 Wieliczka, tel. +48 12 2787002, fax +48 12 2787110, www.kopalnia-pp.pl — *evaporated salt, rock salt.*

- KGHM "Polska Miedź" S.A. (KGHM "Polska Miedź" Joint Stock Co. of Lubin), ul. Marii Skłodowskiej-Curie 48, 59–301 Lubin, tel. +48 76 8481111, fax +48 76 8451527, www.kghm.pl — *rock salt.*
- "Soda Polska Ciech" Sp. z o.o. Zakład Janikosoda w Janikowie ("Soda Polska Ciech" Ltd. Janikosoda Works of Janikowo), ul. Przemysłowa 30, 88–160 Janikowo, tel. +48 52 3544100, fax +48 52 3544333, www.janikosoda.pl — *evaporated salt.*
- "Anwil" Zakłady Azotowe S.A. we Włocławku ("Anwil" Nitrogen Plants Joint Stock Co. of Włocławek), ul. Toruńska 222, 87–805 Włocławek, tel. +48 54 2363091, fax +48 54 2369786, www.anwil.com.pl — *precipitated salt.*
- Zakład Odsalania "Dębieńsko" Sp. z o.o. (Dębieńsko Desalination Plant Ltd.), ul. Młyńska 24, 44–230 Czerwionka-Leszczyny, tel. +48 32 4270280, fax +48 32 4312420, www.odsalanie.com.pl — *evaporated salt.*

SAND FOR LIME-SAND PRODUCTS AND CELLULAR CONCRETE

Overview

Quartz sand used for the production of ***lime-sand construction materials*** and ***cellular concrete*** is generally of ordinary or low quality, with 80–90% SiO_2, 5–10% clayey minerals, and 5–15% content of grains 2–4 mm. This group of quartz sand is sometimes included into the wide group of **industrial sand**. However, in other classifications, group of **industrial sand** does not include sand for ***lime-sand construction materials*** and ***cellular concrete***, as well as ***filling sand*** (see: **SAND, FILLING**) and ***construction sand*** classified as an ***aggregate*** (see: **AGGREGATES, MINERAL**).

Sources

Deposits of Quaternary ***quartz sand*** suitable for the production of ***lime-sand brick*** are of common occurrence in all 16 voivodeships. The largest are documented in northern and central Poland, especially in the Mazowieckie, Lubelskie, Zachodniopomorskie, Kujawsko-Pomorskie, and Łódzkie voivodeships. Deposits in the southern part of the country are smaller and of minor importance. Of the 105 recognized deposits, with resources of 270.5 Mt (as of 31 December 2012), 29 are currently under operation, but 6 of them periodically.

Deposits of Quaternary ***quartz sand for cellular concrete*** are also common in Poland. Out of a total of 59 deposits, containing almost 144 Mt, 14 are in operation, but 2 of them periodically. The largest deposits are in central Poland, especially in the Lubelskie, Łódzkie, Kujawsko-Pomorskie, Wielkopolskie, and Mazowieckie voivodeships. Deposits in northern Poland are of minor importance, whereas deposits in southern Poland are marginal.

Production

Quartz sand for lime-sand products has been extracted at 29 pits in 13 voivodeships, but 6 of them are operated periodically, therefore in 2012 in fact the mine output was recorded only in 23 mines. Production volumes are dependent on the demand from local markets, but commonly do not exceed 50,000 m^3py in a single mine. In the last year the highest level of output was recorded in following mines: **Barcin-Piechcin-Pakość** (76,000 m^3) in Kujawsko-pomorskie voivodeship, **Iława II** (69,000 m^3) in Warmińsko-Mazurskie voivodeship, **Żabinko** (66,000 m^3) in Wielkopolskie voivodeship, **Waliszew I** (66,000 m^3) in Mazowieckie voivodeship, as well as **Teodory** (59,000 m^3) in Łódzkie voivodeship (Tab. 1). All deposits are exploited for the needs of the local ***lime-sand materials*** plants. The financial and economic crisis initiated in 2008 resulted in lower production of the lime-sand products, (Tab. 3), as well as decrease of output of sand for their manufacturing, by more than 32% in 2009 (Tab. 1). Decline in mining output was recorded in almost all the mines. In the following two years, most of them managed to restore the level of output, so that the total mining production amounted to 780,000 m^3 in 2011. The year 2012, especially its second half, brought another decline in demand for lime-sand products and decrease of output of sand for their manufacturing to the level of 731,000 m^3 (Tab. 1).

Tab. 1. Output of sand for lime-sand products

'000 m^3

Year	2008	2009	2010	2011	2012
Mining output	**834**	**560**	**615**	**780**	**731**
Kujawsko-Pomorskie	60	40	66	100	122
Lubelskie	69	27	15	17	16
Łódzkie	62	32	36	44	59
Małopolskie	55	56	43	56	49
Mazowieckie	175	137	151	153	133
Opolskie	28	25	26	34	24
Podkarpackie	39	15	7	20	20
Podlaskie	92	3	9	24	10
Pomorskie	–	32	16	48	42
Świętokrzyskie	40	42	34	33	36
Warmińsko-Mazurskie	121	20	120	111	101
Wielkopolskie	82	120	87	123	115
Zachodniopomorskie	11	11	5	16	4

Source: ***Mineral Resources Datafile***

The lime-sand plants, which operate pits of such sand, are autonomous enterprises or are subordinated to larger enterprises, e.g. **"Niemce" Building Materials Enterprise S.A.**, manufacturing both lime-sand products and cellular concrete blocks. The autonomous enterprises are — among others — in **Żytkowice**, **Silikaty-Trąbki** (Szczecin), **Bełżec,** and newly opened in 2009 the **SIL-PRO Bloczki Silikatowe Ltd.** plant in Godzikowice in the Lower Silesia. As in other sectors of construction materials the significant consolidation has also taken place in lime-sand products sector as well as a series of ownership changes. One of them was the creation of **Xella Poland Ltd.** located in Poznań with 12 plants, including seven producing lime-sand products: Michłów-Reginów, Teodory (since 2009 in group), Iława, Pasym, Trzciniec, Żabinko and Wincentów near Radom. Another example of consolidation is nationwide **"Silikaty Group"**, which consolidated eight lime-sand plants: **Ostrołęka**, **Pisz**, **Przysieczyn**, **Ludynia**, **Leżajsk**, **Klucze**, **Jedlanka**, and **Białystok**. Their combined shares in lime-sand products market are currently 30%.

Quartz sand for cellular concrete was extracted at 12 pits in 8 voivodeships in 2012 (Tab. 2). Production volumes depend on the demand from local markets, but commonly do not exceed 50,000 m^3py in a single mine. In 2012, the highest level of output was recorded in following mines: **Studzienice** (94,000 m^3) in Pomorskie voivodeship, **Tuchorza** (53,000 m^3) in Wielkopolskie voivodeship, and **Lidzbark Welski** (37,000 m^3) in Warmińsko-Mazurskie voivodeship (Tab. 2). All deposits are exploited for the needs of the local cellular concrete production plants, being their owners. Some of these plants use also sand from other sources, i.e. ***construction sand*** of appropriate quality. At present, 23 cellular concrete plants utilize ***quartz sand***, whereas the remaining 7 — ***fly ash*** from power plants (see also: **CONCRETE AND CONCRETE PRODUCTS**).

Tab. 2. Mining output of sand for cellular concrete production

'000 m^3

Year	2008	2009	2010	2011	2012
Mining output	**340**	**322**	**397**	**414**	**355**
Dolnośląskie	21	21	24	23	23
Lubelskie	79	66	15	44	33
Łódzkie	4	21	31	25	19
Mazowieckie	42	47	46	34	19
Pomorskie	–	82	119	140	94
Świętokrzyskie	15	–	–	4	14
Warmińsko-Mazurskie	105	42	62	74	69
Wielkopolskie	54	43	70	69	85
Zachodniopomorskie	19	–	–	–	–

Source: ***Mineral Resources Datafile***

The total mining output of ***quartz sand for cellular concrete*** ranging between 320,000–400,000 m^{3}py, except for 2011, when this level was exceeded, and reached 414,000 m^3 (Tab. 2), however, for the production of cellular concrete good quality raw materials from deposits of construction sand and fly ashes were also utilised instead of such sand.

Trade

Quartz sand for lime-sand products, as well as ***for cellular concrete*** is used entirely for the needs of local lime-sand products and cellular concrete products plants.

Consumption

Lime-sand products produced in autoclaves are made of ***quartz sand***, ***milled lime***, and ***water*** (90% sand, 7% lime, 3% water). They have been widely used in building construction, being cheaper than conventional ceramic building materials. Many types of ***lime-sand products*** are produced, such as ***bricks***, ***tiles***, ***blocks***, ***channels***, etc. Their production after significant decrease to the level of 915,000-940,000 m^{3}py in the crisis years of 2008-2009, was rebuilt in the next years, so that in 2011 it reached more than 1,375,000 m^3, while in 2012 - 1,208,000 m^3 (Tab. 3). In the structure of production the share of lime-sand brick dropped from 58-60% to 48% in 2012. The lime-sand products make only 9% of building wall elements in domestic market, where the largest share have cellular concrete products (43% share in market) and "red ceramics" products (34%).

Tab. 3. Production of lime-sand products in Poland

'000 m^3

Year	2008	2009	2010	2011	2012
Lime-sand wall elements	**1,113.2**	**915.9**	**942.2**	**1,375.9**	**1,208.1**
• *including* lime-sand brick	664.7	437.9	487.8	615.7	579.5

Source: ***The Central Statistical Office (GUS)***

Quartz sand for cellular concrete is used entirely for cellular concrete production. The competition from substitutes (especially cellular concrete made of ***dust*** and ***fly ash*** from power plants and thermal-electric power stations) were the main reasons for weak demand for cellular concrete products based on quartz sand.

Companies involved in lime-sand products and cellular concrete production, as of December 2012

- "Xella Polska" Sp. z o.o. w Warszawie ("Xella Polska" Ltd. of Warsaw), ul. Pilichowiecka 9/11, 02–175 Warszawa, tel. +48 22 5732000, fax +48 22 5732070, www.xella.pl — *lime-sand products*, *cellular concrete products*.
- Zakład Wapienno-Piaskowy "Silikaty" S.A. ("Silikaty" Lime-Sand Plant Joint Stock Co.), Teodory, 98–100 Łask, tel. +48 43 6752651, fax +48 43 6752028, www.silikaty-teodory.pl — *lime-sand products*.
- Zakłady Silikatowe "Żytkowice" S.A. ("Żytkowice" Lime-Sand Works Joint Stock Co.), Żytkowice, 26–930 Garbatka Letnisko, tel. +48 48 6210065, fax +48 48 6210649, www.silikaty-zytkowice.com.pl — *lime-sand products*.
- "Silikaty-Trąbki" sp. z o.o. ("Silikaty-Trąbki" Ltd.), Plac Batorego 3, 70–207 Szczecin, tel. +48 91 4345085, fax +48 91 4346166, www.silikaty-trabki.pl — *lime-sand products.*
- Zakład Wapienno-Piaskowy "Bełżec" Sp. z o.o., (Lime-Sand Plant "Bełżec" Ltd.), 22–670 Bełżec, ul. Wąska 121 tel. +48 84 6652450, fax +48 84 6652338, www.zwp-belzec.pl — *lime-sand products.*
- Przedsiębiorstwo Produkcji Materiałów Budowlanych Niemce S.A. (Production of Building Materials Enterprise of Niemce Joint Stock Co.), 21–025 Niemce k. Lublina, ul. Ceramiczna 6, tel. +48 81 7564400, fax +48 81 7561627, www.ppmb-niemce.com.pl — *lime-sand products*, *cellular concrete products.*
- "Silikaty Ostrołęka" Sp. z o.o. with plants in Pisz, Przysieczyn and Leżajsk ("Silikaty Ostrołęka" Ltd.), Grabowo, 07–400 Ostrołęka, tel./fax +48 29 7602908, www.grupasilikaty.pl — *lime-sand products*.
- Przedsiębiorstwo Produkcyjno-Handlowe "Silikaty-Białystok" Sp. z o.o. ("Silikaty-Białystok" Production and Trade Enterprise Ltd.), ul. Wysockiego 164, 11–167 Białystok, tel./fax +48 85 6751576, www.silikaty.com.pl — *lime-sand products*.
- Zakład Produkcji Silikatów Ludynia Sp. z o.o. ("Ludynia" Lime-Sand Production Plant Ltd. of), 29–105 Krasocin, tel./fax +48 41 3917021 — *lime-sand products*
- "Grupa Prefabet" S.A. ("Grupa Prefabet" Joint Stock Co.), 26–900 Kozienice, tel. +48 48 6142807, fax +48 48 6143789, www.grupa-prefabet.pl — *cellular concrete products*.
- "Solbet" Sp. z o.o. ("Solbet" Ltd.), ul. Toruńska 71, 86–050 Solec Kujawski, tel. +48 52 3874100, fax +48 52 3872209, www.solbet.pl — *cellular concrete products*.
- Bruk-Bet Sp. z o.o. (Bruk-Bet Ltd.), Nieciecza 199, 33-240 Żabno, tel. +48 14 6377778, fax +48 14 6377784, www.bruk-bet.pl — *cellular concrete products*
- SIL-PRO Bloczki Silikatowe Sp. z o.o., (Sil-Pro Bloczki Silikatowe Ltd.) Godzikowice 50 M, 55-200 Oława, tel. +48 71 721 50 50, fax: +48 71 721 50 51, www.sil-pro.pl — *lime-sand products*

SAND, FILLING

Overview

Filling sand, i.e. **quartz sand** used for underground mines filling, has usually ordinary or even low quality. It should demonstrate the following parameters: max. 10–20% content of undersize grains (50 μm), below 0.5% of organic matter, max. 5–15% compressibility at the pressure of 15 MPa, min. 0.0004–0.007 cm/s water-permeability. Due to the high transportation costs and low unit price of filling sand, they are extracted within max. 50 km from underground mines, where they are used.

Sources

Poland is abundant in ***filling sand*** deposits, the majority of which usually occur in the vicinity (within 50 km) of underground mines of coal, copper, and zinc-lead ores. There are 34 deposits recognized (including 30 deposit in Upper Silesia region). Their total resources amount to 2,631 Mt (as of 31 December 2012); about 17% of these are in the 8 developed deposits. The largest deposits are located along the eastern edge of the Upper Silesia Coal Basin, including the operated deposits at **Szczakowa-Pustynia Błędowska**. Another important area is the western edge of the Upper Silesia Coal Basin (which supplies sand for the Rybnik Coal District), including the **Kotlarnia** region as the most significant. Three deposits for copper ore mining purposes are recognized in Lubin area, including **Obora** operated deposit.

Production

Filling sand is predominantly mined in the eastern and western parts of the **Upper Silesia Coal Basin** (for the needs of coal mines) and near **Lubin** (for copper mines). Over 60-65% of total production comes from the eastern part of the Upper Silesia Coal Basin (Tab. 1). The largest supplier (above 50% of domestic production volume) of ***Class I filling sand*** is the **DB Schenker Rail Polska Joint Stock Co**., which exploits deposits in the area of **Szczakowa**, **Pustynia Błędowska**, and **Siersza** on the border of Śląskie and Małopolskie voivodeships. The main consumers of sand from Szczakowa are coal mines in the Upper Silesia, the ZGH Bolesław Zn-Pb ore mine, and Salt Mine Wieliczka. Besides filling sand, the company also offers building sand, as well as foundry sand, but latter ones are marginal part of the **DB Schenker Rail** production as compared to amount of filling sand sales (3.5–5.4 Mtpy). The filling sands production since 2008 began to decline, due to decreasing demand of the coal mines and development of assortments for building applications (total 1.65 Mt in 2012).

The second significant producer of filling sand in the eastern part of Upper Silesia Coal Basin is **CTL Logistic**, which exploits the **Bór Wschód** and **Bór Zachód** deposits, close to coal mines in the Sosnowiec and Dąbrowa Górnicza regions, and delivers ***Classes I***, ***II***, and ***III filling sand***. Another producer is the **PTK Holding Joint Stock Co.**, exploiting the **Kuźnica Warężyńska** deposit in Dąbrowa Górnicza region, which delivers ***Class I filling sand***, but since 2005 all production has been consumed in the building products manufacturing. This deposit has not been mined since 2008.

Tab. 1. Mining output of filling sand in Poland

'000 m^3

Year	2008	2009	2010	2011	2012
Total mining output	**6,401**	**5,928**	**5,090**	**4,405**	**3,762**
Dolnośląskie	1,495	1,594	1,331	1,097	871
Opolskie	822	777	550	482	340
Małopolskie	3,079	2,721	2,541	2,314	1,878
Śląskie	1,005	836	668	512	673

Source: ***Mineral Resources Datafile***

On the western edge of the Upper Silesia Coal Basin there is the **"Kotlarnia" Sand Pit Co.** in Pyskowice, which exploits deposits in the **Kotlarnia** area, which mining output since 2004 has been fully utilized as a construction aggregates.

In Lower Silesia, only one filling sand deposit — **Obora** — has been extracted by **KGHM "Polska Miedź"** for years. The mining output of ***filling sand*** of this company, ranging at 1.1–1.5 Mm^{3}py, was significantly reduced in 2012 to 870,000 m^3. Almost 95% of filling sand is consumed in copper mines in the Lubin area, whereas 5% is sold for individual consumer for engineering construction works. The Sand Pit Obora is now the second domestic producer of filling sand.

After a short period of slight recovery, connected with sales of part of filling sand to building applications, since 2008 its output has declined to the lowest level of 3.7 Mm^3 in 2012. The further decreasing tendency of their use for filling of mine excavations was observed. Since 2009, as a result of the PKWiU classification changes filling sands are recorded under the item 08.12.11.90 "Natural sands". Since 2011, due to the unavailability of data, it is also difficult to estimate the size of their domestic supply based on the information from the largest suppliers, i.e. DB Schenker and Obora sand pit. Until 2010 it could be ca. 5.5-6.0 Mm^{3}py, now probably under 4.0 Mm^{3}py.

The change of PKWiU classification resulted in problems with fixing the average unit values of ***filling sand*** production. It is only possible to present the average unit values for natural sand, which since 2011 has increased to more than 11 PLN/t (Tab. 2).

Tab. 2. The average unit values of filling sand production in Poland — PKWiU 08121190[1]

Year	2008	2009	2010	2011	2012
PLN/t	11.3	10.9	10.0	11.2	11.5
USD/t	4.7	3.5	3.3	3.8	3.5

[1] average unit value of natural sand registered in item **PKWiU** 08121190— **Other natural sand**

Source: ***The Central Statistical Office (GUS)***

Trade

Filling sand is used entirely for the needs of the local underground mines. It is not traded internationally.

Consumption

The consumption of filling sand (used for filling of the mining excavations) was sharply reduced in recent years due to decrease of their consumption in coal mines in the Upper Silesian Coal Basin, and since 2010 in the copper mines too. There are a few reasons of such situation: growing use of other stowing materials (mining waste, flotation tailings, slag and granulated ash used as an additive for filling sand); reduction in hard coal output; decreasing share of expensive stowing methods in the Upper Silesia coal mines.

As a result of filling sand sales, its producers were obliged to commence production of other assortments of sand: construction sand, sand for building chemistry (dry mortars). It is well observed in Upper Silesian filling sand mines.

Principal companies involved in filling sand production in Poland as of December 2012

- “DB Schenker Rail Polska” S.A. (“DB Schenker Rail Polska” Joint Stock Co.), ul. Bukowa 12, 43–602 Jaworzno, tel. +48 32 7584 801, fax 48 32 7584 706, www.rail.dbschenker.pl — *Class I filling sand.*
- KGHM “Polska Miedź” S.A. Zakład Górniczy Piaskownia “Obora” (KGHM “Polska Miedź” Joint Stock Co., “Obora” Sand Pit), ul. Polkowicka 52, 59–305 Rudna, tel. +48 76 8430311, fax +48 76 8430390, www.kghm.pl — *Class I filling sand.*
- CTL Logistic Sp. z o.o. w Sosnowcu (CTL Logistic Ltd. of Sosnowiec), ul. Długa 90, 41–208 Sosnowiec, tel. +48 32 2990111, fax +48 32 2990113, www.ctl.pl — *Class I-III filling sand, building sand*.

SAND, GLASS

Overview

Glass sand is virtually monomineral ***quartz sand***, rich in SiO_2. This is the basic commodity for the glass industry; it should contain over 95% SiO_2, and very small amounts of coloring oxides, such as TiO_2 (0.2–0.02%) and Fe_2O_3 (1.0–0.006%), as well as other components, e.g. Al_2O_3 (3.5–0.15%), or CaO (1.5–0.1%). In Poland, glass sand is graded, depending on the impurities content, as grades **Sp** and **1** to **6**. In respect to grain size distribution, which is critical for the melting process, it is divided into **special** and **basic varieties**, **A** and **B**.

Sources

Over 84% of the resources of ***glass sand and sandstone*** deposits are in the Cretaceous formations of the **Tomaszów Syncline** (Łódzkie voivodeship), where there are 11 proven deposits (including four currently operated), containing 505.8 Mt of sands suitable for ***sand*** production of ***Classes 3***, ***4***, and ***5***. The second important area where Tertiary deposits of the best quality ***sand*** are recognized (78.9 Mt) is the vicinity of **Bolesławiec** (Dolnośląskie voivodeship), suitable even for producing ***sand*** of ***Classes 1***, and ***2***. There are 7 deposits, including only one under operation.

Smaller deposits are found in the Mazowieckie, Wielkopolskie, Świętokrzyskie, and Zachodniopomorskie voivodeships, marginal deposits — in the Lubelskie, Lubuskie, Podkarpackie, and Pomorskie voivodeships. The total resources of the 33 recognized deposits of ***glass sand*** amount to 621.7 Mt, including 179 Mt in 6 deposits under operation as of 31 December 2012. Prospects for the discovery of new deposits are primarily in the Tomaszów and Bolesławiec Synclines.

Production

Glass sand is mined and produced in three large plants. The largest producer is recently the **"Biała Góra" Mineral Mines** in Smardzewice near Tomaszów Mazowiecki, since 2007 in the structure of German company **Quarzwerke GmbH**. Currently three deposits: **Biała Góra I — Wschód**, **Biała Góra II — Wschód**, and **Unewel — Zachód** are under operation. Due to introduction of modernised processing, the company is able to produce glass sand of ***Class 3*** and ***2***, and rarely ***Class 1a***. The mining output after reduction to 729,000 t in 2009, increased in the next years to the record level of 930,000 t in 2011 (large increase of output from Unewel-Zachód deposit). Glass sand production in this plant makes currently 81–84% of its total production, which has recently exceeded above 1 milion tpy. The rest of sand is used for production of other industrial sand grades, mainly foundry sand (see: **SAND, INDUSTRIAL**).

Tab. 1. Mining output of glass sand in Poland

'000 t

Year	2008	2009	2010	2011	2012
Output, total	**2,207**	**1,793**	**1,995**	**2,290**	**2,149**
Dolnośląskie	946	624	695	789	797
Łódzkie	1,139	1,126	1,235	1,451	1,323
Mazowieckie	21	16	17	5	-
Wielkopolskie	101	27	48	45	29

Source: ***Mineral Resources Datafile***

The second important manufacturer is the **"Osiecznica" Glass Sand Pit & Processing Plant** (Dolnośląskie voivodeship), also in structure of **Quarzwerke GmbH**. Output from the **Osiecznica II** deposit, washed and purified in vanners, spirals and electro-magnetic separators, is processed into the best quality ***glass sand*** (***Classes 1–3***), offered in bulk or bags, or into ***sand for ceramics***, ***chemical industry***, ***construction chemistry***, etc. (small amounts). The waste material after processing is used to produce fine- and coarse-grained ***sand for construction and ceramics materials***, ***sand and gravel for filtration***, and ***raw kaolin*** for further processing (see: **KAOLIN**). The level of mining output after significant reduction to 624,000 t in 2009, has indicated a systematical increasing trend in the following years, reaching almost 800,000 t in 2012 (Tab. 1). The level of glass sand production in those years amounted to 600,000-720,000 tpy. Besides domestic customers, ***Classes 1*** and ***1a*** of ***glass sand*** from **Osiecznica** are also exported.

"Grudzeń-Las" Ltd.— a part of the **"Atlas"** company, has been the third producer of glass sand in Poland in recent years. It recovers ***Class 3*** and ***4 of glass sand*** (with predominance of the latter) in **Syski Processing Plant** from output of the **Grudzeń Las** deposit, recognized as ***foundry sand*** deposit, and from **Piaskownica-Zajączków** deposit recognized as ***glass sand*** deposit. The total production of glass sand from both mines, has increased year by year, and reached 666,000 t in 2011, but in 2012 it has been reduced about 18% to less than 550,000 t. The shares of glass sands in the total supply of company declined to 41-42% in recent years.

The output from the remaining two active glass sand mines, i.e. **Ujście Noteckie II**, and **Wyszków-Skuszew**, is consumed directly by neighboring glass-works, i.e. **Ardagh Glass Ujście S.A.** and **Ardagh Glass Wyszków S.A.** The quality of the glass sand in these deposits is rather low, but it meets the requirements of container glass producers. Capital investment of Irish company Ardagh brought the increase of mining output from the Ujście Noteckie deposit in 2008, but in the folowing year 2009 the company was unable to avoid significant production decline resulting from reducing demand of their own glass works. It was especially visible for the Ujście Noteckie II deposit in 2009, and since 2011 in case of the Wyszków-Skuszew deposit, exploitation of which is currently led periodically (Tab 1).

Glass sand is also obtained as a by-product during the processing of ***kaolin*** from the **Maria III** deposit near Bolesławiec, operated by the **"Surmin-Kaolin" Mineral Mines Co.** of **Nowogrodziec**. About 75,000-87,000 tpy of glass sand, mainly ***Class 3***, are produced there.

The mining output of ***glass sand*** exceeded the level of 2 Mt in 2008, mainly due to development of production in both the **Biała Góra** and **Osiecznica** plants. However, in 2009 it has been significantly reduced by about 19% to ca. 1.8 Mt. It was caused by decline of demand for raw materials for manufacturing construction glass and glass containers, as a consequence of the crisis (Tabs. 1, 2). The increase in extraction and production began to be observed in 2010, but its maximum level was recorded in 2011 - almost 2.3 Mt in the case of mining output, and over 2.5 Mt in the case of production. The production volume reported by the Central Statistical Office in recent years, however, should be adjusted in relation to the actual level (an average of about 300,000-350,000 tpy), due to the double production reporting by one of glass sand producers, which recorded wet sand and dry sand manufactured based on it. Despite this adjustment, the level of production in some years exceeds the level of mining output, due to the fact that glass sand is also produced from the foundry sands deposits (especially in the case of the Grudzeń Las mine), and from the kaolinite-rich sandstone by Surmin-Kaolin.

Modernization investments undertaken in the processing plants in the last years contributed to increase of yield of the higher quality sand, so that production of ***Class 1–3*** (mostly from **Osiecznica** plant, **Biała Góra** and partly from **Grudzeń-Las** plants) could make ca. 70% of total domestic production. The share of ***Class 4*** (from **Biała Góra** and **Grudzeń-Las** plants) was about 20–25% and the remaining 5% fell for ***Class 5- 6*** obtained from Wyszków-Skuszew and Ujście Noteckie II mines.

Tab. 2. Glass sand statistics in Poland — CN 2505 10, PKWiU 0812115001

'000 t

Year	2008	2009	2010	2011	2012
Production *	2,006.2[r]	1,800.2[r]	2,110.5[r]	2,282.2[r]	2,211.5
Exports	270.2	156.0	205.3	231.3	209.5
Imports	14.7	7.9	6.9	12.1	19.2
Consumption[a]	1,750.7[r]	1,652.1[r]	1,912.1[r]	2,063.0[r]	2,021.2

The Central Statistical Office data corrected for overdeclared production of TKSM Biała Góra

Source: ***The Central Statistical Office (GUS), own calculation***

The average unit values of ***glass sand*** production in Poland in recent years, with the exception of the crisis year of 2009, remained in the range of 32-35 PLN/t (Tab. 3). Prices of the best quality classes were over 100 PLN/t. The average unit value of exports has lasted on this level, or even higher in recent years (Tab. 3).

Tab. 3. Average unit values of glass sand production and trade in Poland — CN 2505 10, PKWiU 0812115001

Year	2008	2009	2010	2011	2012
Production unit values					
PLN/t	36.2	30.0	34.8	32.8	34.8
USD/t	15.0	9.6	11.6	11.1	10.7
Exports unit values					
PLN/t	94.7	94.4	104.2	110.8	108.2
USD/t	40.6	30.5	34.5	37.9	33.0
Imports unit values					
PLN/t	384.6	695.6	668.3	627.5	538.7
USD/t	163.7	221.0	220.4	213.7	164.6

Source: ***The Central Statistical Office (GUS)***

Trade

Exports of glass sand make 8-9% of domestic production, and after a distinct decrease to 156,000 t in 2009, rose slightly to 205,000-230,000 tpy in the following years (Tab. 2). They are usually limited to the best quality grades, especially of ***Classes 1*** and ***1a***, what was confirmed by the high average units of exports (Tab. 3). The main foreign customers in recent years have been: the Czech Republic (36–44% of exports) Lithuania (19% in 2012), Germany (19%), and Slovakia (12%).

Glass sand imports are much lower, ranging recently between 7,000 and 19,000 tpy. Almost 30-50% came from Germany, but in 2012 from the Czech Republic too (57% of supply). Different grades of glass sand are imported, so their average unit values varies from ca. 212–261 PLN/t of Czech sand to 599–749 PLN/t of German sand, whereas the average value was 538 PLN/t in 2012 (Tab. 3). Some amounts of other industrial sand, e.g. sand for hydraulic fracturing, can also be included in this CN item. Due to significant growth in sand exports, the balance of trade has shown a positive value, and except for 2009 and 2012, increased in recent years, despite still existing differences between the unit values of imports and exports (Tab. 3 and 4).

Tab. 4. Value of glass sand trade in Poland — CN 2505 10

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	25,609	14,734	21,391	25,623	22,654
Imports	5,668	5,499	4,678	7,569	10,326
Balance	**+19,941**	**+9,235**	**+16,713**	**+18,054**	**+12,328**

Source: ***The Central Statistical Office (GUS)***

Consumption

Glass sand is used to produce various types of ***glass*** and ***glass products***. The purest grades, ***Class Sp*** and ***Class 1***, containing less than 0.03% coloring oxides (TiO_2+Fe_2O_3), are consumed by the optical industry to produce ***optical glass*** (***spectacle lenses***), e.g. at the **Jelenia Góra Optical Works**, and laboratory glassware made of ***transparent silica glass***. Sand of ***Class 1*** (rarely ***2***) is applied for the production of ***lead crystal glass***. ***Class 3*** sand is used mainly for the production of ***glass tableware***, whereas ***Class 3*** and ***4 sand for window glass*** and other ***architectural glass***. The lowest classes of sand are used for the production of ***containers*** and ***glass insulators***.

Glassworks in Poland are highly differentiated in terms of size, technological level, production assortments and ownership structure. There are more than 100 glassworks or enterprises dealing with the processing of glass of different sizes. The largest ones are flat ***float*** glassworks with capacities of over 200,000–300,000 tpy each, the smallest are glass tableware factories delivering less than 2,000 tpy. The total supply of glass is growing systematically, mainly due to the development of flat glass and container glass - two of the most dynamically developing branches of the glass industry (Tab. 5). After a decline in production recorded in 2009, when as a consequence of the crisis glass tableware industry as well as technical glass industry has suffered the most significantly, the following years resulted in a gradual increase of the supply of glass and its products to more than 2.6 Mt in 2012. The structure of glass industry in Poland, as in Europe, is dominated by glass containers (52-53% of total supply), and flat glass not further worked (37-38%), which have together more than 80% share. Taking into account the production of the processed products (for construction and automotive glass), manufactured on the basis of “primary” sheets of flat glass, glass production and its products exceeded 3.5 Mt in 2012. The less importance in total glass production have ***glass tableware***, which accounts for ca. 3% (tableware, fancy glass products, mirrors), ***technical glass***, which makes recently 2-3% (laboratory, lighting, electrotechnical glass products), and a wide range of products based on ***glass fiber*** – ca. 3%.

Total production of glass containers, with the exception of 2009, showed a dynamic rising trend reaching more than 1.4 Mt in 2012 (Tab 5). The largest producers are:

- **Owens-Illinois Polska S.A.** (with 40% share of the sales in the glass containers sector) with two glassworks: **Jarosław** (after the expansion the biggest glass work of O-I in the world with 4 glass furnaces and capacity 1,200 tpd) and **Antoninek**;
- **Ardagh Glass plc** with three operations in **Ujście**, **Gostyń**, and **Wyszków** (ca. 20% share of the sales in the glass containers sector);
- **Warta Glass Ltd. Group**, with total production above 10%, with glassworks **HS Sieraków S.A.** - leader in the alcohol bottles producer (1 milion pieces per day) and **HS Jedlice S.A.** (the third jar producer in Poland);
- **Polampack S.A. Glasswork Orzesze** (ca. 7% share of the sales in the glass containers sector), with production capacity 240 t per day.

The other, smaller manufacturers have specialized in the production of some types of glass containers. The largest of them is the **Stolzle Częstochowa Joint Stock Co.** specialized in the pharmaceutical bottles production (ca. 110 tpd with the planned expansion to more than 200 tpd in 2013). Among the smaller producers there are: **HS Czechy Joint Stock Co.** and **Hainz Glas Działdowo Ltd.** manufacturing mainly bottles for cosmetics, **HS Sława Kielce**, **HS Vitrosilicon** in **Pobiedziska**, **HS Wymiarki, Feniks Glassworks** in **Piotrków Trybunalski** and **Kama-Vitrum** in **Wołczyn** as well as producing a bottle of sophisticated shape **Glassworks TUR** in **Szubin.**

Tab. 5. Glass statistics in Poland — CN 7002–7019, PKWiU 2311–2314

'000 t

Year		2008	2009	2010	2011	2012
Production *		**2,428.3**	**2,160.2**	**2,377.5**	**2,478.6**	**2,651.5**
Flat glass not further worked	**PKWiU 2311**	**817.1**	**768.7**	**876.3**	**946.8**	**992.2**
in which float flat glass	PKWiU 231112	*720.4*	*718.0*	*819.6*	*903.3*	*957.0*
Technical glass	**PKWiU 2315**	**67.9**	**59.0**	**59.7**	**55.2**	**63.8**
Glass tableware	**PKWiU 231312–13**	**107.4**	**63.2**	**72.4**	**80.3**	**90.6**
Glass containers	**PKWiU 231311**	**1,270.4**	**1,202.2**	**1,280.9**	**1,305.4**	**1,421.7**
Fiberglass	**PKWIU 2314**	**165.5**	**67.1**	**88.2**	**90.9**	**83.2**
Exports *		**742.0**	**550.7**	**738.5**	**768.5**	**795.3**
Flat glass, not further worked	**CN 7003–7008**	**345.4**	**219.2**	**338.6**	**345.1**	**363.3**
in which float flat glass	CN 7005	*284.0*	*185.3*	*329.6*	*335.2*	*354.3*
Technical glass	**CN 7002,7011,7014–7018**	**36.0**	**21.2**	**22.8**	**28.2**	**28.8**
Glass tableware	**CN 7009,7012,7013**	**131.1**	**114.4**	**124.3**	**127.8**	**140.4**
Glass containers	**CN 7010**	**197.5**	**166.2**	**214.0**	**224.8**	**226.5**
Fiberglass	**CN 7019**	**32.0**	**29.7**	**38.8**	**42.6**	**36.3**
Imports *		**813.9**	**607.2**	**726.1**	**788.3**	**716.4**
Flat glass, not further worked	**CN 7003–7008**	**403.0**	**276.6**	**353.8**	**345.3**	**277.5**
in which float flat glass	CN 7005	*393.2*	*266.1*	*344.0*	*334.4*	*272.0*
Technical glass	**CN 7002,7011,7014–7018**	**36.7**	**21.1**	**24.1**	**21.7**	**18.7**
Glass tableware	**CN 7009,7012,7013**	**83.9**	**66.1**	**72.1**	**83.4**	**87.2**
Glass containers	**CN 7010**	**201.4**	**164.8**	**174.9**	**233.1**	**236.9**
Fiberglass	**CN 7019**	**88.9**	**78.6**	**101.2**	**104.8**	**96.1**
Consumption [a] *		**2,500.2**	**2,216.7**	**2,365.1**	**2,498.4**	**2,572.6**
Flat glass		**874.7**	**826.1**	**891.5**	**947.0**	**906.4**
in which float flat glass		*829.6*	*798.8*	*834.0*	*902.5*	*874.7*
Technical glass		**68.6**	**59.0**	**61.0**	**48.7**	**53.7**
Glass tableware		**60.2**	**14.9**	**20.1**	**35.9**	**37.4**
Glass containers		**1,274.3**	**1,200.8**	**1,241.8**	**1,313.7**	**1,432.1**
Fiberglass		**222.4**	**116.0**	**150.6**	**153.1**	**143.0**

** without processed flat glass*

Source: ***The Central Statistical Office*** *(GUS)*

The similar fluctuations were observed in case of flat glass, not further worked. With the exception of 2009, it grew systematically, reaching in 2012 the level of almost 1 Mt (Tab. 5). As a result of significant foreign investments in this sector, the share of ***float glass*** in the total flat glass production has already exceeded 96%, with the disappearing of the production of glass by traditional methods. More than 80% of flat glass is subject to further processing, in 80-85% for construction, and 15-20% for the automotive industry. Four float glass glassworks currently dominate this sector: **"Pilkington Sandoglass"** in **Sandomierz** — a company of the British glass concern **Pilkington plc**, **"Polfloat Saint Gobain"** in **Dąbrowa Górnicza-Strzemieszyce** of the French concern **Saint Gobain**, **"Guardian Industries Poland"** in **Częstochowa**, a part of the American company **Guardian,** and the youngest on the market - **Euroglas** in Ujazd near Łódź (belongs to Swiss-German company **Euroglas**). The others producers of flat glass in Poland, but of descending importance, were: "**91-Plus Glass Szczakowa**" in Jaworzno, the only one in Europe producer of decreasing amounts of drawn glass with using traditional ***pittsburgh*** method (in 2011 the glass work was liquidated), **Glaspol Jaroszowiec Saint Gobain** supplying flat ornamental glass and reinforced glass (produced by continuous rolling), **Gloss World Ltd.** in Wałbrzych (producing patterned rolled glass), or **Anex-Glas** (former **Kara** Glassworks) in Piotrków Trybunalski.

In the case of ***glass tableware***, after decline in production in the years 2007-2009, due to the difficult economic situation of many glassworks and significant competition of cheaper products imported from Asian countries (mainly from China and Indonesia), from 2010 a gradual increase to over 90,000 t in 2012 was observed (Tab. 5). The structure of glass tableware is dominated by the production of glass made from soda glass (84% of supply). The major producers of this type of glass are two glassworks: "**Krosno"** specialized in ***hand-made tableware***, automatically formed ***sodium tableware***, ***glass fiber*** (the only producer) and ***technical glass*** and **"Irena"** delivering ***crystal glass*** and automatically formed ***sodium tableware***. Other producers include: **"Violetta"** in **Stronie Śląskie**, and **"Sudety Crystal Works"** in **Szczytna**, in the case of ***lead crystal glass***; **"HSG Tarnów"** and **"Szczakowa"** for automatically formed ***sodium tableware***; **"HSG Tadeusz Wrześniak"** in **Tarnów**, and **HSG "Rozalia"** of **Radomsko** and others for hand-made ***tableware***.

The relatively small production of ***technical glass***, after the period of significant reduction to the level of 55,000 t in 2011, rose slightly about 15% to 64,000 t in 2012 (Tab. 5). The major producers of this branch are glassworks manufacturing the special types of glass products: **Termisil Glassworks Wołomin** — ***heat-resistant glass***, **"Biaglass"** of **Białystok** — ***lighting glass***. There are also some companies manufacturing special type of glass, e.g. **Philips Lighting Poland** of Piła — light bulb production (operating by 2009, one of only two such plants in Europe); **Thomson Multimedia Polska** of Piaseczno — one of two in Europe kinescope factories (until 2009), or **Saint-Gobain Isover Polska Ltd**. in Gliwice supplying glass wool. Different types of technical glass are also produced by **Vitrosilicon** in **Żary** and **Iłowa** (water glass, vitreous sodium and potassium silicates and glass blocks), and **Quimicer Poland** in Opoczno specialized in frits production. Anothers plant in this sector are **Jeleniogórskie Optical Plants** specialized currently in production of spectacle lenses, as well as a range of fine glassware manufacturers across the country.

In the case of glass fiber, production levels after a dramatic 50% reduction in 2009, mainly as a result of installation modernization the glassworks **Krosglass SA** and strong competition from low-cost imports from China, began to rebuild gradually to the more than 90,000 t in 2011 (Tab. 5). Production of glass fiber in the form of glass mats, rovings and fabrics are widely used in the production of components of boats and yachts, pipes, tanks, fire protection systems, vehicle components, and to reinforce plastics, vehicle body parts, brake pad, showers, bathtubs, window profiles, etc.

Significant amounts of glass products, especially ***flat glass***, ***glass containers***, and ***glass tableware*** are the subject of international trade. The structure of exports and imports, however, is a little different. While the export is dominated by the raw float glass, accounting for over 45% of foreign sales, so in import glass container makes the biggest share - more than 33%. In the case of flat glass not further worked its main customers were the neighbouring countries such as: Ukraine, Lithuania, Germany, Slovakia and Belarus, in the case of glass tableware and glass containers (with smaller dimensions) they are sent to Germany and more distant countries: France, the United Kingdom, the Netherlands, Italy Denmark, USA and many others.

The sales of flat glass not further worked have growed rapidly since 2009, reaching almost 800,000 t in 2012, which accounted for over 36 % of domestic production. Equally dynamic growth of exports was recorded in case of glass containers, which in 2012 exceeded 226,000 t, i.e. about 16% of domestic production of tableware glass. It is

Tab. 6. Glass products trade balance in Poland — CN 7002–7019

million PLN

Year		2008	2009	2010	2011	2012
Exports, total		**2,170.5**	**1,912.7**	**2,179.8**	**2,591.0**	**2,795.5**
Flat glass*	**CN 7003–7005**	427.3	273.4	406.5	532.9	520.6
Technical glass	**CN 7002,7011,7014–7018**	92.2	99.8	95.0	105.2	101.1
Glass tableware	**CN 7009,7012,7013**	1,043.6	906.1	955.8	1,080.4	1,165.9
Glass containers	**CN 7010**	411.2	411.2	476.6	572.3	679.9
Fiberglass	**CN 7019**	196.2	222.2	245.9	300.2	328.0
Imports, total		**2,280.5**	**2,033.6**	**2,392.3**	**2,798.3**	**2,589.5**
Flat glass*	**CN 7003–7005**	649.9	479.4	554.2	582.0	493.4
Technical glass	**CN 7002,7011,7014–7018**	188.1	167.9	200.7	223.4	159.6
Glass tableware	**CN 7009,7012,7013**	463.7	426.9	515.5	537.6	542.7
Glass containers	**CN 7010**	430.5	456.7	491.3	628.0	636.0
Fiberglass	**CN 7019**	548.3	502.7	630.6	827.3	757.8
Balance, total		**-110.0**	**-120.9**	**-212.5**	**-207.3**	**+206.0**
Flat glass*	**CN 7003–7008**	*–222.6*	*–206.0*	*–147.7*	*–49.1*	*+27.2*
Technical glass	**CN 7002,7011,7014–7018**	–95.9	–68.1	–105.7	–118.2	–58.5
Glass tableware	**CN 7009,7012,7013**	+579.9	+479.2	+440.3	+542.8	+623.2
Glass containers	**CN 7010**	–19.3	–45.5	–14.7	–55.7	+43.9
Fiberglass	**CN 7019**	–352.1	–280.5	–384.7	–527.1	–429.8

** Flat glass, not further worked*

Source: ***The Central Statistical Office (GUS)***

worth to be mentioned that export of ***tableware glass*** more than twice exceeds domestic production, as cheaper products from Asian countries (mainly China, Indonesia) are re-exported. In addition, large amounts of processed flat glass (for construction and automotive applications) are traded internationally. The level of its exports since 2009 exceeds 210,000-230,000 tpy, while the import ranged 120,000-140,000 tpy. Trade in these highly processed products significantly affects the value of the balance of the glass. The inclusion of this group into the trade balance resulted in a highly positive value of trade balance amounting to 720-1,300 milion PLN in the last two years, but removal of these group from the balance gave a negative trade balance of glass in the years 2008-2011 (Tab. 6), between 110-212 million PLN/y. In 2012, the balance showed a surplus ca. 206 million PLN due to a significant reduction in import of "raw" flat glass, and further increase of exports of processed products. In the analyzed period, only tableware glass showed the positive value of the trade balance, as well as the glass containers and "raw" flat glass in 2012. Permanently negative is the balance of technical glass (Tab. 6).

Companies involved in glass sand production in Poland as of December 2012

- Kopalnia i Zakład Przeróbczy Piasków Szklarskich "Osiecznica" Sp. z o.o. ("Osiecznica" Glass Sand Pit & Processing Plant Ltd.), ul. Piaskowa 7, 59–724 Osiecznica, tel. +48 75 7340044, fax +48 75 7312219, www.osiecznica.com.pl — *glass sand of Classes 1–3.*
- Tomaszowskie Kopalnie Surowców Mineralnych "Biała Góra" Sp. z o.o. w Smardzewicach ("Biała Góra" Minerals Mines Ltd. of Tomaszów in Smardzewice), 97–200 Tomaszów Mazowiecki, P.O. Box 73, tel. +48 44 7261801, fax +48 44 7245760, www.piasek.com.pl — *glass sand of Classes 2–4.*
- "Grudzeń Las" Sp. z o.o. w Unewelu ("Grudzeń-Las" Ltd. of Unewel), 26–345 Unewel, tel./fax +48 44 7573234, www.grudzenlas.pl — *glass sand of Class 3–4.*
- Ardagh Glass Ujście S.A. (Ardagh Glass Ujście Joint Stock Company), ul. Huty Szkła 2, 64–850 Ujście, tel. +48 67 2109100, fax +48 67 2109101, www.ardaghglass.com — *glass sand (for in-house consumption).*
- Kopalnie Surowców Mineralnych "Surmin-Kaolin" S.A. w Nowogrodźcu ("Surmin-Kaolin" Mineral Mines Joint Stock Co. of Nowogrodziec), ul. Kaolinowa 35, 59–730 Nowogrodziec, tel. +48 75 7316515, www.surmin-kaolin.com.pl — *glass sand mainly of Class 3, kaolin for ceramic and non-ceramic applications.*

SAND, INDUSTRIAL

Overview

Sand is a loose sedimentary rock, consisting of mineral grains mostly of 0.01 to 2.0 mm size. The most common is **quartz sand**, composed of round quartz grains formed in various geological conditions. Depending on its quality, sand has many applications. The best grades are applied in the glass and ceramics industry (see: **SAND, GLASS**). Sand of somewhat worse quality (min. 93–95% SiO_2) is used for foundries, construction chemistry, water filtering, construction sandblasting, cement durability testing, hydraulic fracturing in oil & gas industry. All these grades belong to the category of **industrial sand**. Ordinary sand (80–90% SiO_2) is utilized for the production of ***lime-sand bricks*** and ***cellular concrete*** (see: **SAND FOR LIME-SAND PRODUCTS AND CELLULAR CONCRETE**), as a filling material in mining (see: **SAND, FILLING**), and in building construction as ***construction sand***, which is commonly classified as an ***aggregate*** (see: **AGGREGATES**).

Sources

The deposits of ***foundry sand*** are the main source for the production of different grades of ***industrial sand***. The largest deposits of ***foundry sand*** are in the Cretaceous formations of the **Tomaszów Syncline** (Łódzkie voivodeship). There are 11 proven deposits, containing 123.2 Mt of sand (approx. 39% of domestic resources), three of which were exploited in the last year (the Biała Góra I-Wschód is operated periodically). In the **Częstochowa** area (Śląskie voivodeship) there are over 40 relatively small deposits, with total resources of 53.7 Mt. Most of them have been abandoned. Six deposits, containing 31.3 Mt, are recognized in the Opolskie voivodeship, but no of them is exploited now. There are single deposits recognized in Dolnośląskie (**Czerwona Woda**, **Krzeszówek -** operated temporarily with no production since 2006), Małopolskie voivodeships (**Szczakowa**) and smaller and undeveloped in the Lubelskie, Mazowieckie, Podkarpackie, Pomorskie, Świętokrzyskie, Wielkopolskie, and Zachodniopomorskie voivodeships. The total resources of 77 recognized deposits of ***foundry sand*** amount to 314.3 Mt (as of 31 December 2012).

Various grades of ***industrial sand*** are also recovered from worse parts of ***glass sand*** deposits, as well as from some deposits of ***natural sand & gravel aggregates***, ***sand for lime-sand products*** and ***for cellular concrete***.

Production

A few companies, which are extracting ***foundry sand*** deposits, are simultaneously the main producers of ***industrial sand***. The vicinity of Tomaszów Mazowiecki in the Łódzkie voivodeship (central Poland) is the most important region of their activity (above 78% of ***industrial sand*** domestic production, Tab. 1). Two large producers are active there — **"Biała Góra" Tomaszów Mineral Mines Ltd.** and **"Grudzeń Las" Ltd.**, as well as smaller one — **"Badger Mining Poland" Ltd.**

Tab. 1. Mining output from foundry sand deposits in Poland

'000 t

Year	2008	2009	2010	2011	2012
Mining output	**1,194**	**1,074**	**1,053**	**1,474**	**1,206**
Dolnośląskie	45	41	13	35	19
Łódzkie	909	799	788	1,210	949
Małopolskie	217	185	220	222	218
Śląskie	26	48	31	7	20

Source: ***Mineral Resources Datafile***

Recently the largest supplier of industrial sand in the Tomaszów region is company **Grudzeń Las Ltd.** extracted the **Grudzeń-Las** deposit (recognized as ***foundry sand*** deposit), and **Piaskownica-Zajączków** deposit (recognized as ***glass sand*** deposit). The total output from both deposits after a period of strong growth to a record level of more than 1.5 Mt in 2011, was reduced by almost 15% in 2012. The total supply of all sand produced in the company, with the exception of 2009 (marked by the crisis), exceeded 1.1 Mtpy, with the record of 2011 when approached up to 1.5 Mt. The company's portfolio is dominated by glass sands making 43% of the supply. Foundry sands make in recent years about 30% of production and over 90% are derived from the Grudzeń Las deposit. Complementing the company's production is sand for construction chemistry and ceramics industry, derived predominantly from the Piaskownica-Zajączków deposit. Their production in 2012 exceeded 303,000 t, which accounted for approximately 30% of total supply. Majority of them are used by owner of the company — **"Atlas"** of **Łódź** — for manufacturing various ***construction chemistry*** products (dry mixes, mortars, adhesives, etc.), while some part is sold to other companies with similar production profile (e.g. Mapei). Also ***filtration sand and gravel*** offered by company, despite water treatment application found purchasers in the construction industry for the production of dry mixes and structural plasters. Their production in 2012 exceeded 80,000 t.

The second supplier of industrial sand in the Tomaszów region is the **"Biała Góra" Minerals Mine Ltd.** of **Tomaszów** in **Smardzewice**. The company was in 2007 purchased by German company **Quarzwerke GmbH**. It extracts three deposits of glass and foundry sand: **Biała Góra I — Wschód**, **Biała Góra II — Wschód** and **Unewel — Zachód**, currently at the combined volume of close to 1 Mtpy, but almost all output comes from parts of deposits recognized for ***glass sand*** production. It is also used primarily for the production of ***glass sand*** (see: **SAND, GLASS**). The production of ***foundry sand*** in this company, after significant decrease to 85,000 t in 2009, rose in next years to the level of above 100,000 tpy. The total company sand production (combined with glass sand, sand for construction chemistry and ceramic industry, sand for construction sandblasting, standardized sand for testing of cement durability, filtration sand and gravel) exceeds the level of 1 Mtpy with huge predominance of glass sand (80-82% of the total supply of the company).

The third producer in this region — **Badger Mining Poland Ltd.** — commenced its production in 1997 on the basis of **Ludwików** foundry sand deposit. Despite the ***foundry sand*** (mainly ***1K***) the company also offers ***sand for construction chemistry***, ***filtration sand***, ***sand for construction sandblasting***, ***sand for hydraulic fracturing in oil & gas industry***, etc. The production has been recently reduced to 20,000 tpy (Tab. 1).

The most important foundry sand supplier outside of Tomaszów Mazowiecki area is the company **DB Schenker Rail Polska S.A.**, which delivers ***1K*** and ***2K foundry sand*** from the **Szczakowa** deposit. Its production after the reduction to about 200,000 t in 2009, increased to 350,000 t in 2010 and remained at that level in the coming years, judging by a similar level of output. However this quantity is only a part of company's activity, compared to huge amount of filling sand and construction sand produced there (total production above 5 Mt in 2010). Foundry sand from DB Schenker Rail Polska was sold both on domestic market and abroad (the Czech Republic and Slovakia), not only for molding applications, but also for chemicals, aggregates for concrete and mortar, abrasives, etc.

Another important producers of industrial sand are:

- **"Kwarc" Ltd.** of **Krzeszówek**, delivering mainly ***sand for construction chemistry***, ***for sandblasting***, and ***for filtration***, in smaller amounts — ***foundry sand***, total amount do not exceed 10,000–11,000 tpy; after bankruptcy of Krzeszówek Sand Mine, the production of company was based on raw material buying from other suppliers;
- **Minerals Cooperative** in **Opole**, supplying ***filtration sand and gravel***, utilized also in abrasives and blasting, basing on mining output from natural aggregate deposits (Brzezie, Groszowice, Przywory, Zielina), recently at ca. 10,000 tpy;
- **Opole Mineral Mines Ltd.** (**Górażdże Kruszywa** group) producing ***foundry sand*** using for molding application as well as in construction chemistry based on the natural aggregate **Nowogród Bobrzański I** deposit, in amount of above 20,000 tpy.

Smaller producers of industrial sand are: **Bolesławiec Refractory Plant**, **Foundry Sand Mine Zawisna II Ltd.** (based on mining output from **Zawisna II** deposits), **"Kuźnica Warężyńska" Sand Pit** (***sand for construction chemistry***), and **"Walmar" Mietków** (***filtration sand and gravel***). ***Dry sand for construction chemistry*** could be produced according to demand by **Kotlarnia Sand Pit**, which exploits Kotlarnia filling sand deposit. ***Chalcedonite filtration sand and grits*** are manufactured by **"Mikrosil"** of **Radom** in Inowłódz mine.

Total production of ***foundry sands***, according to the Central Statistical Office data ranged between 760,000 to 806,000 tpy in the period 2007-2008, with a significant decline in 2009 to about 720,000 t (Tab. 2). This value, however, was corrected for Wielkopolskie voivodeship, where the production of foundry sand does not occur at all. Probably the production of other quartz sand, or worse natural sand was wrongly classified to this position. The very low value of average unit value of these sand sale in this voivodeship (only 11.5 PLN/t) testified for the mistake in clasiffication. A similar correction of production volume was also needed in case of the Opole voivodeship, because the volume of production reported by manufacturers operating there (e.g. OKSM Ltd.) is significantly lower than the Central Statistical Office statistics. Moreover the average unit value of foundry sand sale is also very low (only 18.5 PLN/t). Due to the same reasons a similar adjustment was made in relation to the value of total production data of Central Statistical Office for the year 2010, so that the production volume amounted to 920,000 t (Tab. 2). It is not possible to present the data corrected in the same way for the subsequent years 2011-2012, on the basis of the available statistical data. The data obtained from the three largest suppliers (Grudzeń Las Sp., DB Schenker Rail Poland SA, TKSM Biała-Góra Ltd.) indicated that their summared foundry sand production, after decrease to only 590,000 t in 2009, rose to over 800,000 t in 2010 (Tab. 2). The production levels for following years can be estimated at 870,000-880,000 tpy based on data from two main suppliers (the data from DB Schenker are not available since 2011).

It is currently imposible to estimate the total domestic production of industrial sand based on the Central Statistical Office date. There is only known that the share of foundry sand, which in this group was most important in recent years, is diminishing. Whereas there is noticed a increasing demand for sand using for manufacturing of mortar, plaster and other building applications, especially that they are offered in majority by the same producers as foundry sand. The production of ***filtration sand and gravel***, estimated recently at about 130,000 tpy, is also included in the group of ***industrial sand***. Ca. 70% of their production came from the Tomaszów Mazowiecki region (including about 40,000-80,000 tpy from **Grudzeń Las** and 20,000-30,000 tpy from **TKSM "Biała Góra"**). The part of filtration sand and gravel was also utilized in plasters production and others products of construction chemistry.

Tab. 2. Foundry sand production in Poland

'000 t

Production/Year	2008	2009	2010	2011	2012
Production according the Central Statistical Office data	806.3	720.0*	920.0*	980.0^e	950.0^e
Production of three the biggest suppliers**	742.9	586.7	807.0	884.0^e	873.2^e

* the value without production recorded in Wielkopolskie and Opolskie Voivodeships

** data from: Grudzeń Las Ltd., DB Schenker Rail Polska Joint Stock Co., TKSM Biała-Góra Ltd.

Source: ***The Central Statistical Office (GUS)****, own sources*

Trade

As ***foundry sand*** and ***other industrial sand*** are regarded as raw materials of domestic importance, they are not traded internationally. The small amount was exported from DB Schenker Rail Polska mainly to Slovakia and the Czech Republic. Their trade is recorded together with glass sand under one common CN number (**CN 2505 10**), but most likely the latter constitutes the majority in this group (see: **SAND, GLASS**).

Consumption

Foundry sand is the basic auxiliary raw material for foundry work, used for molding purposes. The development of that technology resulted in the introduction of ***synthetic molding mixes***, manufactured mainly from quartz sand and clay binding materials, such as bentonite. When necessary, small amounts of chromite, zirconium, corundum, olivine, sillimanite, and staurolite sands are also applied. Most of these are deficit materials, the demand for which is covered by import.

The demand for ***foundry sand*** in Poland is practically satisfied by the domestic production. Continuous reductions in the output of castings, especially of ***cast iron*** and ***cast steel***, resulted in decrease in the foundry sand consumption. The significant part of ***foundry sand*** is currently utilised in other applications, of which the most important is the ***construction chemistry*** sector, which year by year consumes increasing amounts of ***foundry and other industrial sand*** (e.g. from **Grudzeń-Las**, **Biała Góra**, **Badger Mining**, **DB Schenker Rail Polska**, **Kwarc Krzeszówek**, etc.). The total consumption of sand in the ***construction chemistry*** industry is estimated to be even ca. 3.0 Mtpy, but the remaining part of sand is delivered by natural aggregates producers.

Principal companies involved in industrial sand production in Poland as of December 2012

- Tomaszowskie Kopalnie Surowców Mineralnych "Biała Góra" Sp. z o.o. w Smardzewicach ("Biała Góra" Minerals Mines Ltd. of Tomaszów in Smardzewice), 97–200 Tomaszów Mazowiecki, P.O. Box 73, tel. +48 44 7261801, fax +48 44 7245760, www.piasek.com.pl — *1K foundry sand, sand for construction chemistry and ceramic industry, sand for steel construction sandblasting, sand for cement durability testing, filtration sand and gravel, quartz powder for tar paper.*
- "Grudzeń Las" Sp. z o.o. w Unewelu ("Grudzeń-Las" Ltd. of Unewel), 26–345 Unewel, tel./fax +48 44 7573234, www.grudzenlas.pl — *1K and 2K foundry sand, sand for construction chemistry and ceramic industry, filtration sand and gravel, quartz powder for ceramics*.
- "Badger Mining Poland" Sp. z o.o. w Tomaszowie Mazowieckim ("Badger Mining Poland" Ltd. of Tomaszów Mazowiecki), ul. Spalska 178, 97–200 Tomaszów Mazowiecki, P.O. Box 67, tel. +48 44 7248822, fax +48 44 7248493, www.badgermining.com.pl — *1K foundry sand, sand for construction chemistry, filtration sand and gravel, sand for steel construction sandblasting, sand for hydraulic fracturing in oil & gas industry.*
- "DB Schenker Rail Polska" S.A. ("DB Schenker Rail Polska" Joint Stock Co.), ul. Bukowa 12, 43–602 Jaworzno, tel. +48 32 7537711, fax 48 32 6177470, www.ptkigk.com.pl *–1K-2K foundry sand, sand for construction chemistry, sand for steel construction sandblasting.*
- "Kwarc" Sp. z o.o. in Krzeszówek. ("Kwarc" Ltd. of Krzeszówek), 58–405 Krzeszów, tel./fax +48 75 7423175, www.kwarc-krzeszowek.pl — *foundry sand, sand for construction chemistry, sand for steel construction sandblasting, filtration sand and gravel.*

- Spółdzielnia Pracy Surowców Mineralnych w Opolu (Minerals Cooperative of Opole), ul. Kardynała Bolesława Kominka 3, 45–032 Opole, tel. +48 77 4542766, fax +48 77 4544942, www.spsm.pl — *foundry sand, filtration sand and gravel, sand for steel construction sandblasting, construction sand and gravel.*
- Opolskie Kopalnie Surowców Mineralnych Sp. z o.o. (Opole Mineral Mines Ltd.), ul. Cementowa 1, Chorula, 47–316 Górażdże, tel. +48 77 4468600, fax +48 77 4468602, www.heidelbergcement.pl/aggregates — *foundry sand, sand for construction chemistry, construction sand and gravel.*
- PTK Holding Kopalnia Piasku "Kuźnica Warężyńska II" sp. z o.o. (PTK Holding "Kuźnica Warężyńska II" Sand Pit Ltd.), ul. Letnia 1, 41–300 Dąbrowa Górnicza, tel. +48 32 2610921, fax +48 32 2610953, www.ptkholding.pl — *sand for construction chemistry.*
- Przedsiębiorstwo Eksploatacji Kruszywa "Walmar" w Mietkowie ("Walmar" Aggregates Construction Enterprise of Mietków), 52–081 Mietków-Proszkowice, tel. +48 71 3168244, fax +48 71 3337203, www.pekwalmar.com.pl — *filtration sand and gravel, sand for steel construction sandblasting.*
- Kopalnia Piasku Kotlarnia S.A. ("Kotlarnia" Sand Pit Joint Stock Co.), ul. Dębowa 3, 47–246 Kotlarnia, tel. +48 77 4848801, fax. +48 77 4848800, www.kotlarnia.com.pl — *3K foundry sand, building sand.*

SCANDIUM

Overview

Scandium (**Sc**) is the lightest of the rare earth elements. Some minerals of scandium are known, e.g. ***thortveitite*** (up to 53.5% Sc_2O_3), ***befamite***, and ***kolbeckite*** (up to 39.2% Sc), which very occasionally form small deposits. These serve as sources of commercial mineral concentrates. However, as scandium occurs in many ores in trace amounts, it is mainly produced as a byproduct during processing of ***uranium ores*** or recovered from tailings or residues remaining after the processing of ***wolframite*** obtained from greisenic deposits. ***Phosphates***, ***coal***, etc. also have potential importance.

Metallic scandium is used as a catalyst, as a constituent of special heat-resistant steel and aluminum alloys applied in space technology, and for laboratory purposes. As an additive **scandium oxide** improves the quality of special glass, including high resolution color kinescopes, and is also used in the production of lasers, semi-conductors, ***yttrium-gallium-scandium garnets***, and ***ferrites*** for electronics. **Scandium arsenide** and **scandium phosphide** are used in the production of the most temperature-resistant refractories (with a melting point near 2,700°C).

Sources

Poland has neither ***scandium*** nor any ***scandium-bearing*** mineral deposits.

Production

There is no production of ***scandium-bearing*** minerals or ***scandium commodities*** in Poland.

Trade

Domestic demand for scandium commodities is met entirely by imports, which are not separately recorded by the **Central Statistical Office** (**GUS**). They are listed together with the group of ***rare earth metals*** and ***yttrium***. In the years of 2008–2012, the total imports figure of these ***metals*** was ranging between 0.6–7.9 tpy (see: **RARE EARTH ELEMENTS**). The main sources of imports in recent years were Germany, the Netherlands and other Western European countries, China and in 2012 the Czech Republic. The trade balance of ***scandium commodities*** has been consistently negative in recent years, depending on import volume and the market price.

Consumption

The consumption pattern of ***scandium*** and ***scandium compounds*** in Poland is not available. Most likely they are used as catalysts, in the production of special glasses, lasers, and semi-conductors, and in electronics.

SCHIST, MICA AND PHYLLITE

Overview

Mica-schist and **phyllite-schist** are metamorphic rocks containing mainly minerals of the ***mica*** group (***sericite***, ***muscovite***, ***biotite***). They are used as mineral powders for ***tar papers***, as well as ***mineral fillers*** in bituminous pavement mixes, paints, and plastics. Phyllite schist, easily split into thin plates, was formerly also used to make roof tiles (***roofing slate***).

Sources

The total reserves of ***mica-schist*** recognized in **Orłowice** deposit near Świeradów Zdrój and in **Jawornica** deposit near Kłodzko amounted to 6.7 Mt, as of 31 December 2012. ***Phyllite-schist*** occurs in the vicinity of Głuchołazy and Głubczyce (voivodeship of Opole), in the large **Dewon-Pokrzywna** deposit, and the smaller **Chomiąża** deposit. In 2010 another deposit of ***phyllite-schist*** was recognized in **Pokrzywna** area and the total resources of these rocks increased to 17.9 Mt, as of 31 December 2012.

Production

Mica-schist is extracted from the **Orłowice** deposit in the **Jerzy** mine by the **Jelenia Góra Mineral Mines**. The raw material from this mine was milled into ***mineral powder*** (fraction 0.32–2.5 mm, 80% of production) and two grades of ***dust*** (the by-product of milling): under 0.315 mm and under 0.08 mm. This production was ceased owing to lower demand from domestic tar paper producers. The schist milling plant was moved to Jarnołtówek, where company mined ***phyllite-schist*** from **Dewon-Pokrzywna** deposit. Total output from **Orłowice** deposit ranged between 2,000 and 5,000 tpy with the exception of increase to 18,000 tpy in the 2008 (Tab. 1). Small amounts of ***mica-schist*** (500–1,000 tpy) were also extracted in **Jawornica** mine.

Tab. 1. Mica-schist and phyllite-schist statistics in Poland

'000t

Year	2008	2009	2010	2011	2012
Mica schist					
Production = Consumption[a]	19.3	3.1	3.0	5.3	3.1
Phyllite schist					
Production = Consumption[a]	13.8	23.9	56.7	157.0	189.6

Source: ***Mineral Resources Datafile, producer's data***

Exploitation of the ***phyllite-schist*** in the **Dewon-Pokrzywna** deposit in Jarnołtówek by the **Jelenia Góra Mineral Mines S.A.** was ceased in 2009. In 2008 the company extracted 13,800 tpy of the phyllite-schist (Tab. 1), utilized in majority as decorative and building stones and also in tar paper production. Since 2009 the new owner of the mine has been **"Dewon" Ltd.** The output of ***phyllite-schist*** strongly increased, from 23,900 t in 2009 to 189,600 t in 2012, but ***mineral powders*** and ***dusts*** have no longer been produced.

Trade

Mica-schist and ***phyllite-schist*** are not traded internationally.

Consumption

Mineral powder, produced formerly on the basis of ***mica-schist*** and then ***phyllite-schist***, was utilized for ***tar paper*** production. Due to decreasing tar paper production in Poland, consumption of schist powder in this application was terminated in the last years. ***Mineral dust***, the by-product of ***mica-schist*** or ***phyllite-schist*** milling, were utilized in the production of insecticides and for insulation, and as filling ballast in paints, plastics, and bituminous pavement mixes. The ***phyllite-schist*** products, which had the finest grain size, were used as a pigment for paints — ***schist gray***.

Currently, ***mica-schist*** and ***phyllite-schist*** are used exclusively as decorative and building stones.

Companies involved in mica-schist and phyllite-schist production in Poland, as of December 2012

- Jeleniogórskie Kopalnie Surowców Mineralnych w Szklarskiej Porębie (Jelenia Góra Minerals Mines of Szklarska Poręba), ul. B. Czecha 2, 58–580 Szklarska Poręba, tel. +48 75 7172001, fax +48 75 7172515, www.jksm.pl — *mica-schist tile.*
- Przerób Kamienia Sebastian Nowak (Sebastian Nowak, Processing of Stone), Jawornica 9, 57–343 Lewin Kłodzki, tel./fax +48 74 8698665, www.marmur.fr.pl — *mica-schist tile.*
- Dewon Sp. z o.o. (Dewon Ltd.), 48–267 Jarnołtówek, tel. +48 77 4397581, fax +48 77 4397770 — *phyllite-schist tile.*

SELENIUM

Overview

There are over 40 known **selenium** (**Se**) minerals, but there are no deposits of the industrial importance. Selenium as an admixture, or as an accompanying element, is usually associated with copper (***chalcopyrite***, ***bornite***), and also with iron (***pyrite***), lead, nickel, cobalt, molybdenum, silver, and others. Primary selenium is predominantly recovered from ***selenium-containing anode slimes*** (containing usually 10–30% Se) or from ***furnace dust***, generated in copper smelters, as well as – though to an ever smaller scale – from scrapped selenium-based copier drums.

The largest consumer of **selenium** is the glass-making industry. Other important applications are in metallurgy and chemistry, and in the production of photoreceptors, pigments, agricultural feed additives, and many others.

Sources

Selenium occurs as a dispersed element in the ***copper ore*** deposits of the **Fore-Sudetic Monocline**, but its resources have not been estimated. The selenium content varies from 3.6 to 6.1 g/t (ave. 4.5 g/t), depending on the type of ore. It is recovered from the ***anode slime*** generated in course of copper concentrate metallurgical processing. The slime contains an average of 1.0–1.7% Se. Recovery is mandated by regulations, due to the high toxicity of selenium emitted into the atmosphere.

Production

The only ***selenium*** producer in Poland has been copper manufacturer **KGHM Polska Miedź S.A.** ***Black selenium powder***, containing approx. 99% Se, has been obtained at its **Precious Metals Plant**, in the **Boliden Kaldo** process from ***anode slime*** and ***furnace dust*** generated at the **Głogów** and **Legnica** copper refineries. In the last three years the output of selenium, which generally follows fluctuations of the refined copper production, substantially increased, achieving 90 tons in 2012 (Tab. 1).

Tab. 1. Selenium statistics in Poland — CN 2804 90

t

Year	2008	2009	2010	2011	2012
Production	81.9	73.1	79.0	84.7	90.2
Imports	19.1	8.2	14.5	13.2	13.0
Exports	52.1	51.0	48.1	54.1	59.1
Consumption[a]	48.9	30.3	45.4	43.8	44.1

Source: ***The Central Statistical Office (GUS), producers' data***

Trade

The exportation of selenium from Poland has ranged from 48 to 59 tpy, according to fluctuations of principal buyers' demand. The most regular recipients have been Germany, Italy, and Ukraine, while Hong-Kong has emerged as the top destination for selenium from Poland in recent years (Tab. 1, 2). Variable amounts of selenium were simultaneously imported to Poland, basically from Germany (more than 50% of the total imports), Belgium, Austria, and France. The trade balances, which until 2010 averaged 5-6 million PLN per annum, in the following years significantly improved, approaching 17 million PLN in 2012 (Tab. 3).

Tab. 2. Polish exports of black selenium, by country — CN 2804 90

t

Year	2008	2009	2010	2011	2012
Exports	**52.1**	**51.0**	**48.1**	**54.1**	**59.1**
Belgium	–	–	4.1	–	13.4
Bulgaria	1.0	–	–	–	0.8
China	–	5.3	11.0	–	–
Czech Republic	2.1	1.3	–	–	–
Estonia	–	–	0.2	0.3	0.1
Finland	–	–	–	2.0	0.6
Germany	10.1	7.7	4.8	3.1	0.4
Hong-Kong	–	–	–	27.3	37.7
Hungary	–	–	1.0	–	–
India	–	–	–	–	0.6
Italy	28.1	32.1	21.6	17.0	0.6
Lithuania	5.2	–	0.9	0.6	0.9
Slovenia	–	–	–	–	1.0
Spain	–	–	1.0	–	–
Ukraine	4.0	2.9	3.0	2.7	1.6
United Kingdom	–	–	–	0.4	0.9
Others	1.6	1.7	0.5	0.7	0.5

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of black selenium trade in Poland — CN 2804 90

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	7,442	6,663	8,950	18,257	20,538
Imports	2,748	1,063	2,745	3,946	3,684
Balance	**+4,694**	**+5,600**	**+6,205**	**+14,311**	**+16,854**

Source: ***The Central Statistical Office (GUS)***

The unit values of ***selenium*** exportation from Poland matched the changes in international prices of selenium, fluctuating in the wide range from 42 and 114 thousand USD/t in the last five years (Tab. 4). Most recently they almost tripled as compared to 2009 due to the international prices improvement.

Tab. 4. The unit values of selenium exports from Poland — CN 2804 90

Year	2008	2009	2010	2011	2012
PLN/t	142,840	130,638	186,072	337,473	347,508
USD/t	60,976	42,388	60,845	113,935	106,610

Source: ***The Central Statistical Office (GUS)***

Consumption

In the last three years the apparent consumption of selenium in Poland stabilized at 44-45 tpy (Tab. 1). The principal domestic applications of selenium are the following: the glass manufacturing industry, ceramics, glazes, paints, and plastics, special types of steel, nonferrous metals alloys, chemistry, etc. The detailed end-use distribution of ***selenium*** and ***selenium salts*** in Poland has been difficult to ascertain.

Companies involved in selenium production in Poland, as of December 2012

- KGHM Polska Miedź S.A. w Lubinie (KGHM Polska Miedź Joint Stock Co.), ul. Skłodowskiej-Curie 48, 59–301 Lubin, tel. +48 76 8478200, fax +48 76 8478500, www.kghm.pl — *black selenium*.

SILICON

Overview

Commercial **silicon metal** (**Si**) is obtained by the reduction of ***quartz*** or ***quartzite*** with coal or coke in electric furnaces. Five grades are distinguished: ***Si99***, ***Si98.5***, ***Si98***, ***Si97***, and ***Si96*** (where the digits represent the respective percentage of Si). **Silicon** is used mainly in the production of aluminum and in the chemical industry. It may serve as a constituent of alloys of copper, nickel-copper, nickel, ferronickel for plastic working, vanadium; in Fe-Si-Mg alloys, or pre-alloys with aluminum; and solders for aluminum, copper, brass, or bronze. It is also used for the production of ***carbocorundum***, ***silicides***, and ***silica-organic compounds*** (***silicones***), which are becoming more and more popular in refractory materials, abrasives, and other branches of industry. **Metallic semiconductor-grade silicon** and **high purity Si monocrystals** are also very common in electronics (integrated circuits). The widely known **silicon carbide** (**carbocorundum**, **SiC**) is highly suitable for the production of silicon carbide refractories and abrasive materials. It is also used in the production of the resistance elements in electric furnaces (***silite rods*** and ***products***).

Silicon compounds, **ferrosilicon**, and **silicon-rich ceramic products** (containing SiO_2), enamels, glass, etc. are produced from ***quartz*** and ***rocks*** rich in SiO_2, not from **metallic silicon**. Ferrosilicon is used almost exclusively in the steel-making industry as an oxygen-removing alloy additive.

Sources

High quality ***crystalline quartzite*** from the Świętokrzyskie Mountains and ***vein quartz*** from deposits in Lower Silesia (see: **QUARTZITE AND QUARTZ**) may be a domestic source of raw materials for the production of ***commercial grade silicon***, ***silicon compounds***, and ***alloys***. The extent to which these materials will be utilized will depend upon the cost and the energy requirements, as well as on demand from domestic industry.

Production

The **Topsil Semiconductor Materials S.A.,** former **Cemat-Silicon** of **Warsaw** has been the only domestic supplier of ***polished silicon plates*** and ***plates with epitaxial layer*** (totaling approx. 100,000–140,000 items per month as 100 mm polished wafer equivalent) made of ***pure*** and ***doped silicon monocrystals*** using the Czochralski single crystal growth method. Production is based on imported ***polycrystalline silicon*** (30–45 tpy). The product assortment is constantly being expanded, in pace with the increasing demand from the electronics industry, but exact data are not available (Tab. 1).

The **Łaziska Smelter** is the only domestic manufacturer of various grades of ***ferrosilicon***, primarily those containing 75% Si, but also 65% and 45% Si (Tab. 2). It delivers also decreasing amounts of ***ferrosilicomanganese*** (25,061 t in 2008, 9,700 t in 2009, 112 t in 2010, 378 t in 2011 and only 81 t in 2012, see: **MANGANESE**). Taking into account the ***ferrosilicon*** trade statistics, the domestic demand in the years 2008–2012 can be evaluated at the level of ca. 9,400–22,100 tpy (Tab. 2).

Trade

Domestic demand for ***silicon metal*** is supplemented by imports, which in the years of 2008–2009 reached level of almost 12,000 tpy, and in period 2010–2012 increased, up to the record level of 17,800 t (Tab. 1). The regular suppliers of ***silicon*** are Norway, Germany, Australia, China, the Netherlands, Brazil, France, the US, and Belgium, but recently the main suppliers were Brazil, the Netherlands, France, Germany, Taiwan and Russia (Tab. 3). Variable amounts of ***ferrosilicon*** are also traded, and in period 2008–2012 its imports varied between 15,500–21,900 tpy, but exports were exceeding imports – even by 4 times – and has been changing between 53,400–76,000 tpy, except for 2009 when they dropped to only 16,200 t (Tab. 2).

Tab. 1. Silicon statistics in Poland — CN 2804 61–69

t Si

Year	2008	2009	2010	2011	2012
Production	NA	NA	NA	NA	NA
Imports	11,743	11,943	17,093	17,572	17,802
Exports	892	1,089	803	1,383	1,674
Consumption[a]	NA	NA	NA	NA	NA

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Ferrosilicon statistics in Poland — CN 7202 21–29

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Production	56.0	9.7	53.2	72.7	78.1
Imports	19.5	15.9	21.9	18.7	15.5
Exports	53.4	16.2	63.7	76.0	72.1
Consumption[a]	22.1	9.4	11.4	15.4	21.5

Source: ***The Central Statistical Office (GUS), the data from producers***

The trade balance in ***silicon*** had been negative in recent years, with an increasing tendency in the years 2008–2010 (Tab. 4), and in 2010 there was particular increase of trade balance, when it deepened to the record value of 242 million PLN, but in two next years improved and amounted almost 176 million PLN, due to lower international prices (Tab. 5). The trade balance of ***ferrosilicon*** was in the years 2008–2012 positive (Tab. 4), due to exports volume exceeding imports (Tab. 2). Trade balance in ***ferrosilicon*** ranged between almost 4 million PLN and 295 million PLN. The changes on international markets influence the unit values of ***silicon commodities*** imports to Poland (Tab. 5).

Tab. 3. Polish imports of silicon, by country — CN 2804 61–69

t Si

Year	2008	2009	2010	2011	2012
Imports	**11,743**	**11,943**	**17,093**	**17,572**	**17,802**
Australia	403	5	–	48	336
Austria	20	374	121	47	–
Belgium	41	3	27	37	38
Bosnia and Hercegovina	335	936	354	336	791
Brazil	2,542	4,519	4,693	6,654	7,825
China	264	48	1,105	567	24
Czech Republic	380	316	510	46	73
Denmark	–	57	141	88	78
France	2,644	1,146	2,155	1,025	1,445
Estonia	21	–	24	2	–
Germany	1,375	952	1,408	2,247	2,139
Italy	27	42	112	222	857
Latvia	285	47	–	–	–
Macedonia	1	–	24	–	–
Malaysia	20	–	–	60	–
Netherlands	416	1,189	2,331	2,932	2,484
Norway	1,968	26	284	240	1,008
Philippines	21	73	22	–	0.0
Russia	144	656	1,549	871	387
Slovakia	12	114	11	–	–
South Africa, Republic of	48	–	–	–	–
Taiwan	702	1,395	1,666	1,468	2
Thailand	–	–	473	527	286
United Kingdom	4	8	24	119	2
USA	45	12	41	10	2
Others	25	24	18	26	25

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Value of silicon commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Silicon CN 2804 61–69					
Exports	22,192	26,443	40,434	41,852	40,466
Imports	111,530	122,856	282,690	228,052	216,206
Balance	**-89,338**	**-96,413**	**-242,256**	**-186,200**	**-175,740**

Ferrosilicon CN 7202 21–29					
Exports	222,882	70,676	299,671	401,997	324,914
Imports	82,273	66,708	106,235	106,442	87,119
Balance	**+140,009**	**+3,968**	**+193,436**	**+295,555**	**+237,795**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Unit value of silicon commodities imports to Poland

Year	2008	2009	2010	2011	2012
Silicon CN 2804 61–69					
PLN/t	9,838	10,287	16,538	12,978	12,146
USD/t	3,974	3,394	5,469	4,419	3,712
Ferrosilicon CN 7202 21–29					
PLN/t	4,219	4,195	4,851	5,700	5,614
USD/t	1,800	1,365	1,603	1,944	1,719

Source: ***The Central Statistical Office (GUS)***

Consumption

Several dozen tons of ***high purity silicon*** are consumed by the domestic electronics, and the remaining ***silicon***, containing less than 99.99% Si, is used by the non-ferrous metal industry for alloys with Al, Cu, Ni, and for solder production, etc.

Alloyed steel producers are the main consumers of ***ferrosilicon*** and ***ferrosilicomanganese*** (see: **MANGANESE**), both domestic and imported, at the total level of 60,000–80,000 tpy.

Companies involved in silicon materials production in Poland, as of December 2012

- "Topsil Semiconductor Materials" S.A. w Warszawie ("Topsil Semiconductor Materials" Joint Stock Co. of Warsaw), ul. Wólczyńska 133, 01–919 Warszawa, tel. +48 22 8351939, fax +48 22 8657735 www.topsil.com — *plates of silicon monocrystals*.
- Huta "Łaziska" S.A. w Łaziskach Górnych ("Łaziska" Smelter Joint Stock Co. of Łaziska Górne), ul. Cieszyńska 23, 43–170 Łaziska Górne, tel. +48 32 2241500, fax +48 32 2241523, www.hlsili.pl — *ferrosilicon, ferrosilicomanganese*.

SILVER

Overview

Silver (**Ag**) is known and used since ancient times. It was used in jewellery and as instrument of payment (coins of silver and its alloys). The last function was very important in the Middle Ages, but it lost its significance after discovery of America, when great amounts of American silver entered European market. Nowadays, industrial applications are the most important: initially in photography, but currently in electronics mainly. Jewellery is still important consumer of silver.

The majority of world **silver** supply comes from mine production. However, only 20–25% of silver mine production origin from its primary deposits, while 75–80% is recovered as a by-product of base metal ore treatment. Considerable quantities of silver are also recycled.

Sources

In Poland, ***silver*** occurs in ***copper ore*** deposits in the **Fore-Sudetic Monocline**, which contain 40–80 g Ag/t of ore (57 g Ag/t in average). Silver occurs there in the form of impurities, mainly in ***bornite*** and ***chalcocite***, while silver minerals such as ***stromeyerite***, ***tennantite***, and ***native silver*** have minor importance. Traditional sources of silver — ***Zn-Pb ore*** deposits in the **Silesia-Cracow** region — have currently marginal importance. Silver is present mainly in ***galena*** and ***sphalerite*** there, but average silver content in ore is under 10 g/t. The total silver resources in ***copper ore*** amount to 104,898 t, including 72,470 t of available reserves in deposits currently being exploited or developing (as of 31 December 2012). The developed deposits of ***zinc-lead ore*** contain only 1,960 t of silver.

Production

Silver, contained in copper ores extracted by **KGHM "Polska Miedź" S.A.**, passes into copper concentrates. ***Silver contents in copper concentrates*** amount to 400–1,000 g/t. The total silver volume in copper concentrates reached 1,373 t in 2004, with reduction to ca. 1,150-1,200 tpy in the following years (Tab. 1). These concentrates, as well as some imported silver-bearing copper concentrates are processed at the KGHM's copper smelters to copper anode, which later on is used in copper electrorefining process, with so-called ***silver-bearing anode slimes*** (35–50% Ag) as by-product. They are entirely processed by the **Precious Metals Plant** at the **Głogów Copper Smelter** (capacity about 1,400 tpy Ag). This plant produces ***high-purity refined silver*** graded at more than 99.99% Ag, mainly in ***granule*** (pellet) and ***bar*** form. Silver bars of **KGHM-HG** brand have been granted a **"Good Delivery"** certificate by the **London Bullion Market Association**. The production of silver by the **Precious Metals Plant** reached the record volume of 1,344 t in 2004, with decrease to 1,161 t in 2010. In the following two years it increased again, to 1,260 t and 1,274 t, respectively.

Tab. 1. Silver raw materials statistics in Poland

t Ag

Year	2008	2009	2010	2011	2012
Silver-bearing copper ores concentrates					
Production = Consumption[a]	1,161	1,207	1,183	1,167	1,149
Silver, refined - CN 7106 91					
Production	1,221	1,221	1,175	1,278	1,292
Imports	5	47	3	7	5
Exports	1,078	1,171	1,192	1,188	1,309
Consumption[a]	148	97	-14	97	-12

Source: ***The Central Statistical Office (GUS)***

Small amounts of ***refined silver*** are produced by the **Mennica-Metale Szlachetne Co.** in **Warsaw** (daughter company of the State Mint, on the basis of silver scrap) and by **Non-ferrous Metals Institute** in **Gliwice** (from some silver-bearing wastes from KGHM copper smelters). **Ag-Tech Ltd.** of **Katowice** was small producer of ***refined silver*** on the basis of ***metal Dore*** produced by **Miasteczko Śląskie Zinc Smelter** (20–40 tpy) in the years 1999–2005. The total ***refined silver*** production out of KGHM amounted to 75 t in 2004, but in recent years it decreased to 18-22 tpy due to production abandonment by **Ag-Tech Ltd.** The total domestic ***refined silver*** production achieved record level of 1,419 t in 2004, with reduction to 1,175 t in 2010 and recovery to 1,292 t in 2012 (Tab. 1).

Trade

Poland — precisely **KGHM "Polska Miedź" S.A.** — is the largest European exporter of ***refined silver*** to Western Europe (Tab. 2). The **"Good Delivery"** certificate was granted for KGHM's ***silver bars*** by the **London Bullion Market Association** and by the **London Metal Exchange**, while for KGHM's ***silver granules*** by the **London Metal Exchange**. This is why a large portion of silver exports was directed to United Kingdom to London market. However, in some years exports to London market were temporarily reduced, with increasing deliveries to Belgium, Germany, the US, and - irregularly - to other countries (Tab. 2). The share of ***silver granules*** in total sales is about 80%, while ***bars*** about 20%.

Imports of ***refined silver*** to Poland were commonly negligible and irregular, commonly up to 5-7 tpy (Tab. 1). However, in 2009 they incidentally rose to 47 t, coming mainly from Germany and Italy.

The ***silver*** trade balance has been consistently highly positive. In the last two years, due to very high international silver prices, it climbed to record value of ca. 4 billion PLN/y (Tab. 3). Silver exports have a significant share in total Polish exports, especially regarding minerals trade.

Tab. 2. Exports of silver from Poland, by country — CN 7106 91

t Ag

Year	2008	2009	2010	2011	2012
Exports	**1,078**	**1,171**	**1,192**	**1,188**	**1,309**
Belgium	304	200	120	93	68
Canada	–	–	–	19	–
China	10	–	0	–	–
Czech Republic	–	–	–	0	3
Estonia	–	20	–	0	–
Germany	129	120	156	19	20
India	10	–	3	–	–
Slovakia	–	–	–	0	41
Switzerland	–	–	–	–	20
United States	40	20	195	278	–
United Kingdom	580	800	710	777	1,155
Others	5	11	8	2	2

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of silver trade in Poland — CN 7106 91

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	1,270,542	1,684,407	2,310,590	3,962,470	4,256,955
Imports	5,597	71,590	4,777	7,863	18,399
Balance	**+1,264,945**	**+1,612,817**	**+2,305,813**	**+3,954,607**	**+4,238,556**

Source: ***The Central Statistical Office (GUS)***

The average unit values of ***silver*** exports from Poland rose over four times since 2005, what was in general accordant to its world prices increase (Tab. 4).

Tab. 4. Average unit values of silver exports from Poland — CN 7106 91

Year	2008	2009	2010	2011	2012
PLN/t	1,179,093	1,438,633	1,938,878	3,335,527	3,252,298
USD/t	497,928	462,415	647,772	1,140,605	995,135

Source: ***The Central Statistical Office (GUS)***

Consumption

The structure of ***silver*** consumption in Poland is difficult to ascertain, because data on silver scrap recovery, as well as change of producers' and users' stocks are unavailable. Users of silver, especially in jewellery, are very dispersed. Apparent consumption of primary silver amounted to 100–150 tpy in recent years, though it approached even negative values due to high level of exports, probably partly from stocks (Tab. 1). The real industrial consumption of primary silver is estimated at 25–40 tpy, while over 100 tpy in jewellery and other silver and silver-plated goods. Coinage with use of silver at the

State Mint is occasional. The silver demand pattern in Poland probably differs a lot from demand pattern in developed countries. Photographic and electronic industries share are negligible. Production of rolled and drawn products, as well as some catalysts, are probably the main industrial applications of silver in Poland. The real level of silver consumption (with silver scrap taken into account) may be even a few times higher (300–500 tpy), while share of jewellery and other silver and silver-plated goods in total consumption reaching even 90%.

Companies involved in silver production in Poland as of December 2012

- KGHM "Polska Miedź" S.A. w Lubinie (KGHM "Polska Miedź" Joint Stock Co. of Lubin), ul. Marii Skłodowskiej-Curie 48, 59–301 Lubin, tel. +48 76 8478200, fax +48 76 8478500, www.kghm.pl — *refined silver*.
- Mennica-Metale Szlachetne S.A. w Warszawie (Mennica-Metale Szlachetne Joint Stock Co. of Warsaw), 00–958 Warszawa, ul. Pereca 21, tel. +48 22 7639901, fax +48 22 7639907, www.mennica-metale.com.pl — *refined silver*.
- Instytut Metali Nieżelaznych w Gliwicach (Non-ferrous Metals Institute of Gliwice), 44–100 Gliwice, ul. Sowińskiego 5, tel. +48 32 2380200, fax +48 32 2316933, www.imn.gliwice.pl — *refined silver*.

SODIUM COMPOUNDS

Overview

Sodium compounds include various types of **sodium carbonates** and **sulfates**, both extracted from deposits and synthetically prepared. **Synthetic sodium carbonate** (**calcined soda**) is manufactured mainly using the ***Solvay*** method, based on ***brine*** and ***limestone***. This method provides approx. 70% of the world's production of **sodium carbonate**. The remainder is extracted from deposits, mainly of ***trona***. **Sodium sulfates** are obtained from natural sources — deposits of ***mirabilite*** and ***thenardite***, but also as by-products from the production of ***synthetic fibers***, ***hydrochloric acid***, etc.

Another important sodium commodity is **sodium hydroxide** (**caustic soda**) NaOH, exclusively an artificial product. In the past it was produced from ***calcined soda***, now it comes mainly from the electrolysis of ***sodium chloride*** NaCl (by which ***chlorine*** is also obtained).

Sodium compounds are among the most important raw materials for the chemical, glass-making, detergent, and paper-making industries. Poland is now one of European most significant producers of **calcined** and **caustic soda**, as well as an exporter of **calcined soda**.

Sources

The domestic sources for ***calcined soda*** production are ***limestone*** and ***salt*** deposits. There are two active soda plants in the Kujawy region, based on ***limestone*** from the **Piechcin** and **Barcin** deposits and ***brine*** from the **Góra** and **Mogilno** ***salt*** deposits.

Rock salt is also a basic material for ***caustic soda*** production. The companies that manufacture the latter are also based on the ***salt brine*** from **Góra** and **Mogilno** ***salt*** deposits, as well as on ***rock salt*** from **Kłodawa** ***salt*** deposit.

Production

The soda industry in Poland consists of two large plants — **Mątwy** and **Janikowo** — in the Kujawy region in central Poland, which belong to **Soda Polska CIECH Co.** The ***calcined soda*** production in these plants was around 1,100,000 tpy in the recent years, only in 2009 it dropped to under 900,000 t due to lower exports level (Tab. 1). However, since 2010 domestic demand rose significantly and production went back to ca. 1,100,000 tpy. About half of total production comes from each plant.

Tab. 1. Calcined soda statistics in Poland — CN 2836 20

‘000 t

Year	2008	2009	2010	2011	2012
Production	1,119.9	892.8	1,019.7	1,071.2	1,125.5
Imports	24.8	30.6	18.7	12.0	12.6
Exports	533.5	349.3	361.1	386.6	405.0[e]
Consumption[a]	611.2	574.1	677.3	696.6	733.1[e]

Source: ***The Central Statistical Office (GUS)***

There is no information on the production volume of ***sodium sulfate*** in Poland available. It is known that it was manufactured by the **Alwernia Chemical Works**.

Almost 80% of the production of ***caustic soda*** (***sodium hydroxide***) in Poland is made by the electrolysis of ***sodium chloride solution***, in the course of producing ***chlorine***. The main producers are the **“Zachem” Chemical Plant** of **Bydgoszcz**, and the **“Anwil” Nitrogen Plant** of **Włocławek** (based on ***brine*** from the **Góra** and **Mogilno** deposits of the **Inowrocław Salt Mines**). The production of sodium hydroxide rose sharply in the years 2005–2007, up to ca. 1,110,000 t gross weight in 2007, with ca. 45% reduction in the next three years. In the last two years, production exceeded 800,000 tpy again. Concentration of ***soda lye*** (main form of sodium hydroxide) went down from 48–49% to 37–40% NaOH. ***Soda lye*** production amounted to 801,500 t gross weight in 2012 (299,900 t NaOH), while ***solid caustic soda*** production — 73,600 t gross weight. Total production in terms of tons NaOH rose from 375,500 t in 2005 to 467,200 t in 2007, with reduction to only 274,200 t in 2010 and revival to 372,300 t in 2012.

Tab. 2. Caustic soda statistics in Poland — CN 2815 11

‘000 t

Year	2008	2009	2010	2011	2012
Production	922.1	880.4	610.3	828.4	875.1
Imports	6.1	6.2	9.4	10.7	8.7
Exports	68.0	59.1	44.8	49.8	64.3
Consumption[a]	860.2	827.5	574.9	789.3	819.5

Source: ***The Central Statistical Office (GUS)***

Trade

Exports of ***calcined soda*** exceeded level of over 500,000 tpy until 2009, but recently it sharply declined to 350,000-405,000 tpy (Tab. 3). Polish calcined soda is shipped to over 40 countries. Among the main recipients are the Czech Republic, Germany, Finland, Sweden, Norway, and Slovakia. Imports of ***calcined soda*** in the years 2008–2012 was varying between 12,000–31,000 tpy, coming mainly from the Ukraine, Russia, Belgium and Bosnia&Hercegovina (Tab. 1).

Caustic soda in the form of ***soda lye*** is also traditionally exported to many European customers, as well as to numerous Latin American, Southeast Asian, and African countries (over 50 recipients). The volume of these exports varies between 45,000–68,000 tpy (Tab. 4). Imports of ***caustic soda*** are marginal: 6,000–11,000 tpy (Tab. 2).

Tab. 3. Polish exports of calcined soda, by country — CN 2836 20

'000 t

Year	2008	2009	2010	2011	2012
Exports	**533.5**	**349.3**	**361.1**	**386.6**	**405.0**[e]
Austria	35.6	32.8	2.6	5.9	NA
Belgium	0.8	1.5	1.6	7.4	NA
Czech Republic	156.2	121.3	136.3	112.2	NA
Denmark	4.0	1.9	3.1	1.5	NA
Estonia	11.8	7.5	12.3	0.0	NA
Finland	60.2	37.2	43.4	45.5	NA
France	2.1	5.7	0.8	10.1	NA
Germany	112.1	38.4	28.1	46.9	NA
Hungary	0.1	0.0	9.3	6.2	NA
India	0.0	0.0	5.0	–	NA
Indonesia	2.9	–	–	15.9	NA
Italy	8.2	3.7	1.8	1.3	NA
Lithuania	1.7	3.4	3.6	5.9	NA
Netherlands	3.6	4.7	4.7	6.4	NA
Nigeria	–	–	0.5	5.1	NA
Norway	34.4	24.4	28.5	36.6	NA
Slovakia	19.2	14.2	14.4	0.5	NA
Sweden	53.1	42.7	59.5	55.1	NA
Thailand	0.2	–	–	8.5	NA
United Kingdom	22.2	5.4	1.7	1.8	NA
Venezuela	–	–	1.0	4.0	NA
Others	5.1	4.5	1.0	9.8	NA

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Polish exports of caustic soda, by country — CN 2815 11

'000 t

Year	2008	2009	2010	2011	2012
Exports	**68.0**	**59.1**	**44.8**	**49.8**	**64.3**
Angola	-	-	-	1.9	2.4
Saudi Arabia	-	-	-	2.9	4.7
Argentina	1.0	0.2	0.4	0.0	0.2
Belarus	0.0	1.0	2.4	1.4	1.4
Belgium	0.5	0.4	0.6	0.7	0.9
Brazil	10.1	9.6	7.6	6.0	5.9

Chile	1.2	1.1	1.6	0.5	1.7
China	1.9	3.5	2.5	2.4	2.4
Colombia	3.7	2.4	2.3	2.7	2.8
Czech Republic	3.3	2.2	1.8	1.8	2.8
Ecuador	2.6	1.4	1.7	1.0	1.5
Germany	4.7	1.6	1.8	1.9	1.2
Italy	4.3	2.1	1.8	2.5	3.0
Lithuania	1.2	0.7	1.2	1.0	1.6
Netherlands	1.0	0.2	0.4	0.0	0.6
Peru	0.7	3.1	0.5	0.6	1.3
Senegal	-	-	-	0.7	1.5
Spain	1.7	1.5	1.3	1.0	1.1
Ukraine	2.6	3.7	2.1	0.7	3.2
Venezuela	3.1	1.7	0.9	1.3	1.0
Others	24.4	22.7	13.9	18.8	23.1

Source: ***The Central Statistical Office (GUS)***

Sodium sulfate imports to Poland amounts to 40,000–76,000 tpy, coming mainly from Spain, Austria, the Czech Republic, Russia and Germany. Their exports were marginal, except of 2011 (Tab. 5).

Tab. 5. Sodium sulfate statistics in Poland — CN 2833 11–19

‘000 t

Year	2008	2009	2010	2011	2012
Production	NA	NA	NA	NA	NA
Imports	39.8	52.3	56.9	76.0	71.4
Exports	0.9	1.0	0.5	9.6	2.8
Consumption[a]	NA	NA	NA	NA	NA

Source: ***The Central Statistical Office (GUS)***

The balance of ***calcined soda*** and ***caustic soda*** trade is constantly positive, varying between 215-290 and 45-100 million PLN/y, respectively. The balance of ***sodium sulfate*** trade is continuously negative and recently it increased to over – 40 million PLN (Tab. 6).

Tab. 6. Value of sodium compounds trade in Poland

‘000 PLN

Year	2008	2009	2010	2011	2012
Calcined soda CN 2836 20					
Exports	306,918	283,113	227,576	268,638	NA
Imports	17,171	24,165	12,077	10,218	12,165
Balance	**+289,747**	**+258,948**	**+215,499**	**+258,420**	**NA**

Caustic soda CN 2815 11					
Exports	89,671	88,022	58,317	76,563	120,193
Imports	7,255	10,489	13,790	19,556	19,352
Balance	**+82,416**	**+77,533**	**+44,527**	**+57,007**	**+100,841**
Sodium sulfate CN 2833 11–19					
Exports	478	587	493	7,175	2,164
Imports	17,226	30,645	28,778	39,606	43,306
Balance	**-16,748**	**-30,058**	**-28,285**	**-32,431**	**-41,142**

Source: ***The Central Statistical Office (GUS)***

The average unit values of ***calcined soda*** exports had increasing tendency recently, up to 259 USD/t in 2009, with almost 20% drop since 2010 (Tab. 7). Average unit values of ***calcined soda*** imports and ***sodium sulfates*** exports are very variable as a result of their low quantities. Average unit values of ***sodium sulfates*** varied between 166-189 USD/t. Average unit values of ***caustic soda*** trade in recent years noticeably rose to over 500 USD/t, with temporary reduction in 2010 (Tab. 7).

Tab. 7. Average unit values of sodium compounds trade in Poland

Year	2008	2009	2010	2011	2012
Calcined soda CN 2836 20					
Exports unit values					
— PLN/t	575.2	810.5	630.2	694.9	NA
— USD/t	241.1	259.0	209.3	235.9	NA
Imports unit values					
— PLN/t	691.9	790.2	644.8	851.2	965.0
— USD/t	286.0	236.0	213.5	287.3	296.3
Caustic soda CN 2815 11					
Exports unit values					
— PLN/t	1,356.4	1,489.0	1,302.6	1,538.0	1,868.7
— USD/t	571.9	474.8	431.4	519.1	574.6
Imports unit values					
— PLN/t	1,228.7	1,681.3	1,461.6	1,820.1	2,219.0
— USD/t	522.3	542.5	479.8	629.9	676.8
Sodium sulphate CN 2833 11–19					
Exports unit values					
— PLN/t	532.1	573.6	1,002.4	746.8	780.0
— USD/t	221.0	189.5	334.3	256.3	242.7

	Imports unit values					
—	PLN/t	432.7	585.8	505.5	521.2	606.0
—	USD/t	184.2	188.8	166.9	177.7	185.9

Source: ***The Central Statistical Office (GUS)***

Consumption

In Poland, the principal consumers of ***calcined soda*** are the glass-making, detergents, and chemical industries. The growth of these two first industries (financed partly by foreign capital) should continue, and assure stable domestic demand in the coming years (Tab. 1). ***Sodium sulfate*** has similar applications, but the main customer is the paper industry. ***Caustic soda*** finds application mainly in the chemical industry, the paper industry, and sewage-treatment plants. It competes with calcined soda in some applications.

Companies involved in sodium compounds production in Poland, as of December 2012

- Soda Polska CIECH S.A. (Soda Polska CIECH Joint Stock Co.), ul. Fabryczna 4, 88–101 Inowrocław, tel. +48 52 3541500, fax +48 52 3537043, www.izch.com.pl — *calcined soda.*
- Anwil S.A. we Włocławku (Anwil Joint Stock Co. of Włocławek), ul. Toruńska 222, 87–805 Włocławek, tel. +48 54 2363091, fax +48 54 2361983, www.anwil.pl — *caustic soda.*
- Zachem S.A. w Bydgoszczy (Zachem Joint Stock Co. of Bydgoszcz), ul. Wojska Polskiego 65, 85–825 Bydgoszcz, tel. +48 52 3747100, fax +48 52 3610282, www.zachem.com.pl — *caustic soda, sodium hypochlorite.*

STONE, DIMENSION

Overview

The group of **crushed** and **dimension stones** consists of magmatic, metamorphic, and sedimentary rocks, characterized by suitable resistance to climatic factors, compression, and wear. They are suitable for **dimension stone elements** (***blocks***, ***slabs***, ***ashlars***, ***pitcher***, ***curbs***, etc.) and **crushed stone** (**crushed aggregates**), commonly used in building, road, and railway construction (see: **AGGREGATES, MINERAL**). In order to determine whether they can be applied in buildings, roads, or railways, the rocks should be thoroughly examined: the mineral composition to detect any constituents which may decompose under prevailing climatic conditions, and the physical and mechanical properties — density, water absorption, compression strength, grindability, freeze-resistance, emulgation index, etc.

Deposits of **dimension stones** should be mined manually (by stopping), with use of expansive mortars, with special machines for block cutting (cutting burner, diamond rope) or with a special type of explosives (blasting powder). **Stone road pitcher** and **curbs** are manufactured almost entirely from ***granites*** in Poland.

Sources

Rocks utilize for the production of ***crushed*** and ***dimension stone*** are recognized in the one common group. The most of these rocks is useful only for the production of crushed aggregates, so resourcse base of this group of rocks is presented in detail in the chapter: **AGGREGATES, MINERAL**.

The majority of deposits of rocks suitable for ***dimension*** and ***road stone products,*** including deposits of ***granite***, ***syenite***, ***marble***, and ***sandstone***, are located in the Lower Silesia. Moreover, there are numerous ***decorative limestone*** and ***sandstone*** deposits in the Świętokrzyskie Mountains and in the Carpathians. A few deposits of ***dolomite*** and ***travertine*** are of minor importance. ***Dimension granite*** deposits, which have commercial value, occur in three massifs in Lower Silesia: **Strzegom-Sobótka**, **Strzelin-Żulowa**, and **Karkonosze**. The total resources of granite (most of them suitable for the production of dimension stone) amount to ca. 1,688 Mt[1].

Syenite is the other magmatic rock suitable for dimension stone production in Lower Silesia. It occurs in the **Niemcza** area in two varieties: **Przedborowa** and **Kośmin**, with total resources of ca. 56 Mt.

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[1] From the total reserves and output of ***building and road stone*** according to ***Mineral Resources Datafile***, the reserves and output of ***granite*** utilized for quartz-feldspar raw material production were excluded.

Marbles are recognized also entirely in the Lower Silesia: in the **Kaczawa Mountains**, **Kłodzko** area and **Eastern Sudetes**. Total resources of 11 deposits amount to ca. 53 Mt.

Sandstone of numerous varieties is the second important rock suitable for dimension stone production in Poland. Regarding the amount of reserves, the main varieties are: ***white "joint" sandstone*** of **Stołowe Mountains** (8 deposits, ca. 37 Mt) and **North Sudetic Depression** (26 deposits, 55 Mt); ***white and yellow Szydłowiec sandstone*** (41 deposits, 90 Mt) and ***Żarnów sandstone*** with recently increasing importance (28 deposits, 7 Mt) in the northern part of Świętokrzyskie Mountains in the central Poland, and a few types of sandstone of **Polish Flysch Carpathian**. Among the ***Carpathian sandstone*** the most significant are ***Green Godula sandstone*** from **Brenna** area in the western part of the Carpathians (12 deposits, 66 Mt), ***Grey Krosno sandstone*** (8 deposits, 135 Mt), ***Grey-yellow Istebna sandstone*** (9 deposits, 3 Mt) and ***Grey Magura sandstone*** (11 deposits, ca. 133 Mt). Such varieties as: ***Red Permian sandstone*** of **Intrasudetic Depression** (3 deposits, 5 Mt); ***Red Suchedniów*** and ***Tumlin sandstone*** in the northern part of **Świętokrzyskie Mountains**, and other varieties of ***Carpathian sandstone***: Cergowa and Ciężkowice ones are of minor importance.

Production

Mining output of rocks, suitable for the production of ***slabs***, ***pitcher***, ***curbs***, etc., increased from 1.3 Mtpy in the years 2008–2010 to 1.5 Mt in 2011, with the reduction to 1,4 Mt in 2012 (Tab. 1). In reality, it can be higher by max. 10%, when accessory ***blocks*** and ***pitcher*** production in ***limestone*** and ***granite crushed aggregates*** plants will be included. Mining output is dominated by granites, coming mainly from **Strzegom** area. Their output grew from 1.0 to 1.2 Mtpy in the years 2008–2012 (Tab. 1).

Tab. 1. Mining output of the rocks suitable for dimension stone production

'000 t

Year	2008	2009	2010	2011	2012
Dolomite	5	3	3	4	3
Granite	1,000	973	1,050	1,241	1,189
Limestone	9	14	8	6	5
Marble	2	2	7	3	3
Sandstone	278	256	218	257	221
Syenite	8	8	8	7	4
Total	**1,302**	**1,256**	**1,294**	**1,518**	**1,425**

Source: ***Mineral Resources Datafile, authors' estimations***

Sandstone is the second important dimension stone, especially ***Cretaceous sandstone*** from Lower Silesia (Tab. 1). Dimension sandstone output fluctuated between 220,000 tpy and 280,000 tpy in the years 2008–2012. It was period of the significant changes in areas of concentration of the production. The extraction of "Joint" sandstones from **Lwówek Śląski** region decreased by nearly a half, whereas the level of production of "Joint" sandstones from **Radków** and **Długopole** area sharply increased. The output of ***Szydłowiec sandstone*** remained at the stable level but the growing trend in the

Żarnów sandstone has been stopped since 2011. The extraction of the ***Carpathian sandstones*** firstly increased as a result reopening the Górka Mucharz mine, but afterwards dropped because of the suspension of the output from **Wola Komborska** deposit in 2012. Recently, the number of sandstone deposits from which ***split tiles*** and ***ashlars*** are obtained significantly grew in the northern part of ***Świętokrzyskie Mountains***, especially in **Mroczków Gościnny**, **Tresta Wesoła** and **Pilichowice** areas. They are also extracted in many quarries in the ***Carpathians*** (e.g. **Barcice**, **Wierchomla**). Share of sandstones in the total output of dimension stone dropped from 21% to 15% (Tab. 1), whereas share of limestone - only ca. 1%. Decreasing importance of dimension limestone is a result of temporary cease of the blocks extraction from **Bolechowice**, **Pińczów** (recommenced in 2010) and **Wola Morawicka** deposits in Kielce area. Other types of rocks have small share in the total output, no more than 1% each, and are not expected to increase.

Reported domestic production of ***dimension*** and ***road stone*** (Tab. 2) is currently much higher than their mining output (Tab. 1). It is partly a result of accompanying dimension and road stone production in some ***granite***, ***basalt***, and ***limestone crushed aggregates*** plants (total production in such plants is estimated at 0.1 Mtpy), and partly due to production of ***pitcher***, ***splits***, and ***other elements*** from pebbles in some sand & gravel mines in the northern Poland. Moreover, some dimension rock products obtained on the basis of imported blocks can also be included in this amount. Additional thing to be considered is illegal mining, especially of sandstone and limestone in central and eastern Poland, amount of which is unknown.

Tab. 2. Dimension and road stone statistics in Poland — CN 2515,2516,6801,6802[1]

'000 t

Year	2008	2009	2010	2011	2012
Production[2]	**3,425.9**	**3,836.4**	**4,598.5**	**6,223.6**	**4,118.0**
• dimension blocks and raw slabs	3,125.9	3,576.4	4,430.7	5,897.8	3,828.8
— *from granite*	*573.3*	*1,059.7*	*1,891.2*	*1,736.7*	*1,535.6*
— *from marble*	*7.5*	*1.4*	*1.6*	*1.2*	*1.1*
• pitcher and other road stone	300.0	260.0	167.8	325.8	289.2
Imports	**596.3**	**455.5**	**490.4**	**1,436.6**	**1,542.9**
Exports	**170.9**	**162.6**	**163.3**	**182.3**	**200.9**
Consumption[a]	**3,851.3**	**3,929.3**	**4,925.6**	**7,477.9**	**5,460.0**

[1] with the exception of **CN 6802 10**

[2] sold, only production of companies with over 10 employees is reported

Source: ***The Central Statistical Office (GUS)***

Official data on the total production of ***dimension stone*** and ***road stone*** in Poland, as well as their assortment structure, are coming from large and medium smaller companies only (over 10 employees). According to the Central Statistical Office's data the total domestic production of ***dimension stone*** rose to the record level 6.2 Mt in 2011, with a drop to 4.1 Mt in 2012 (Tab. 2) However, real production estimated on the basis of mining output of dimension stone, as well as from the mentioned above accompanying production, as well as on the basis of imported raw blocks and slabs, probably ranged from ca. 1.4 to 2.5 Mtpy in the years 2008–2012. ***Road stone*** production strongly fluctuated between 168,000 tpy and 326,000 tpy in the recent years (Tab. 2). Data on assortment structure of ***dimension stone*** show that ***granite*** constitutes 77–84% of their total supply, ***sandstone*** — 15–21%, with marginal share of other types of rocks. Regarding structure of ***road stone*** production (***pitcher*** and ***curbs***), share of ***granite*** is much more dominant (over 90%), with marginal importance of ***syenite*** and ***basalt*** pitcher and curbs.

The most important dimension stone in Poland is traditionally ***granite***. Dimension granite production in Poland is concentrated in Lower Silesia, mainly in **Strzegom** and **Strzelin** areas. ***Dimension granite*** was extracted in 2012 from 26 quarries amounted to ca. 1,200,000 t: 19 of them delivered only ***dimension stone*** and/or ***road stone*** (pitcher etc.), while 7 of them — both dimension and road stone, as well as ***crushed aggregates*** (Tab. 3). In **Strzegom** area, the most important producers were: **Borowskie Kopalnie Granitu**, **“Morstone” Strzegom, “Granit” Strzegom**, **“Grabinex” Strzegom, “Skalimex-Borów” Kostrza**, **PPHiU “Piramida” Strzegom**, **“Wekom II” Kostrza,“Kwarc” Kostrza**, **“Skalimex-Grantin” Sobótka, “GT&F Corporation Polska” Kostrza**, **“Granimex” Strzegom** (Tab. 3). Dimension granite production is also carried on by over dozen smaller mines in this area. The majority of them provide ***blocks***, ***raw slabs***, ***pitcher***, and ***curbs***. Since 2009 ***dimension stones*** have not been extracted in **“Gniewków” Granite Mine** which was taken over by the **Olsztyńskie Mineral Mines Ltd.** (a large producer of ***mineral aggregates***). Also **“Granimex” Strzegom** and **“Zimnik” Mściwojów**, traditionally big suppliers of ***dimension granite***, commenced the production of ***crushed aggregates***. On the other hand, extraction of granite blocks from **Borów-Południe** deposit was started by **Grażyna Hyżyńska** in August 2009. Moreover, a small quantity of granite blocks was obtained in the years 2010–2011 from the newly opened **Strzegom–Artur** mine by **Kampol Ltd.**.

Quarries of **Strzelin** granite have minor importance as dimension granite producers (Tab. 3). The largest number of blocks and smaller dimension elements (dozens of thousand tpy) of these granite has been extracted from Strzelin deposit. The new owner of deposit, **“Kruszywa Strzelin”**, considerably increased the output of granite from Strzelin deposit in the years 2008–2009, being predominantly directed to crushed aggregates production. Since the beginning of 2011, the Strzelin deposit is operated by **Stonopol Ltd**. and **Mineral Polska Ltd.** The blocks of granite are extracted only by the first of the mentioned companies.

Only one quarry extracted ***dimension granite*** of **Karkonosze** type in **Szklarska Poręba** until 2011.

Tab. 3. Main producers of dimension and road stone in Poland in 2012

Producer	Type of rock	Deposit	Mining output	Yield of blocks
			[‘000 t]	[%][e,1]
• **“Borowskie Kopalnie Granitu” Ltd., Borów**	GSgm	Borów	232	>90
• **“Morstone” Ltd., Strzegom**	GSgm	Morów II	161	>95

• **"Granit Strzegom" S.A., Strzegom**	GSgm	Strzegom kam. 25/26, Żółkiewka I, Żółkiewka III	181	60
• **"Grabinex" Ltd, Strzegom**	GSgm	Gra-bina Śląska kam.15/27	146	70
• **"Skalimex-Borów" S.A., Kostrza**	GSgm	Borów 17	135	>65
• **PPHiU "Piramida" Ltd, Strzegom**	GSgm	Borów I — quar. 49A	71	>95
• **"Wekom II" Ltd., Kostrza**	GSgm	Kostrza	66	>80
• **PWPiSKB "Kwarc" Ltd, Kostrza**	GSgm	Borów I — quar. 49	41	>95
• **"Skalimex-Grantin" Ltd., Sobótka**	GSgm	Strzeblów II	65	50
• **"GT & F Corporation Polska" Ltd, Kostrza**	GSgm	Kostrza-Piekiełko, Kostrza-Lubicz	34	>95
• **"Granimex" S.A., Strzegom**	GSgm	Graniczna II	98	30[2]
• **Kopalnia Granitu "Pokutnik", Paszowice**	GSgm	Pokutnik	29	>95
• **PPH "Hyżyński" Ltd., Borów**	GSgm	Borów-Południe	29	>90
• **Kopalnia Granitu "Zimnik" Ltd, Mściwojów**	GSgm	Zimnik I	224	<10
• **"Euro-Granit" Ltd., Strzegom**	GSgm	Żółkiewka-Wiatrak	20	>95
• **PPU "Czernica-Granit" Ltd., Czernica**	GSgm	Czernica	43	40
• **"Globgranit" Strzegom Ltd., Żółkiewka**	GSgm	Żółkiewka IV	32	>50
• **PPHU "Ted-Rob" T. Kaliciński, R. Lema**	GSgm	Barcz I	17	>95
• **"Braun-Granit" Ltd., Nowa Sól**	GSgm	Czernica-Wieś	51	>30
• **"Granit Wiatrak" Ltd., Graniczna III Mine**	GSgm	Graniczna III	18	80
• **"Fer-Granit" Ltd., Rogoźnica**	GSgm	Rogoźnica-Las	5	>95
• **"Kruszywa Strzelin" Ltd., Strzelin**	GStn	Strzelin	822	<10
• **"Mikoszów Wieś" Granite Mine Bronisław Badecki, Mikoszów**	GStn	Mikoszów-Wieś	2	>95
• **"Sjenit" S.A., Piława Górna**	Sy	Kośmin	287	>1
• **"Slag Recycling" Ltd., Kraków**	Sy	Przedborowa	31	<3
• **PWiOM "Marmur-Sławniowice", Sławniowice**	M	Sławniowice	3	>95
• **"Dolomit" Ltd., Libiąż**	D	Libiąż	28	<10
• **"Morawica" Limestone Mine S.A.**	LD	Morawica III	1,780	<1
• **Kopalnie Piaskowca "Radków" Ltd., Radków**	SJ	Radków, Szczytna Zamek	37	>70

• **"ATS-Stein" Ltd., Bolesławiec**	SJ	Zbylutów I	11	>70
• **"Gruszecki" Co., Bielany Wrocławskie**	SJ	Czaple, Skała, Zbylutów	11	>70
• **"Kamieniarz" Ltd., Kielce**	SJ	Nowa Wieś Grodziska III	11	>70
• **"Jan Zbylutów IV" Sandstone Mine, Zbylutów**	SJ	Zbylutów IV –Jan	10	>70
• **"Hofmann Polska" Ltd., Kraków**	SJ	Żerkowice-Skała, Żerkowice-Skała Zachód, Wartowice	8	>70
• **"Piasmar" Z.R. Więcławek, Bystrzyca Kłodzka**	SJ	Długopole	8	>70
• **"Piaskowiec Czerwony" Quarry, Nowa Ruda**	SP	Bieganów	1	>70
• **"Surowce Mineralne", Kielce**	ST	Tumlin-Gród	2	>70
• **"Sosnowica" Co., Sosnowica**	ST	Sosnowica, Kopulak 1	1	>50
	SSz	Szydłowiec	12	>70
• **"Kamieniarz" Ltd., Kielce**	SSz	Śmiłów 1	7	>70
• **Roman Kaczmarczyk, Opoczno**	SZ	Żarnów 1	3	>70
• **Andrzej Kosek, Miedzna**	SZ	Sielec I	2	>80
• **"Kamieniarstwo Pawlik", Strzałków**	SCrZ	Chełmska Góra II	2	>80
• **"Polski Kamień Naturalny Mucharz-Skawce" Ltd., Zembrzyce**	SCa	Górka Mucharz	124	<30
• **Tadeusz Brach, Wola Komborska**	SCa	Wola Komborska I	20	>30
• **ZKB "Skalnik" Ltd., Barcice**	SCa	Barcice I	14	<50
• **B. & W. Mleczek, Stróża**	SCa	Tenczyn-Lubień I	2	<50
• **"Kamieniołom Barwałd" Ltd., Barwałd**	SCa	Barwałd	156	<1
• **"Kopalnia Łupka Szarogłazowego", Jenków**	S	Jenków	44	<1

Legend: **D** — Dolomite, **GKa** — Karkonosze Granite, **GSgm** — Strzegom Granite, **GStn** — Strzelin Granite, **LD** — Decorative Limestone, **M** — Marble, **S** — Slate, **SB** — Jurassic Borucice Sandstone, **SCa** — Carpathian Sandstone, **SCrZ** — Cretaceous Zagórze Sandstone, **SJ** — Joint Sandstone, **SP** — Permian Sandstone, **SSz** — Jurassic Szydłowiec Sandstone, **ST** — Triassic Sandstone, **SZ** — Jurassic Żarnów Sandstone, **Sy** — Syenite, **T** — Travertine

[1] blocks and smaller dimension stone

[2] mainly lumps use for pitcher and ashlar production

Source: ***Mineral Resources Datafile, authors' estimations***

Syenite is another magmatic rock traditionally used for dimension stone production. It has been mined from the **Kośmin** deposit, by ***"Sjenit"* S.A.,** and since 2006 from **Przedborowa** deposit by "**Slag Recycling" Ltd.** The total output of ***syenite blocks*** and ***smaller dimension stones*** dropped from 8,000 to 4,000 tpy in the recent years (Tab. 3).

Marbles are important as ***dimension stone***, as well as for ***marble grits*** production. They were extracted from **Sławniowice** deposit in Eastern Sudetes and until 2011 in **Stronie Śląskie** area (Tab. 3). Total mining output amounts to a few thousand tpy. Production of ***large marble blocks*** amounts only to ca. 1,000–2,000 tpy, while the rest is used for ***small tiles*** and ***grits for terazzo***.

Among sedimentary rocks, ***sandstone*** of various types is currently the most important dimension stone in Poland. A few different types are used for this purpose: Lower Silesian white ***"joint" sandstone*** from **Lwówek Śląski**, **Radków**, and **Bystrzyca Kłodzka** areas, ***sandstone of Szydłowiec type*** and ***Żarnów type*** (Świętokrzyskie Mts.) and various types of ***Carpathian sandstone***. "Joint" sandstones from **Lwówek Śląski** region are currently the most important of them. Eleven mines belonging to eight companies are active there, while their total output considerably dropped from over 100,000 tpy in 2008 to 55,000 tpy in 2012. The output of "joint" sandstone occurring in the **Radków** and **Bystrzyca Kłodzka** areas (from **Radków** and **Długopole** deposits as well as from **Szczytna–Zamek** deposit since 2009) increased from 10,000–30,000 tpy to 45,00 t in 2012. There is a wide range of sandstone varieties in the Świętokrzyskie Mountains. The most important of them are white and yellow ***Jurassic sandstones*** extracted in ***Szydłowiec*** area by over dozen private person. Their total output achieved 20,000–30,000 tpy in the last five years. The other operated quarries of various colours ***Jurassic sandstones*** are situated near **Żarnów** and **Opoczno**. They supply between 20,000 and 55,000 tpy of sandstone split tiles and blocks (extracted only in **Sielec**, **Dąbie** and **Wolica** area). The ***Cretaceous sandstone*** occurring in the Świętokrzyskie Mountains are exploited in the amount of a few thousands tpy from deposits situated near the **Przedbórz**. Significant decrease of the output of the red ***Triassic sandstone*** (especially ***Tumlin sandstone*** from **Sosnowica** and **Tumlin–Gród** deposits, and additionally ***Suchedniów sandstone*** from **Kopulak 1** deposit) was reported, from 12,000 tpy in 2008 to 4,000 tpy in 2012 (tab. 3). In the Carpathians the main producer of dimension sandstone is **Tadeusz Brach Co.,** although the level of production decreased from over 40,000 tpy to 20,000 tpy as a result of the suspension of extraction from **Wola Komborska** deposit in 2012. A new important supplier of blocks of ***Krosno sandstone*** from **Górka Mucharz** mine, which was recently reopened, is **"Polski Kamień Naturalny Mucharz-Skawce" Ltd.** Small quantities of ***blocks*** and ***smaller dimension stone*** are extracted in **Barwałd** and **Sobolów** quarries and also in **Brenna** area. Other producers, e.g. **"Skalnik" Co.** of **Barcice**, provide mainly split tiles.

Decorative dimension limestone has been extracted for centuries from various deposits of so-called ***Kielce "marbles"*** in the Świętokrzyskie Mountains near Kielce. Recently, the level of the marble blocks production dropped significantly. The **Pińczów Dimension Stone Works** used to be their dominant supplier, but they sold **Bolechowice** mine in 2007, and **Wola Morawicka** mine two years later. Moreover, in 2009 it has not operated **Pińczów** deposit. The output from **Bolechowice** deposit, acquired by **PKB "Bolechowice"**, was recommenced in 2009. The majority of the extracted raw material has been utilized for mineral aggregates production purposes whereas output of limestone lumps has been at the level of a few hundred tpy. Also the limestone mined in **Wola Morawicka** deposit, operated in 2009 by "**Pol–Bot Kruszywa" S.A.,** was utilized predominantly for the crushed aggregates production. New producer of limestone blocks and slabs in the Pińczów area has been "**Marmur-Płytki" Co.** operating **Włochy** deposit, but the output level did not exceed 2,000 tpy. Some dimension limestone is obtained also in the **Jaźwica** and **Morawica III** mines, where crushed aggregates are primarily produced. Moreover, sources of small amounts of limestone lumps were **Józefów** and **Babia Dolina** deposit in Lublin area as well as **Czepów** deposit in Łódź area. Another variety of decorative limestone used as dimension stone were traditionally **travertine** occurring in **Raciszyn-Zalesiaki** area in central Poland. The output from **Raciszyn II** deposit, carried out by **WKG Trading**, was restarted in 2009 but the majority of mined travertine was utilized for mineral aggregates production. A new source of small amounts of travertine blocks (a few dozen tons) are **Raciszyn** and **Zalesiaki** deposits. Triassic ***dolomite*** from **Libiąż** is the only dolomite in Poland partly dressed into dimension blocks and smaller dimension stones (a few thousand tons per year).

Trade

In the recent years both the volume and structure of ***dimension*** and ***road stone*** trade have changed considerably. ***Dimension stone*** imports strongly increased from the level of 427,000–547,000 tpy in the years 2008–2010 to 1.3–1.5 Mtpy in 2011–2012, as a result of the significant growth in ***raw granite blocks*** and ***slabs*** deliveries. ***Raw blocks*** and ***slabs*** comprised a majority of these imports with the only exception in 2010, when ***worked dimension stone*** predominated (Tab. 4, 5). The most important imported rocks have been ***granite*** and ***related rocks.*** Deliveries of ***processed slabs*** of these rocks fluctuated between 150,000 and 240,000 tpy, whereas the imports of ***raw granite blocks and slabs*** increased from 200,000–300,000 tpy to the record level 0.9–1.2 Mtpy in last two years. They were purchased from above 20 countries, primarily from South Africa and India until 2011 (Tab. 4). Since then the majority of raw block and slabs supplies came from Sweden and in 2012 also from Norway. Important suppliers were also Finland, Ukraine, Spain and Brazil (Tab. 4). Deliveries of ***marble*** and ***relative rocks*** significantly dropped, from 9,400 tpy in 2008 to 2,600 tpy in 2012, with Italy and Germany as main suppliers. Imports of ***sandstone*** blocks and slabs are still marginal, whereas supplies of the other rocks are very changeable (between 3,100 tpy and 157,400 tpy).

Tab. 4. Crude or roughly worked dimension stone imports to Poland

'000 t

Year	2008	2009	2010	2011	2012
Imports, total	**308.1**	**239.8**	**218.1**	**1,067.0**	**1,270.6**
Marbles, limestones and other carbonate rocks CN 2515	**9.4**	**6.7**	**5.9**	**4.7**	**2.6**
Germany	3.3	1.8	1.0	0.1	0.1
Italy	3.9	2.7	3.2	3.0	1.7

Portugal	0.5	0.5	0.2	0.3	0.2
Spain	0.6	0.8	0.5	0.6	0.2
Turkey	0.3	0.2	0.4	0.1	0.1
Others	0.8	0.7	0.6	0.6	0.3
Granites CN 2516 11,12	**293.3**	**228.9**	**195.1**	**904.2**	**1,228.4**
Angola	4.6	4.4	5.4	6.5	6.0
Belgium	0.4	0.2	1.1	0.2	0.5
Brazil	10.3	9.0	5.5	4.5	4.9
China	0.9	0.1	1.1	2.5	1.1
Finland	21.9	22.3	15.1	13.0	10.9
France	2.0	0.9	1.2	1.7	0.8
Germany	9.1	5.8	6.5	0.4	3.4
India	43.7	45.3	29.6	35.1	30.3
Italy	6.1	1.8	0.2	0.4	0.4
Norway	3.5	2.6	2.8	2.4	274.1
Portugal	2.3	0.1	0.7	2.7	1.0
Russia	1.2	0.6	0.4	0.0	0.1
South Africa, Republic of	108.9	87.0	64.4	66.9	70.7
Spain	13.8	9.8	7.6	17.2	7.2
Sweden	42.6	19.2	33.9	737.2	805.1
Ukraine	17.8	16.1	18.1	10.6	7.7
Zimbabwe	2.7	1.5	1.4	2.3	3.5
Others	1.5	2.2	0.1	2.9	0.7
Sandstones CN 2516 20	**2.3**	**1.1**	**1.0**	**0.7**	**0.7**
Germany	0.6	0.0	0.3	0.0	–
India	0.5	0.3	0.3	0.4	0.2
Spain	0.6	0.5	0.0	–	0.0
Ukraine	0.1	0.1	0.2	0.2	0.3
Others	0.5	0.2	0.2	0.1	0.2
Other rocks CN 2516 90	**3.1**	**3.1**	**16.1**	**157.4**	**38.9**
China	0.6	0.1	0.0	0.2	0.4
Norway	–	–	13.5	154.0	33.2
Sweden	0.3	0.4	–	0.1	3.7
Ukraine	1.7	2.1	2.3	2.7	1.1
Others	0.5	0.5	0.3	0.6	0.5

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Worked dimension stone imports to Poland

'000 t

Year	2008	2009	2010	2011	2012
Imports, total	**238.8**	**187.4**	**238.9**	**273.5**	**221.2**
Marbles, limestones and other carbonate rocks CN 6802 21,91,92	**43.2**	**31.8**	**29.6**	**29.3**	**26.6**
China	2.1	2.0	2.6	3.0	3.5
Czech Republic	7.0	6.1	5.9	4.2	3.8
Egypt	1.4	0.9	0.6	0.6	0.7
Greece	0.0	0.2	0.0	0.1	0.1
Germany	1.5	1.3	2.1	2.2	2.4
India	1.7	1.3	1.6	3.2	1.1
Italy	14.5	8.3	7.2	6.2	6.5
Portugal	0.4	0.2	0.3	0.3	0.5
Spain	5.4	3.7	3.2	3.2	2.5
Turkey	4.9	4.6	3.9	4.1	3.7
Others	4.3	3.2	2.2	2.2	1.8
Granites CN 6802 23,93	**185.3**	**149.8**	**200.8**	**235.2**	**180.7**
Belgium	6.2	2.1	5.6	2.3	0.6
Brazil	3.2	2.8	3.1	1.4	0.9
China	116.2	98.7	124.7	168.1	122.6
Germany	3.2	2.4	3.9	5.6	6.0
India	31.6	25.1	36.1	41.3	38.2
Italy	7.8	6.0	6.5	5.0	3.5
South Africa, Republic of	0.7	3.0	9.6	2.9	1.5
Spain	10.6	3.3	3.3	3.5	1.7
Sweden	3.2	4.7	2.9	0.5	1.7
Others	2.7	1.7	5.1	4.6	4.0
Other rocks CN 6802 29,99	**10.3**	**5.8**	**8.5**	**9.0**	**13.9**
China	1.2	1.5	2.1	3.6	4.2
Czech Republic	0.1	0.1	0.7	0.2	0.4
Germany	0.2	0.2	0.1	0.4	4.0
India	1.6	0.8	1.2	0.9	0.6
Italy	2.5	2.5	3.3	0.1	1.8
Slovakia	3.4	–	–	0.0	–
Spain	0.2	0.0	0.1	1.3	0.6
Others	1.1	0.7	1.0	2.5	2.3

Source: ***The Central Statistical Office (GUS)***

Imports of ***processed slabs*** range from ca. 221,000 to 274,000 t in the years 2008–2012, except of 2009 when they dropped to 187,400 t (Tab. 5). The substantial reduction of amount of ***marble*** slabs supplies, especially from Italy and the Czech Republic, is systematically reported. In general, the stable level of deliveries of granite slabs, mostly of Chinese and Indian origin, is noted.

Imports of ***road stone*** varied over a wide range, from ca. 28,000 to 96,000 tpy, as a result of changing volume of supplies from Germany, Slovakia and China. (Tab. 6).

Tab. 6. Pitcher and curbs imports to Poland — CN 6801

'000 t

Year	2008	2009	2010	2011	2012
Imports	**49.4**	**28.3**	**33.4**	**96.1**	**51.1**
China	0.7	0.5	4.7	45.4	25.2
Germany	44.9	5.1	5.9	7.0	1.0
Slovakia	1.2	17.5	18.2	37.0	21.5
Ukraine	1.5	4.5	3.9	5.2	3.3
Others	1.1	0.7	0.7	1.5	0.1

Source: ***The Central Statistical Office (GUS)***

Exports of ***dimension stone*** from Poland was constantly increasing, from ca. 90,300 t in 2008 to ca. 138,200 t in 2012 (Tab. 7, 8). Mainly ***raw blocks*** and ***slabs*** were exported, in the amounts of 67,000–105,000 tpy (Tab. 7), with a considerably lower share of ***processed stone*** (19,000–33,000 tpy) (Tab. 8). ***Granite blocks*** and ***slabs*** — raw and processed — were primarily exported (Tab. 7, 8). Their main recipient were Switzerland (exceeding the Germany), where the considerable amounts of the Strzegom granite ashlars are utilize to strengthen of embankments in the Alps. The ***processed slabs*** from ***other stones*** (including sandstones) were sold in the amount of 6,000–13,000 tpy, primarily to Germany. Exports of the ***raw block*** and ***slabs*** from ***sandstone*** and ***other rocks*** (probably ***syenite*** and/or ***travertine***) didn't exceed a few thousand tpy (Tab. 7).

Tab. 7. Crude or roughly worked dimension stone exports from Poland

'000 t

Year	2008	2009	2010	2011	2012
Exports, total	**67.2**	**75.4**	**80.0**	**99.1**	**105.4**
Marbles, limestones and other carbonate rocks CN 2515	**1.2**	**0.8**	**0.9**	**0.8**	**1.0**
Slovakia	1.1	0.7	0.5	0.4	0.7
Others	0.1	0.1	0.4	0.4	0.3
Granites CN 2516 11,12	**62.0**	**69.8**	**77.1**	**96.5**	**102.5**
Austria	0.0	0.1	–	0.0	0.1
Czech Republic	0.1	0.0	0.7	0.6	1.1
France	0.1	1.2	0.3	0.3	0.6

Germany	31.9	29.3	29.7	34.4	30.2
Switzerland	29.5	39.0	45.7	60.3	69.8
Others	0.4	0.2	0.7	0.9	0.7
Sandstones CN 2516 20	**3.9**	**4.8**	**1.9**	**0.8**	**1.8**
Germany	3.9	4.8	1.8	0.7	1.5
Others	0.0	0.0	0.1	0.1	0.3
Other rocks CN 2516 90	**0.1**	**0.0**	**0.1**	**1.0**	**0.1**
Germany	–	0.0	–	–	–
Slovakia	0.0	0.0	0.0	0.9	0.0
Others	0.1	0.0	0.1	0.1	0.1

Source: ***The Central Statistical Office (GUS)***

Tab. 8. Worked dimension stone exports from Poland

'000 t

Year	2008	2009	2010	2011	2012
Exports, total	**23.1**	**18.9**	**20.9**	**18.6**	**32.8**
Marbles, limestones and other carbonate rocks CN 6802 21,91,92	**1.5**	**1.2**	**1.4**	**1.4**	**5.6**
Germany	0.1	0.0	0.0	0.0	3.1
Russia	0.5	0.6	0.8	0.8	1.4
Ukraine	0.7	0.4	0.3	0.2	0.2
Others	0.2	0.2	0.3	0.4	0.9
Granites CN 6802 23,93	**11.5**	**11.5**	**10.2**	**8.5**	**14.0**
Austria	0.4	0.4	0.3	0.3	0.3
Czech Republic	0.5	0.4	0.5	0.1	1.3
Germany	5.8	7.0	6.0	4.4	9.0
Russia	0.8	0.9	0.3	0.2	0.1
Slovakia	1.3	0.4	0.9	1.0	0.6
Switzerland	1.6	1.6	1.5	1.7	1.7
Others	1.1	0.8	0.7	0.8	1.0
Others rocks CN 6802 29,99	**10.1**	**6.2**	**9.3**	**8.7**	**13.2**
Germany	9.4	5.1	8.6	8.3	12.6
Others	0.7	1.1	0.7	0.4	0.6

Source: ***The Central Statistical Office (GUS)***

Stone pitcher and ***curbs*** were the main export products of this group exclusively in 2008. Their exports decreased from ca. 81,000 t to 63,000 tpy in the last five years (Tab. 9). They have been sold mostly to Germany and Slovakia.

Tab. 9. Pitcher and curbs exports from Poland — CN 6801

'000 t

Year	2008	2009	2010	2011	2012
Exports	**80.7**	**68.3**	**62.5**	**64.6**	**62.7**
Austria	0.4	0.2	0.3	0.2	0.2
Czech Republic	–	0.9	1.1	0.7	0.7
Germany	68.7	54.7	48.1	36.9	41.8
Latvia	0.9	0.0	0.0	0.2	0.2
Lithuania	1.6	0.0	0.2	0.7	0.9
Slovakia	8.2	11.7	12.5	25.4	17.6
Sweden	0.0	0.2	0.0	0.1	0.1
Others	0.9	0.6	0.3	0.4	1.2

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***crude*** or ***roughly worked dimension stone*** has been consistently negative and dropped to ca. 189 million PLN in 2012 (Tab. 10). The trade balance in ***worked dimension stone*** has also been negative. The deficit was at the level 320–331 million PLN/year, with a slightly improvement in 2009 and 2012 (Tab. 10). On the other hand, the positive trade balance in ***pitcher*** and ***curbs*** was reported year by year, with the exception of 2011. However, it visibly lowered from ca. 17 million PLN in 2008 to less than 1 million PLN in 2012. The combined trade balance in ***dimension stone*** in Poland became negative in 1997 for the first time. In the years 2008–2012 deficit varied depending on imports volume between 351 and 507 million PLN/year.

Tab. 10. Value of dimension stone trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Crude or roughly worked dimension stone CN 2515,2516					
Exports	20,656	75,338	27,777	36,711	45,851
Imports	201,124	239,712	156,132	205,607	234,896
Balance	**-180,468**	**-164,374**	**-128,355**	**-168,896**	**-189,045**
Worked dimension stone CN 6802					
Exports	26,617	21,711	53,318	55,718	76,031
Imports	357,799	221,191	383,051	381,719	352,802
Balance	**-331,182**	**-199,480**	**-329,733**	**-326,001**	**-276,771**
Pitcher and curbs CN 6801					
Exports	24,406	19,587	17,332	16,576	18,002
Imports	7,789	6,758	9,565	28,605	17,085
Balance	**+16,617**	**+12,829**	**+7,767**	**-12,029**	**+917**

Source: ***The Central Statistical Office (GUS)***

The average unit values of trade of ***raw blocks*** and ***slabs*** made of ***marble*** and ***other carbonate rocks*** are very variable due to low level of this trade. They are reported at the level of 873–2,486 USD/t in exports and 485–668 USD/t in imports (Tab. 11). The average unit values of ***granite raw blocks*** and ***slabs*** exports ranged from 97 to 118 USD/t in recent years, while their imports unit values dropped from 265 USD/t to 54 USD/t as a result of very low cost of imported granite from Norway (25 USD/t, Tab. 11). The average unit values of trade of ***sandstone raw blocks*** and ***slabs*** are very variable due to very low quantities of their imports and exports (Tab. 11). The average unit values of trade of ***raw blocks*** and ***slabs*** made of ***other rocks*** are very variable due to significant changes in their assortment structure. The average unit values of ***pitcher*** and ***other road stone*** exports dropped from 130 USD/t in 2008 to 88 USD/t in 2012 as a result of low unit values of pitcher exported to Slovakia. On the contrary, the unit values in imports had increasing tendency and rose from 67 USD/t in 2008 to over 100 USD/t in last two years (Tab. 11).

Tab. 11. Average unit values of dimension and road stone trade in Poland

Year	2008	2009	2010	2011	2012
Marbles, limestones, and other carbonate rocks, crude or roughly worked CN 6802 21,91,92					
Exports unit values					
— PLN/t	2,082.4	3,141.2	7,620.4	6,039.5	4,291.5
— USD/t	873.0	1,025.2	2,486.2	2,015.4	1,308.0
Imports unit values					
— PLN/t	1,121.7	1,766.5	1,789.9	1,961.1	1,830.6
— USD/t	484.8	575.5	590.1	667.8	560.6
Granite, crude or roughly worked CN 2516 11					
Exports unit values					
— PLN/t	246.0	301.9	304.5	343.9	375.8
— USD/t	106.1	96.6	99.9	117.7	115.2
Imports unit values					
— PLN/t	613.7	809.0	747.0	198.3	178.5
— USD/t	265.0	258.5	245.8	68.4	54.4
Sandstone, crude or roughly worked CN 2516 20					
Exports unit values					
— PLN/t	640.5	627.3	641.2	688.5	832.3
— USD/t	270.5	201.4	215.4	236.9	259.2
Imports unit values					
— PLN/t	1,130.9	1,212.3	1,249.3	1,029.9	854.4
— USD/t	480.9	394.9	411.8	341.7	259.8

Other rocks, crude or roughly worked CN 2516 90					
Exports unit values					
— PLN/t	2,102.4	9,578.9	1,319.7	182.6	22,103.0
— USD/t	772.1	3,073.2	438.1	62.9	6,968.6
Imports unit values					
— PLN/t	640.9	488.2	161.5	70.5	128.8
— USD/t	274.9	154.2	54.0	22.4	39.7
Pitcher and other road stones CN 6801					
Exports unit values					
— PLN/t	302.6	286.6	277.3	256.5	287.0
— USD/t	130.1	92.7	91.0	88.0	88.0
Imports unit values					
— PLN/t	157.7	239.1	286.4	297.7	334.1
— USD/t	66.6	75.8	93.4	102.1	101.1

Source: ***The Central Statistical Office (GUS)***

Consumption

The majority of the compact rocks extracted in Poland are utilized for the production of ***crushed aggregates***, which are consumed by the road, railway, and civil construction industries. Only a small percentage of the total production is constituted by ***large*** and ***small dimension stone*** for civil construction, as well as by ***pitcher*** and ***curbs*** for road construction.

Total domestic consumption of ***dimension*** and ***road stone***, according to official data (the Central Statistical Office) rose to ca. 4–7 Mtpy in the recent years. According to author's estimations the level of consumption was much lower. It increased from ca. 1.5–1.7 Mtpy in the years 2008–2010 to ca. 2.8 Mtpy in the years 2011–2012 (Tab. 2). Since the beginning of the 1990s, Polish dimension stone market was opened for imported products. It resulted in growing share of foreign suppliers on domestic market of ***blocks*** and ***raw slabs***, up to 50% in volume terms and up to ca. 70% in value terms in 2012. In ***dimension sandstone*** branch domestic producers still dominate (over 99%), but in case of ***dimension granite*** branch this share decreased to ca. 50%, while in ***dimension marble*** branch — about 40%.

Dimension stone elements (***wall sidings***, ***floor slabs***, ***tombstones***, etc.) manufactured mainly from domestic granite, syenite, and marble, as well as from decorative "marble" and sandstone, are used for monuments and public buildings, and — on a smaller scale — for private dwellings. ***Smaller stone elements*** (***window sills***, ***stairs***, etc.) made of the same rock materials are also in common use. Imported dimension stone blocks are used for the same purposes as domestic products, being very competitive. Domestic dimension stone is still dressed mainly in Lower Silesia, at plants close to the deposits. Imported dimension stone is dressed in numerous private stone workshops spread all over the country, but mostly in the vicinity of large cities. However, large stone plants in Lower Silesia (e.g. in Strzegom area) also use increasing amounts of imported stone to diversify their market offer. Share of imported stone on the ***worked dimension stone*** market rose to over 50% in volume terms and ca. 60% in value terms.

Use of ***road stone*** (***pitcher***, ***curbs***, etc.) in Poland show increasing tendency, although they are undoubtedly not as commonly use as in other countries, e.g. Germany. The interior market of road stone, after strong decrease from 220,000–270,000 tpy to ca. 140,000 t in 2010, spectacularly grew to 357,000 t in 2011. In 2012 it slightly dropped to 278,000 t. The rising demand for ***pitcher***, ***curbs***, etc. was caused by growing number of road investments. Polish market of road stone was dominated (in over 97%) by domestic producers of ***granite pitcher*** and ***curbs*** from Strzegom and Strzelin area, with minor importance of manufacturers of ***syenite*** and ***basalt pitcher***. Share of foreign suppliers was variable and usually did not exceed 20%, except the years 2010–2011 when it increased to 24–27%.

Value of domestic market of ***raw dimension*** and ***road stone*** achieved the level of ca. 400–500 million PLN in the years 2008–2012, except of 2011 when increased to ca. 580 million PLN. When we take into account also ***processed dimension stone***, the combined value of national market of ***dimension*** and ***road stone*** amounted to over 1.0 billion PLN, with a growth to 1.3 billion PLN in 2011. Share of imported stone on this market amounted to 40–60% in the recent years.

Principal companies involved in dimension and road stone production in Poland as of December 2012

- Borowskie Kopalnie Granitu Sp. z o.o. w Borowie (Borowskie Granite Mines Ltd. of Borów), Borów, 58–172 Gniewków, tel. +48 74 8563053, fax +48 74 8563052, www.bkg.com.pl — *granite blocks and slabs, ashlar, pitcher, curbs.*
- “Morstone Trade” Sp. z o.o. w Strzegomiu (“Morstone Trade” Ltd. of Strzegom), ul. Wałbrzyska 10, 58–150 Strzegom, Tel. +48 746494949, fax. +48 746494940, www.morstonetrade.pl — *granite blocks and slabs.*
- “Granit Strzegom” S.A. w Strzegomiu (“Granit Strzegom” Joint Stock Co. of Strzegom), ul. Górnicza 6, 58–150 Strzegom, tel. +48 74 8560000, fax +48 74 8560001, www.granit-strzegom.com.pl — *granite blocks and slabs, ashlar, pitcher and curbs, crushed stone.*
- “Grabinex” Sp. z o.o. (“Grabinex” Ltd. Granite Mine), ul. Kopalniana 13, 58–150 Strzegom, tle. +48 74 8553399, fax +48 74 8554540, www.grabinex.pl — *granite blocks and slabs, pitcher, cubs, crushed stone, crushed aggregates.*
- “Skalimex-Borów” S.A. (“Skalimex-Borów” Joint Stock Co.), Kostrza, ul. Borowska 6, 58–150 Strzegom, tel. +48 74 8563063, fax +48 74 8563066, www.skalimex-borow.com.pl — *granite blocks and slabs, ashlar, pitcher and curbs, crushed stone.*
- PPHiU “Piramida” Sp. z o.o (“Piramida” Ltd., Granite Mine), ul. Kopernika 30, 58–150 Strzegom, tel. +48 74 8553797, fax +48 74 8552923, www.piramida-strzegom.pl — *granite blocks and slabs, pitcher and curbs.*
- “Skalimex-Grantin” Sp. z o.o. Kopalnia Granitów (“Skalimex-Grantin” Ltd., Granite Mine), ul. Chwałkowska 23, 55–050 Sobótka, tel. +48 71 3162025, fax +48 71 3162026, www.skalimex-grantin.com.pl — *granite blocks and slabs, ashlar, pitcher and curbs, crushed stone.*
- “GT&F Corporation Polska” Sp. z o.o., Kopalnie Granitu w Kostrzy (“GT&F Corporation Polska” Ltd., Granite Mines of Kostrza), ul. Kopernika 2a, 58–150 Kostrza,

tel. +48 74 8554121, fax +48 74 8555036, www.mfgranit.com — *granite blocks and slabs, ashlar, pitcher, crushed stone.*

- “Kwarc” Sp. z o.o. (“Kwarc” Ltd. Granite Mine), Kostrza, ul. Kopernika 27, 58–150 Strzegom, tel. +48 74 8553833, fax +44 74 8516818, www.kwarc.pl — *granite blocks and slabs, pitcher, ashler, crushed stone.*
- “Granimex” Sp. z o.o. w Strzegomiu (“Granimex” Ltd. of Strzegom), Strzegom, Al. Wojska Polskiego 63, 58–150 Strzegom, tel. +48 74 8556890 www.granimex-granit.pl — granite blocks and slabs, ashlar, pitcher and curbs, crushed stone.
- “KG Zimnik” Sp. z o.o. w Zimniku (“Zimnik” Ltd. Granit Mine of Zimnik), Zimnik 37, 59-407 Mściwojów, Polska, tel./fax +48 76 872 84 56 www.zimnik.pl— *granite blocks and slabs, pitcher, curb, crushed stone.*
- “Stonpol” Sp. z o.o. w Mikoszowie (“Stonpol” Ltd. of Mikoszów) Mikoszów 47, 57–100 Strzelin, tel./fax +48 71 329 98 28, www.stonpol.com.pl — *granite blocks, ashlar, and pitcher.*
- “Sjenit” S.A. w Guminie (“Sjenit” Joint Stock Co. of Gumin), Gumin 18, 58–230 Niemcza, tel. +48 74 8373000, fax +48 74 8371213, www.sjenit.com.pl — *syenite aggregates, syenite blocks and slabs, grits.*
- “Slag Recycling” Sp. z o.o. (“Slag Recycling” Ltd.), ul. Igołomska 28a, 31–983 Kraków, tel. +48 12 6421435, fax +48 12 6441842, www.sjenitprzedborowa.pl — *syenite aggregates, blocks, pitcher.*
- Przedsiębiorstwo Wydobycia i Obróbki Marmuru “Marmur-Sławniowice” (“Marmur-Sławniowice” Marble Mining and Working Enterprise), Sławniowice 103, 48–300 Głuchołazy, tel. +48 77 4398018, fax +48 77 4398019, www.marmur-slawniowice.pl — *marble blocks and slabs, grits.*
- Przedsiębiorstwo Produkcyjno-Handlowe “Dolomit” Sp. z o.o. (“Dolomit” Production and Trade Enterprise Ltd.), ul. Kamienna 9, 32–530 Libiąż, tel. +48 32 6277281, fax +48 32 6277273, www.dolomitlibiaz.pl — *dolomite blocks and slabs, pitchers, crubs, crushed stones, crushed aggregates.*
- “Hofmann Polska” Sp. z o.o. (“Hofmann Polska” Ltd.), ul. Morawskiego 5, 30–102 Kraków, tel. +48 12 4222589, fax +48 12 4229094, www.hofmann.com.pl — *sandstone blocks and slabs and lumps.*
- “Kopalnie Piaskowca” S.A. w Bolesławcu (“Kopalnie Piaskowca” Joint Stock Co. of Bolesławiec), ul. Modłowa 1, 59–700 Bolesławiec, tel. +48 75 7323636, fax +48 75 7324860, www.kopalniepiaskowca.com.pl — *sandstone blocks and slabs, split tiles, crushed stone.*
- “ATS-Stein” Sp. z o.o. Kopalnie Piaskowca (“ATS-Stein” Ltd. Sandstone Mines), 59–700 Bolesławiec, ul. Ogrodowa 6, tel. +48 75 7353440, fax +48 75 7353441 — *sandstone blocks and slabs, split tiles.*
- Kopalnia Piaskowca “Jan Zbylutów IV” w Zbylutowie (“Jan Zbylutów IV” Sandstone Mine of Zbylutów), ul. Jemiołowa 15, 59–700 Bolesławiec, tel. +48 757324133, fax +48 757324133, www.kopalniapiaskowca.pl — *sandstone blocks and slabs, pitcher,ashlars, crushed stone.*
- “Gruszecki” Sp. z o.o. (“Gruszecki” Ltd.), ul Wrocławska 26, 55–075 Bielany Wrocławskie, tel. +48 71 3112398, fax. +48 71 3112757, www.gruszecki.com.pl — *sandstone slabs, split tiles.*

- "Piasmar" Sp. j. ("Piasmar" General Partnership), ul. Konopnickiej 4, 57–500 Bystrzyca Kłodzka, tel./fax +48 74 8111633, www.piasmar.com — *sandstone blocks and slabs, pitcher.*
- Kopalnie Piaskowca "Radków" Sp. z o.o. ("Radków" Sandstone Mines Ltd.), ul. Jagiellońska 18, 57–420 Radków, tel. +48 74 8712948, fax +48 74 8712645, www.piaskowceradkow.pl — *sandstone blocks and slabs, pitcher, crushed stone.*
- "Kamieniarz" w Kielcach ("Kamieniarz" of Kielce), ul. Cedro-Mazur 6, 25–252 Kielce, tel. +48 41 3022424, fax +48 41 3022426, www.modlinski.com — *sandstone blocks and slabs, split tiles, crushed stone.*
- PUH "Sosnowica" S.C. ("Sosnowica" Sandstone Mine), 26–120 Bliżyn, tel. +48 41 3745452, fax +48 41 3745070 — *sandstone blocks, slabs and split tiles.*
- Zakład Kamiennych Materiałów Budowlanych, Eksport-Import Andrzej Kosek (Andrzej Kosek, Plant of Stone Building Materials, Export-Import), Miedzna, ul. Drewniana 2/2, 26–307 Białaczów, tel. +48 44 7581640, fax +48 44 7581636, www.piaskowiec.com.pl — *sandstone blocks and slabs, split tiles, crushed stone.*
- "Polski Kamień Naturalny Mucharz-Skawce" Sp. z o.o. ("Polski Kamień Naturalny Mucharz-Skawce" Ltd.), 34–210 Zembrzyce, Śleszowice 240, tel. +48 33 4880190, fax +48 33 8739028, http://www.kamieniolom-mucharz.pl — *sandstone blocks, slabs, split tiles, and aggregates.*
- Zakład Wydobycia Kamienia Budowlanego Tadeusz Brach (Tadeusz Brach, Plant of Mining of Building Stone), 38–421 Wola Komborska 55, tel./fax +48 13 4354412 — *blocks and slabs, split tiles*.

STRONTIUM

Overview

Strontium (**Sr**) forms only two minerals of practical value: ***celestite*** $SrSO_4$, and — less common — ***strontianite*** $SrCO_3$. Deposits of ***celestite*** and ***celestite-fluorite ores*** are the main source of strontium. Celestite commonly co-exists with ***native sulfur***, ***barite***, and ***Zn-Pb-Ag ores***, and is obtained as a by-product during processing. **Celestite concentrate** (90–97% $SrSO_4$), is commonly transformed into **synthetic strontium carbonate**, containing 98% $SrCO_3$ (as opposed to 90–92% in **natural strontianite**). **Metallic strontium**, produced in small amounts by the electrolysis of molten ***strontium chloride*** $SrCl_2$, is used as an additive in Al-Si alloys.

Strontium has many applications, particularly for the production of ***color picture tubes***, ***ceramic ferrites***, ***paints***, and ***pigments***, and in pyrotechnics, medicine, and the electrolysis of zinc, ceramics, etc.

Sources

There are no deposits of ***strontium minerals*** in Poland. The resources of the remaining part of the small **Czarkowy** ***celestite*** deposit (containing 15–28% $SrSO_4$) are estimated at 5,300 t. Considerable amounts of ***celestite*** occur in the ***sulfur-bearing limestone*** deposits in **Tarnobrzeg** region. The Frasch method of exploitation these deposits currently used does not provide any possibility for extracting ***celesite***.

Production

There is no production of ***strontium minerals*** in Poland. On the basis of imported ***strontium carbonate***, some ***strontium compounds*** are manufactured in small amounts.

Trade

The demand for ***strontium*** and ***strontium compounds*** is covered by imports. The most important is ***synthetic strontium carbonate***. In the years 2006–2010, its imports decreased from ca. 2,300 to only 144 t (Tab. 1). Until 2009, Germany were the main supplier (80–94% of imports), whereas in the years 2009–2012: Japan (63–82%) and Germany (34–18%). Strontium carbonate of standard quality is probably imported mainly from Germany in diminishing amounts (from 1,140 t in 2007 to only 31 t in 2012), while Japan delivers probably high quality material at the level of 50-160 tpy. As a result, ***strontium carbonate*** trade deficit in the years 2009–2012 rose by 51%, in spite of 65% imports volume decrease (Tab. 2), as average unit values of imports increased by ca. 340% (Tab. 3). Previously, small amounts of strontium carbonate were incidentally re-exported to various countries. ***Strontium oxide*** and ***hydroxide*** are also imported, but on an irregular basis. There are incidental imports of ***strontium metal*** (max. several kgpy).

Tab. 1. Strontium carbonate statistics in Poland — CN 2836 92

t

Year	2008	2009	2010	2011	2012
Imports = Consumption[a]	486.3	80.2	144.1	196.1	169.1

Source: ***The Statistical Office (GUS)***

Tab. 2. Value of strontium carbonate trade in Poland — CN 2836 92

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	1	–	1	4	6
Imports	1,396	686	1,500	2,237	2,121
Balance	**-1,395**	**-686**	**-1,499**	**-2,233**	**-2,115**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Average unit values of strontium carbonate imports to Poland — CN 2836 92

Year	2008	2009	2010	2011	2012
PLN/t	2,871	8,554	10,409	11,406	12,543
USD/t	1,188	2,923	3,457	3,958	3,838

Source: ***The Central Statistical Office (GUS)***

Consumption

No accurate information is available on the application of imported ***strontium compounds***.

SULFUR

Overview

Sulfur (**S**) occurs in the lithosphere in its native form (***native sulfur***), but it is far more commonly encountered in many minerals and compounds. Generally, sulfur is obtained from deposits of ***native sulfur*** and ***pyrites*** (**voluntary production**) or recovered from ***crude oil***, ***natural gas***, and ***off-gases*** during the smelting of ***sulfide concentrates*** of copper, zinc, lead, nickel, and molybdenum (**involuntary production**).

Sulfur has been in use for several thousand years. Nowadays it is utilized primarily in the chemical industry, to make **sulfuric acid** and other sulfur compounds. Sulfuric acid (accounting for more than 85% of sulfur consumption) is used mostly in the production of phosphate fertilizers and developed leaching uranium and copper from their ores. Other industries, including rubber and paper-making, claim much smaller shares of the total consumption of sulfur and sulfuric acid.

Sources

Native sulfur deposits are the main source of sulfur in Poland. Other primary sources include ***copper***, ***zinc***, and ***lead sulphide ore*** deposits, as well as ***sulfurized crude oil***, ***natural gas***, and ***coal***, but these are of minor importance. The secondary sources are ***waste sulfuric acid*** and ***processing water*** from sulfur extraction.

Deposits of ***native sulfur*** occur in Poland in the northern part of the **Carpathian Foredeep**, in Miocene gypsum-displacing limestone. Deposits are generally located in three regions: **Staszów**, **Tarnobrzeg**, and **Lubaczów**. As of 31 December 2012, there are 14 deposits, containing 511 Mt of S. Since 2002, **Osiek** deposit is the only extracted deposit. The available reserves of this deposit amounted to 24.7 Mt of S.

Until 1996 official resources of ***sulfur*** in ***sulphide ores*** of ***copper***, ***lead***, and ***zinc*** were assessed at ca. 35.5 Mt of S. In the years 2008-2009, resources of sulfur in deposits were recalculated. Currently estimated resources of sulfur are listed only for 3 undeveloped deposits, at a total level of 5.5 Mt of S. The resources of sulfur in ***sulphide lead*** and ***zinc ore*** 9 deposits are estimated at ca. 2.67 Mt of S, of which ca. 1.53 Mt of S in two extracted deposits (**Olkusz** and **Pomorzany**). The sulfur resources in ***coal***, ***crude oil***, and ***natural gas*** deposits have not yet been estimated, except for 4 ***natural gas*** deposits: **Barnówko-Mostno-Buszewo** (**BMB**) — 501,000 t of S; **Cychry** — 39,000 t of S; **Zielin** — 4,000 t of S; **Górzyca** — 2,000 t of S (as of 31 December 2012).

Production

In August 2001, **Jeziórko-Grębów-Wydrza** deposit extraction was abandoned, while in September 2001 **“Siarkopol” Tarnobrzeg** declared insolvency. Since this time,

native sulfur is produced only by the **Osiek** mine of **"Siarkopol" Grzybów**. Until 2009, ***native sulfur*** had still the largest importance as sulfur source for the domestic economy. In 2009, native sulfur exports, as well as domestic sales, collapsed (Tab. 1,2). Sulfur mining output dropped by ca. 65%, while share of ***native sulfur*** in total domestic supply of ***sulfur in all forms*** (***SAF***) decreased to only ca. 36% (Tab. 1). For the first time in history, share of sulfur from involuntary production (recovered elemental sulfur, recovered sulfuric acid) exceeded 50% of total domestic supply of SAF. In 2010, but especially in the years 2011–2012 domestic and foreign demand for sulfur rose and production in Osiek mine increased, but not to 2008 level. As a result, share of native sulfur in SAF supply rose to over 55% (Tab. 1).

Tab. 1. Production of sulfur in all forms (SAF) in Poland

'000 t S

Year	2008	2009	2010	2011	2012
Production, total[a]	**1,278.9**	**734.7**	**1,019.8**	**1,189.1**	**1,229.2**
Elemental sulfur CN 2503, 2802	**984.9**	**477.7**	**766.8**	**916.1**	**962.2**
• Native sulfur from Osiek mine (Frasch method)	762.1	262.8	516.7	657.1	676.8
• Byproduct sulfur	222.8	214.9	250.1	259.0	285.4
— *from natural gas*	*21.3*	*24.8*	*24.9*	*23.8*	*25.3*
— *from oil refineries and coking plants*	*201.1*	*189.6*	*224.7*	*234.6*	*259.7*
— *others*	*0.4*	*0.5*	*0.5*	*0.6*	*0.4*
Byproduct (sulfuric acid)[a]	**294.0**	**257.0**	**253.0**	**273.0**	**267.0**

Source: ***The Central Statistical Office (GUS), producer data***

Tab. 2. Elemental sulfur statistics in Poland — CN 2503, 2802

'000 t

Year	2008	2009	2010	2011	2012
Production	987.5	479.0	769.2	918.3	963.1
Imports	104.0	36.4	53.1	55.7	30.4
Exports	474.0	181.7	438.0	421.4	536.5
Stock changes	72.1	39.2	-98.5	7.8	6.6
Consumption	545.4	294.5	482.8	544.8	450.4

Source: ***The Central Statistical Office (GUS)***

In the years 2008–2012, the volume of ***elemental sulfur*** recovered from ***petroleum*** refining at the **Płock** refinery (**PKN ORLEN S.A.**) and at the **Gdańsk** refinery (**Grupa LOTOS S.A.**), or from the desulfurization of ***natural gas***, ***coke-oven gas***, and ***processing water***, was continuously increasing, with temporary reduction in 2009 (Tab. 1). In general, share of involuntary elemental sulfur in total SAF supply rose from 17% to 23% in this period (only in 2009 it amounted to 29%). The majority was coming from the desulfuring installations in both refineries, which have combined capacity of 240,000-260,000 tpy of S. There are only small desulfuring systems in cookeries, gas plants, and other industrial plants (treatment of processing water), based mainly on arsenic-soda technology.

The production of sulfur in forms other than elemental made 22–25% of the total supply of ***sulfur in all forms*** until 2008 and in the years 2010–2012, only in 2009 it temporary rose to 35% (Tab. 1). Sulfur is recovered in the form of ***sulfuric acid***, ***liquid sulfur dioxide*** SO_2, and ***oleum***, in copper and zinc smelters, and also in cokeries. The main sulfuric acid plants are the copper smelters operated by **KGHM "Polska Miedź" S.A.** at **Głogów I**, **Głogów II**, and **Legnica**, the **"Miasteczko Śląskie" Zinc Smelter S.A.**, the **ZGH "Bolesław" Mining and Smelting Plant S.A.**, and in cokeries.

The total production volume of ***sulfur in all forms*** (*SAF*) showed an increasing tendency in the years 2004–2007, up to 1.35 Mt of S. In the years 2008–2009 it was reduced to 0.73 Mt of S due to collapse of natural elemental sulfur production. Since 2010 SAF production has been recovered, achieving 1.23 Mt S in 2012, i.e. similar amount as in 2008 (Tab. 1).

Trade

In 2009, ***elemental sulfur*** exports were reduced from 474,000 to 182,000 t (Tab. 3), while share of exports in total sales of domestic production of ***elemental sulfur*** - to ca. 38% (Tab. 2). Since 2010 sulfur exports rose again, up to 537,000 t in 2012, while share of exports in total sales of domestic production - to 56%, i.e. level reported in the years 2003–2007. The most important recipients were Morocco and the Czech Republic, but substantial amounts were sold also to Brazil, Senegal, Argentina, Mexico, Egypt and Finland (Tab. 3). Small quantities were sold to over 45 countries, also in Africa, Asia and both Americas. ***Elemental sulfur*** imports also dropped in 2009–2012 by ca. 70% (Tab. 2), coming almost exclusively from Germany (90%).

Tab. 3. Polish exports of elemental sulfur, by country — CN 2503, 2802

'000 t

Year	2008	2009	2010	2011	2012
Exports	**474.0**	**181.7**	**438.0**	**421.4**	**536.5**
Argentina	–	–	–	–	15.8
Austria	8.2	0.4	4.8	1.1	0.8
Brazil	30.1	–	44.0	22.0	–
China	8.8	–	–	0.0	–
Croatia	2.3	1.2	2.0	2.5	1.3
Czech Republic	53.9	32.7	41.3	49.8	53.9
Egypt	–	–	–	5.6	10.0
Finland	4.8	0.0	20.8	13.2	0.2
Germany	1.9	0.8	2.3	7.0	8.8
Hungary	1.0	0.8	2.0	1.1	0.8
Mexico	–	–	–	–	52.7
Morocco	344.7	137.8	249.1	305.2	341.2
Nigeria	0.1	0.1	0.0	0.1	11.3

Romania	1.0	1.0	1.4	1.7	1.9
Senegal	–	–	52.8	–	26.4
Slovakia	3.0	1.0	1.4	1.7	1.8
Slovenia	0.6	0.3	0.4	0.5	0.4
Spain	0.1	–	6.6	0.0	0.0
Sweden	2.4	0.2	1.9	0.4	0.5
Ukraine	0.5	0.0	0.5	0.6	0.9
Others	10.6[r]	5.4[r]	6.7[r]	8.9	7.8

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***elemental sulfur*** has been positive in recent years (Tab. 4). Rapid growth of world sulfur prices between middle of 2007 and September 2008, resulted in parallel growth of sulfur unit values in Polish trade. Export prices rose by ca. 260% (in PLN/t) and ca. 350% (in USD/t), while import prices — by 340% and 440%, respectively (Tab. 5). It influenced the increase of positive trade balance by 140% to 243 million PLN. In 2009 exports prices returned to 2007 level. Simultaneously, exports volumes dropped by over 60%, what resulted in reduction of positive trade balance to only 25 million PLN. In the years 2010–2012 exports unit values rose by 137%, while imports unit values - by 148%. Increase of exports volume decided on growth of positive trade balance to ca. 256 million PLN in 2012 (Tab. 4).

Tab. 4. Value of elemental sulfur trade in Poland — CN 2503, 2802

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	348,620	40,994	124,078	169,959	286,650
Imports	105,373	15,644	23,780	48,166	30,483
Balance	**+243,247**	**+25,350**	**+100,298**	**+121,793**	**+256,167**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. Average unit values of elemental sulfur trade in Poland — CN 2503, 2802

Year	2008	2009	2010	2011	2012
Exports unit values					
PLN/t	735.5	225.6	283.3	403.4	534.3
USD/t	326.5	71.6	93.5	134.7	163.9
Imports unit values					
PLN/t	1,012.9	429.9	448.0	865.1	1,067.9
USD/t	449.4	140.0	148.2	294.2	323.8

Source: ***The Central Statistical Office (GUS)***

Consumption

The domestic structure of ***sulfur*** consumption corresponds with world trends. In recent years, ca. 80–85% of the sulfur supply was used in the production of ***sulfuric acid***; 4–11% for the manufacture of ***carbon disulfide*** CS_2; the rest for the manufacture of rubber, plastic products, paper, manufacture of food products and production of other sulfur compounds, e.g. ***liquid hydrogen sulfide*** H_2S, ***insecticides***, etc.

In the years 2011–2012, ca. 380,000–450,000 tpy of ***elemental sulfur*** were used to produce 1.18–1.35 Mtpy of ***sulfuric acid*** in phosphate and nitrogen fertilizers plants. It was mainly recovered in the **"Police" Chemical Plant**, and share of this company in total sulfuric acid supply amounted to 64-68%. Sulfuric acid production was also rebuilt in other plants: the **"Fosfory" Gdańsk**, the **"Siarkopol" Chemical Plant** of **Tarnobrzeg**, in **Nitrogen Works** of **Tarnów** and **"Puławy" Nitrogen Plant**. The rest of H_2SO_4 is supplied by plants in non-ferrous metal smelters, with **KGHM "Polska Miedź" S.A.** as the main supplier (ca. 650,000 t in 2011-2012). The total production of ***sulfuric acid*** in Poland increased to ca. 2.0–2.2 Mt, with over 19% of production being exported (Tab. 6).

Tab. 6. Sulfur compounds statistics in Poland

'000 t

Year	2008	2009	2010	2011	2012
Sulfuric acid CN 2807					
Production[1]	2,101.9	1,514.8	1,977.6	2,183.5	1,976.7
Imports	2.8	9.0	10.9	6.1	2.9
Exports	411.6	316.0	277.0	418.1	388.8
Consumption[a]	1,693.1	1,207.8	1,711.5	1,771.5	1,590.8
Carbon disulfide CN 2813 10					
Production	55	NA	NA	NA	NA
Exports	52	30	29	23	17
Consumption[a]	3	NA	NA	NA	NA

[1] together with recovered sulfuric acid

Source: ***The Central Statistical Office (GUS)***

"Siarkopol" Grzybów has the largest ***carbon disulfide*** plant in Europe, but majority of production is exported on European market. In recent years, its production was strongly decreasing to 20,000–25,000 tpy of CS_2 (lack of exact data) consuming annually 25,000–30,000 tpy of ***elemental sulfur*** (Tab. 6).

The trade balance of ***sulfuric acid*** and ***carbon disulfide*** have been positive from many years. In case of sulfuric acid strong fluctuations of trade balance were recorded: from 9 million in 2011 to 102 million PLN in 2010. In case of CS_2 in the years 2010–2012 exports volumes were declining, while prices increasing, so positive trade balance was still over 30 million PLN (Tab. 7).

Tab. 7. Value of sulfuric acid and carbon disulfide trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Sulfuric acid CN 2807					
Exports	13,925	25,141	105,528	12,458	31,792
Imports	1,945	3,322	3,138	3,192	4,474
Balance	**+11,980**	**+21,819**	**+102,390**	**+9,266**	**+27,318**
Carbon disulfide CN 2813 10					
Exports	32,542	32,925	54,080	40,953	32,392
Imports	34	53	43	41	197
Balance	**+32,508**	**+32,872**	**+54,037**	**+40,912**	**+32,195**

Source: ***The Central Statistical Office (GUS)***

Companies involved in sulfur and sulfuric acid production in Poland as of December 2012

- Kopalnie i Zakłady Chemiczne Siarki "Siarkopol" S.A. w Grzybowie ("Siarkopol" Joint Stock Co. Sulfur Mines and Chemical Plant of Grzybów), 28–200 Staszów, tel. +48 15 8643939, fax +48 15 8643717; www.siarkopol.org — *elemental sulfur (native), carbon disulfide*.
- PKN ORLEN S.A. Rafineria Płock (Polish Oil Company ORLEN Joint Stock Co. Oil Refinery of Płock), ul. Chemików 7, 09–411 Płock tel. +48 24 3650000, fax +48 24 3654040; www.orlen.pl — *elemental sulfur (byproduct)*.
- Grupa LOTOS S.A. Rafineria Gdańsk (LOTOS Group Joint Stock Co. Oil Refinery of Gdańsk), ul. Elbląska 135, 80–718 Gdańsk tel. +48 58 3087111, +48 58 3088111, tel./fax +48 58 3015733; www.lotos.pl — *elemental sulfur (byproduct).*
- KGHM "Polska Miedź" S.A. (KGHM "Polska Miedź" Joint Stock Co. of Lubin), 59–301 Lubin, ul. Marii Skłodowskiej-Curie 48, tel. +48 76 7478200, fax +48 76 7478500; www.kghm.com.pl — *sulfuric acid (byproduct).*
- Huta Cynku "Miasteczko Śląskie" S.A. ("Miasteczko Śląskie" Zinc Smelter Joint Stock Co. of Miasteczko Śląskie), ul. Woźnicka 36, 42–610 Miasteczko Śląskie, tel. +48 32 2888444, fax +48 32 2888687; www.hcm.com.pl — *sulfuric acid (byproduct).*
- Zakłady Górniczo-Hutnicze "Bolesław" S.A. ("Bolesław" Mining and Smelting Plant Joint Stock Co. of Bukowno), ul. Kolejowa 37, 32–332 Bukowno, tel. +48 32 2955100, fax +48 32 2955000; www.zgh.com.pl — *sulfuric acid (byproduct).*
- Zakłady Koksownicze "Zdzieszowice" Sp. z o.o. w Zdzieszowicach (Coke Works "Zdzieszowice" Ltd. of Zdzieszowice); ul. Powstańców Śląskich 1, 47–330 Zdzieszowice, tel. +48 77 4841000–2, fax +48 77 4841414, www.zkz.com.pl — *sulfuric acid (byproduct).*
- Zakłady Chemiczne Police S.A. (Police Joint Stock Co. Chemical Plant), ul. Kuźnicka 1, 72–010 Police; tel. +48 91 3171717, 3174296, fax +48 91 3173603; www.zchpolice.pl — *sulfuric acid.*

- Zakłady Azotowe “Puławy” S.A. w Puławach (“Puławy” Nitrogen Plants Joint Stock Co. of Puławy), Al. Tysiąclecia Państwa Polskiego 13, 24–110 Puławy, tel. +48 81 8863431, fax +48 81 8875444, www.zapulawy.pl — *sulfuric acid, oleum.*
- Fosfory Sp. z o.o. Gdańskie Zakłady Nawozów Fosforowych (Fosfory Phosphate Fertilizers Plant Ltd. of Gdańsk), ul. Kujawska 2, 80–550 Gdańsk; tel./fax. +48 58 3073892, fax. +48 58 3073791; www.fosfory.com.pl — *sulfuric acid.*
- Zakłady Azotowe S.A. w Tarnowie-Mościcach (Nitrogen Plants Joint Stock Co. of Tarnów-Mościce), ul. Kwiatkowskiego 8, 33–101 Tarnów, tel. +48 14 6330781, fax +48 14 6330718, www.azoty.tarnow.pl — *sulfuric acid, oleum.*
- Zakłady Chemiczne “Siarkopol” Tarnobrzeg Sp. z o.o. w Tarnobrzegu (“Siarkopol” Tarnobrzeg Chemical Plants Ltd. of Tarnobrzeg), ul. Zakładowa 50, 39–402 Tarnobrzeg 4, tel. +48 15 8555710, fax. +48 15 8229797, www.zchsiarkopol.pl — *sulfuric acid.*

TALC AND PYROPHYLLITE

Overview

Talc and **pyrophyllite** are magnesium and aluminum silicates (respectively), formed in conditions of metamorphism or hydrothermally. The compacted talc variety is known as **steatite** (**soapstone**, **soap-rock**), whereas compacted pyrophyllite is called **agalmatolite**. These find commercial application in the paper, ceramics, plastics, rubber, paint, and cosmetics industries. The higher melting point of pyrophyllite accounts for its use in refractories and in special ceramic materials.

Sources

No ***talc*** or ***pyrophyllite*** deposits are recognized in Poland. There are only some occurrences of ***talc-chlorite schist*** containing ***Ca-Mg talc*** in the Lower Silesia at **Braszowice**, **Wiry**, and **Sobótka**. Despite huge resources, the extraction of this schist has been considered to be uneconomic due to low quality of concentrates obtained.

Production

Neither ***talc*** nor ***pyrophyllite*** is produced in Poland.

Trade

In Poland, the domestic demand for ***talc*** and ***related commodities*** is satisfied by imports. Finland and Austria maintained their position of the largest suppliers, followed by Italy, the Netherland, Belgium, China and France (Tabs. 1, 2). Recently, total imports of ***talc*** and ***steatite*** to Poland ranged from 25,900 to 28,300 tpy, with the exception of significant drop to 18,400 t in 2009 (Tab. 1). Small re-exports were also reported, mostly to Ukraine, Belarus, Romania, Estonia, the Czech Republic, Lithuania, Hungary and Germany (Tab. 1). The trade balance in these commodities was consistently negative. As a result of changes in volume of supplies, deficit deepened from 27 million PLN in 2008 to over 37 million PLN in 2012 (Tab. 3).

Tab. 1. Talc and steatite statistics in Poland — CN 2526

'000 t

Year	2008	2009	2010	2011	2012
Imports	28.3	18.4	25.9	26.1	27.4
Exports	0.8	0.8	0.8	0.7	0.8
Consumption[a]	27.5	17.6	25.1	25.4	26.6

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Polish imports of talc and steatite, by country — CN 2526

'000 t

Year	2008	2009	2010	2011	2012
Imports	**28.3**	**18.4**	**25.9**	**26.1**	**27.4**
Austria	8.2	3.2	3.2	4.4	5.8
Belgium	1.6	1.3	1.7	2.7	2.6
China	1.7	1.4	2.0	2.9	1.6
Finland	10.6	6.2	9.0	8.8	7.3
France	0.8	1.0	2.1	1.6	1.6
Germany	1.2	1.0	1.0	1.1	1.0
Italy	0.9	2.6	3.0	2.6	3.0
Netherlands	1.9	0.3	2.9	1.2	2.7
Slovakia	1.0	1.1	0.8	0.6	1.0
Others	0.4	0.3	0.2	0.2	0.8

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Value of talc and steatite trade in Poland — CN 2526

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	1,448	1,718	1,864	2,992	1,756
Imports	28,396	26,710	34,930	36,137	38,538
Balance	**-26,948**	**-24,992**	**-33,066**	**-33,145**	**-36,782**

Source: ***The Central Statistical Office (GUS)***

The average unit values of ***talc*** and ***related raw materials*** imports, varied between 431 and 474 USD/t in the recent years (tab. 4). They varied depending on changing prices for Finnish and Austrian talc in general. The average unit values of talc from Finland ranged from 458 to 492 USD/t, whereas the Austrian ones (from **Naintsch Mineralwerke GmbH** ¾ part of **Luzenac Group**) changed between 213 and 294 USD/t.

Tab. 4. Unit value of imports of talc and steatite to Poland — CN 2526

Year	2008	2009	2010	2011	2012
PLN/t	1,001.9	1,451.2	1,346.2	1,382.3	1,407.3
USD/t	424.5	473.9	446.5	472.4	430.9

Source: ***The Central Statistical Office (GUS)***

Consumption

The structure of domestic demand for ***talc*** and related materials is not known. Major markets for the highest quality grades of these commodities are paper, ceramics, pharmaceutical, cosmetics, and plastic industries, whereas the lower grades are utilised in the production of paints, rubber (e.g. milled Slovakian talc), and roofing materials. The most important consumer of imported from Austria talc is ceramics (mainly ceramic tiles industry). **Ground steatite** is utilized for example in electrotechnics ceramics (insulator) and **steatite slabs** are used for fireplace facing. The distributor of Finnish talc to Poland has been **Omya Co.** from Warszawa. The apparent consumption of ***talc*** and related materials ranges from 25,100 tpy to ca. 27,500 tpy in the years 2008–2012, with the exception of 2009, when it dropped to 17,600 t (Tab. 1).

TANTALUM

Overview

The basic sources of **tantalum** (**Ta**) are ***tantalum ore*** (Nb:Ta ratio 0.3–5), ***tantalum-niobium ore*** (5–20), and ***niobium ore*** (over 20), occurring in albitite, pegmatite, and placer-type deposits. **Tantalite concentrates**, containing 60–65% Nb_2O_5+Ta_2O_5, require complicated chemical and metallurgical processing in order to obtain **tantalum metal**. Another source for direct tantalum recovery is ***tantalum-bearing tin slag***.

Tantalum is utilized mostly in the production of electronic components (tantalum capacitors) and in space technology, telecommunications, transport, and armaments (aircraft, missiles, radio communications).

Sources

There are no deposits of ***tantalum ore*** in Poland.

Production

There is no production of ***tantalum commodities*** in Poland. ***Tantalum*** has occasionally been recovered from secondary materials by the former **Unitra-Cemat Co.** in **Skawina**.

Trade

Domestic demand for ***tantalum commodities*** is met by highly variable imports (Tab. 1). ***Tantalum metal***, ***powders***, ***scrap***, ***wastes*** and ***tantalum products*** have been imported basically from Germany and Austria, and - most recently - from China, EU countries and the US. Re-exports of ***tantalum products***, ***scrap***, and ***wastes***, most frequently to Germany, United Kingdom and Russia, have been also noted. The balance of ***tantalum commodities*** trade reflects the type and quality of material traded. The value has been negative in the years 2008–2012, except for 2010 when large value of re-exported ***tantalum scrap*** caused that the trade balance became positive (Tab. 2). The unit values of tantalum commodities imports to Poland depend on imports volume and prices on international markets, especially for 2012 (Tab. 3) .

Consumption

The demand for ***tantalum commodities*** in Poland is not known. ***Tantalum*** is used in the production of high-speed steel, parts resistant to high temperature and chemicals (primarily in electronics), and surgical instruments.

Tab. 1. Tantalum commodities statistics in Poland — CN 8103

kg

Year	2008	2009	2010	2011	2012
Imports	5,455	1,049	2,793	1,688	258
Exports	18	–	703	42	35
Consumption[a]	5,437	1,049	2,090	1,646	223

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of tantalum commodities trade in Poland — CN 8103

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	0	–	247	41	36
Imports	157	92	139	216	189
Balance	**-157**	**-92**	**+108**	**-175**	**-153**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of tantalum commodities imports to Poland — CN 8103

Year	2008	2009	2010	2011	2012
PLN/kg	29	88	50	128	733
USD/kg	12	28	16	44	224

Source: ***The Central Statistical Office (GUS)***

TELLURIUM

Overview

Tellurium (**Te**) is among the elements that occur in the lithosphere in the lowest concentrations. The several dozen tellurium minerals do not form their own deposits. Tellurium also occurs as an admixture in many minerals, especially in ***copper*** and ***lead ores*** and some ***silver*** and ***gold ores***. It is obtained from ***copper anode slime*** (2–8%, average 3% Te), and to a lesser extent from ***lead*** electrometallurgy. The production of **pure tellurium** requires hydrometallurgical operations and the distillation or zone melting of **raw tellurium**. The production of tellurium from secondary sources is negligible.

The first commercial application of **tellurium** was as a rubber curing agent (after the Second World War). Nowadays, 50% of the world supply of this metal is consumed by the steel-making industry.

Sources

Poland has no prospects for the discovery of ***tellurium-bearing ore*** deposits. Some ***tellurium*** concentrations occur in ***copper ore*** deposits of the **Fore-Sudetic Monocline**.

Production

Tellurium is not recovered from ***anode slimes*** (the remainder after the electrolytic refining of ***copper***) in Poland.

Trade

Domestic demand for ***tellurium*** is satisfied by very variable imports (Tab. 1), on irregular basis, mainly from Belgium and other European countries, and partially from China, the US, and Japan (Tab. 1).

The balance of ***tellurium*** trade has always been negative, and it highest value were recorded in period 2010–2011 as an effect of increased imports volume (Tab. 2). The variable unit values of tellurium imports to Poland depend mainly on its quantity, but in recent years mainly on international prices, especially for 2011 (Tab. 3).

Consumption

The structure of ***tellurium*** consumption in Poland is unknown. Most likely it is used mainly for alloying steels and non-ferrous metal alloys.

Tab. 1. Tellurium statistics in Poland — CN 2804 50 90

kg Te

Year	2008	2009	2010	2011	2012
Imports = Consumption[a]	**1,055**	**907**	**2,260**	**1,646**	**1,514**
Belgium	301	405	806	301	456
China	6	10	5	8	319
Denmark	–	–	–	–	98
France	1	–	–	–	–
Germany	300	292	369	424	318
Japan	1	1	–	–	–
Netherlands	–	199	738	392	–
United Kingdom	446	–	325	520	–
USA	–	–	17	1	323

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of tellurium trade in Poland — CN 2804 50 90

'000 PLN

Year	2008	2009	2010	2011	2012
Imports = **Balance**	**-541**	**-524**	**-1,461**	**-1,806**	**-946**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit value of tellurium imports to Poland — CN 2804 50 90

Year	2008	2009	2010	2011	2012
PLN/kg	513	578	646	1,097	625
USD/kg	224	183	220	388	190

Source: ***The Central Statistical Office (GUS)***

THALLIUM

Overview

Thallium (**Tl**) is dispersed in a significant number of sulfides and other minerals in ***zinc***, ***lead ore***, and ***pyrite*** deposits. Thallium, as **thallium hydroxide**, is hydrometallurgically extracted from ***dust*** and other ***waste materials*** obtained during the processing of ***Zn***, ***Pb***, and ***Cu ores***.

Thallium was used for the first time in medicine in 1896, but its commercial application began in 1925, after its toxicity to rodents was discovered. Nowadays, the most promising uses of thallium are in superconductivity (***Tl-Cu oxide***) and laser techniques based on X-ray radiation emitted by excited thallium atoms, a non-invasive technology for obtaining three-dimensional pictures of parts of living cells.

Sources

Thallium occurs in the ***zinc*** and ***lead ore*** deposits in the **Silesia-Cracow** region, in amounts of 0.02–0.1% Tl. The resources of thallium were estimated at 11,410 t Tl (as of 31 December 2008). In the years of 2009–2012 these resources were not reported in the Polish Mineral Resources Datafile.

Production

Thallium production was abandoned in 1988 and to date has not been recommenced.

Trade

The domestic demand is satisfied by importing of ***thallium-bearing materials*** and ***end-products***. Imports of ***thallium unwrought*** and ***powders*** in 2009 and in 2010 was not recorded by the Central Statistical Office, while in 2008 it amounted to 1 kg, coming from the US. In years of 2011–201 2 imports amounted to 1 kgpy coming only from Switzerland. The value of imports in these years was not exceeding 2,300 PLN per year. In the years 2008–2012 there was no trade in ***thallium waste materials and scrap***. In case of ***other thallium products*** imports were not recorded in 2010, but in 2008 they amounted to 1,230 kg, valued 115,398 PLN (51,421 USD), coming mainly from China and the United Kingdom. In 2009 these imports decreased to only 3 kg valued 2,200 PLN (795 USD) and the sole source were the US. In the years of 2011–2012 the sole supplier were Germany, and the imports amounted to 14 kg valued 10,305 PLN (3,248 USD) in 2011 and 30 kg valued 20,744 PLN (6,433 USD) in 2012. Exports of thallium commodities occurred in 2010, when 7 kg valued 73,192 PLN were directed to the US, and in 2011, when they amounted to less than 1 kg valued 3,269 PLN and being directed to Switzerland and the US.

Consumption

No data about the structure of ***thallium*** consumption in Poland are available.

THORIUM

Overview

Thorium (**Th**) forms many minerals, but individual deposits are unknown. The main sources of thorium are ***thorium-bearing monazite*** concentrates and ***zircon*** concentrates; occasionally other minerals occur in ***pegmatite*** deposits.

Thorium is a radioactive element (isotope Th^{232}); however, only a small percentage of the supply is utilized as nuclear reactor fuel.

Sources

There are ***thorium minerals*** concentrations at **Bogatynia**, **Szklarska Poręba**, and **Wołowa Góra** (West Sudety Mountains), as well as **Różanka** (Kłodzko Valley), but they are of no economic value.

Production

Thorium is not recovered in Poland.

Trade

Thorium and ***thorium compounds*** and ***alloys*** were occasionally imported until 1998 mainly from Canada. In the period 1998–2012, there were no imports at all. In recent years there was recorded regular imports of ***thorium products*** (bars, rods, tapes, sheets, etc.), which amounted to record volume of 739.5 t in 2008 and in the years 2009–2010 dropped to ca. 8.3 t in 2010. In 2011 imports sharply increased to 154.3 t, but in 2012 decreased to 91.9 t (Tab. 1). The regular supplier in the years of 2008–2011 were Germany, and other imports sources were Western Europe countries such Belgium, Finland, France, and Sweden. In 2011 there were imports from the US but in 2012 imports from Germany disappeared and deliveries were coming from Hungary, Switzerland, China and Republic of South Korea. Moreover, in the last five years variable amounts were also exported (Tab. 1). In period 2008–2010 main receivers were the Netherlands and Germany, but in 2011 the purchasers were Lithuania and Ukraine, and in 2012 exports were directed to the Netherlands and Denmark.

The trade balance of ***thorium products*** has always been negative, and had a decreasing tendency in the years of 2008–2010, but after sharp increase in 2011 improved again in 2012 (Tab. 2), depending on the quantity of imports and market price, influencing the unit values of imports. It was particularly evident in 2010, when the lowest volume of imports met the highest unit value of imports of thorium products (Tab. 1 and 3).

Tab. 1. Thorium products statistics in Poland — CN 2844 30 61

t

Year	2008	2009	2010	2011	2012
Imports	739.5	89.8	8.3	154.3	91.9
Exports	9.6	0.0	–	4.6	0.4
Consumption[a]	729.9	89.8	8.3	149.7	91.5

Source: ***The Central Statistical Office (GUS)***

Tab. 2. Value of thorium products trade in Poland — CN 2844 30 61

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	42	0	–	15	13
Imports	1,815	324	227	1,244	875
Balance	**-1,773**	**-324**	**-227**	**-1,229**	**-863**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of thorium products imports to Poland — CN 2844 30 61

Year	2008	2009	2010	2011	2012
PLN/kg	2.4	3.6	27.5	8.1	9.5
USD/kg	1.1	1.2	9.1	2.7	2.9

Source: ***The Central Statistical Office (GUS)***

Consumption

Thorium products are used in Poland (lack of data) in the production of highly fire-resistant and robust materials.

TIN

Overview

Tin (**Sn**) forms a large number of minerals, but only ***cassiterite*** SnO_2 is of commercial importance. It forms individual primary deposits of the vein, stockwerk, graisene or porphyry types, but secondary deposits — alluvial and beach placers — are more important. A significant amount of **tin metal** is also obtained from secondary sources.

Tin metal is utilized for the production of alloys with copper, lead, and other metals, as well as for solders, and chemicals. The most common end-uses include tinning steel plates (for canned goods, soft drinks, etc.) and solders for the electronics.

Sources

The resources of ***tin ore*** in Poland, recognized in two deposits, i.e. **Gierczyn** and **Krobica** in the Izerskie Mts. (4.6 Mt with ave. 0.5% of Sn), have been re-classified into non-economic due to the poor quality of the ore and their small size. Actually, they have been cancelled from the mineral resources datafile. However, there are prospective resources of tin ore in the **Stara Kamienica shale range** (**Western Sudetes**) that are estimated at 20 Mt with ca. 100,000 t of metallic Sn.

Production

Primary tin has not been produced in Poland. ***Secondary tin 99.9%*** has been obtained at the recycling plant opened in 2004 by the **Fenix Metals Ltd**. in Tarnobrzeg. The company was formed in 2003 as a joint venture between **Dan Engineering** of Denmark and **Stoop** of Belgium. ***Pure tin*** has been recovered from almost any combination of tin-lead containing residues (even with as low as 15% Sn and a balance of Pb, Sb and Bi) by the use of a smelting short rotary furnace (commissioned in 2005) and a electric vacuum distillation furnace added in 2008 (the capacity of 3,500 tpy of metal). The business of **Fenix Metals** has been basically a combination of tin material recycling and manufacturing of ***solder products*** (including ***lead-free Sn-Cu soldering alloys***) and ***pure tin*** (min. 99.9% Sn) as well as other ***alloys*** (e.g. ***Sn-Sb-Pb***, ***Sn-Bi-Pb***, ***Sn-Cu-Co - Fenix100***, ***white metals***, and ***jewellery alloys***) in a form of ingots, bars, and sticks. In the years 2008-2012 the total production of ***secondary tin*** and ***tin-based alloys*** at the plant ranged from 2,600 to 3,200 tpy (including 300-1,300 tpy of Sn). **Fenix Metals** has now become a fully integrated tin business and a pre-eminent supplier of tin solder alloys to the European market.

Trade

From among ***tin commodities*** imported to Poland, the most important have been: ***tin metal*** (including ingots and other shapes of remelted tin waste and scrap) (Tab. 1), ***tin scrap and waste*** (3,037 t and 3,688 t in 2011-2012 respectively, basically from the Netherlands, Belgium, the UK, and Germany) for the needs of **Fenix Metals**, and ***tin alloys*** (39 and 296 t in 2011-2012, mainly from Germany, and Italy). In the last five years the importation of ***tin metal*** ranged between 1,200 and 1,800 tpy, showing generally a declining tendency (Tab. 1). Recently its principal suppliers have been Indonesia, Belgium, and the Netherlands. Some amounts of tin commodities have been also exported, including ***tin metal*** sold basically to Poland's neighbouring countries such as Belarus, Ukraine and Slovakia (Tab. 1).

Tab. 1. Tin statistics in Poland — CN 8001 10

t Sn

Year	2008	2009	2010	2011	2012
Imports	**1,814**	**1,591**	**1,281**	**1,517**	**1,229**
Belgium	18	5	45	199	265
Bolivia	–	20	–	–	30
Brazil	–	265	50	–	–
China	48	40	–	110	31
Czech Republic	–	–	30	–	–
Finland	27	–	24	–	–
France	10	11	15	13	15
Germany	34	557	8	72	141
Indonesia	271	33	410	287	271
Italy	–	–	6	4	4
Luxembourg	–	–	–	42	–
Malaysia	65	–	5	48	40
Netherlands	237	481	67	98	201
Peru	70	–	20	–	20
Portugal	–	–	–	3	–
Russia	–	–	1	–	–
Singapore	232	–	–	–	–
Slovakia	48	24	–	1	–
Spain	–	5	–	6	–
Thailand	77	–	–	45	20
United Kingdom	677	120	580	590	192
Vietnam	–	30	20	–	–
Exports	**259**	**251**	**404**	**529**	**512**
Consumption[a]	**1,555**	**1,340**	**877**	**988**	**717**

Source: ***The Central Statistical Office (GUS)***

In the years 2008-2012 the deficit in ***tin*** trade balance varied in a wide range between 47 and 72 million PLN per annum (Tab. 2). It was generally matched with LME prices of tin.

Tab. 2. Value of tin trade in Poland — CN 8001 10

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	12,055	11,243	25,553	41,814	37,535
Imports	75,415	58,607	75,871	113,451	88,094
Balance	**-63,360**	**-47,364**	**-50,318**	**-71,637**	**-50,559**

Source: ***The Central Statistical Office (GUS)***

The unit values of ***tin*** imported to Poland followed the changes in tin metal quotations at the **LME**. In 2009 they dropped by around 36% of 2008 as a consequence of international prices reduction. In the following years, however, in response to higher quotations, the unit costs of tin importation significantly improved (Tab. 3).

Tab. 3. The unit value of tin imports to Poland — CN 8001 10

Year	2008	2009	2010	2011	2012
PLN/t	41,571	36,838	59,228	74,786	71,656
USD/t	18,084	11,532	19,756	25,681	21,947

Source: ***The Central Statistical Office (GUS)***

Consumption

In Poland ***tin*** is utilized for the production of ***wire***, ***bars***, ***solders***, and a variety of alloys, e.g. ***bearing alloys***, ***printer's alloys***, and ***low-melting alloys*** (produced by the **Hutmen** of Wrocław, among others), ***solders*** (**Fenix Metals** of Tarnobrzeg, **PPHU Cynlut** of Radom and **Cynel Unipress Ltd.** of Warsaw), as well as for various ***bronzes*** and ***bronze products*** (manufactured by **Łabędy Metals Mill**, and the **Non-Ferrous Metals Institute** in **Gliwice**), and ***chemicals***.

Traditional end-uses of ***tin*** and ***tin alloys*** include: radiator manufacturing (for the automobile industry), soldering of lead roofs, whitemetal for the railways, coating of copper wire, electroplating (cans and containers). Among the most important consumers has become the electronic industry (soldering), as well as the float glass sector (in the process of flat glass manufacturing the molten glass is floated over molten tin). The detailed domestic consumption pattern of tin is unknown.

Companies involved in tin commodities production in Poland as of December 2012

- Fenix Metals Ltd., Zakładowa 50, 39–400 Tarnobrzeg, tel. +48 15 8229636, fax +48 15 8229671, www.fenixmetals.com — *secondary tin, tin-based soldering alloys*.

TITANIUM

Overview

Titanium (**Ti**) is one of the most common elements in the lithosphere and occurs in many minerals. The main source of titanium minerals is placer deposits of ***beach sand***, containing ***ilmenite*** $FeTiO_3$ and ***rutile*** TiO_2. Magmatic deposits of ***ilmenite***, ***titanium magnetite***, and ***titanium hematite*** are also important. The ore from such deposits is processed into **titanium-bearing slag** (**Sorel slag**) or directly into **synthetic rutile**. Other titanium minerals, i.e. ***anatase*** TiO_2 and ***leucoxene*** (hydrated and oxidized ilmenite) are of marginal importance. They are produced only in Brazil (anatase) and Australia (leucoxene).

Titanium has been used as a steel additive since the beginning of the twentieth century. Later, it came to be widely used as a matrix or additive for the non-ferrous metal alloys especially needed by the aircraft and aerospace industries. It is therefore considered a strategic metal. In the late 1920s, after the introduction of **titanium white** (artificial titanium oxide, TiO_2), which is chemically stable and has high covering power, the market for titanium was considerably expanded. Currently, titanium white supplies 50–60% of the needs of such industries as paint and varnish or paper-making, replacing the formerly used zinc and barium white pigments. Over 90% of titanium mineral commodities are used for this purpose.

Sources

Resources of ***titanium minerals*** and other heavy minerals have been found in the **Ławica Odrzańska** and **Ławica Słupska** sandbanks. The investigated resources of titanium minerals there amount to 12,000 t.

Production

Titanium ore is not mined in Poland.

Trade

The demand for ***titanium minerals*** is satisfied by imports of ***ilmenite concentrates***. Their main supplier was Norway's company **Titania AS**, which sign a long-term contract with the **Police Chemical Plant** the sole Polish producer of ***titanium white***. Smaller amounts of ***ilmenite concentrates*** came primarily from Ukraine and the Czech Republic and in 2012 also from China (Tab. 1). Imports of ***titanium metal*** and ***titanium powder*** was at the level of ca. 40 tpy in the years 2008–2009, but afterwards it sharply increased to ca. 1,800 t in 2011 and dropped again to 55 t in 2012 (Tab. 1). The main suppliers were Germany, the Netherlands, China as well as Belgium and Spain in the recent years. Imports of ***titanium alloys***, mostly ***ferrotitanium***, and ***ferrosilicotitanium***, were reported at the level of 100–300 tpy (Tab. 1), and the main suppliers were the Germany, Russia, United Kingdom, and the Netherlands.

Tab. 1. Titanium commodities statistics in Poland, by country

Year	2008	2009	2010	2011	2012
Titanium ores and concentrates CN 2614 00 ['000 t]					
Imports	**91.2**	**84.4**	**105.4**	**99.1**	**84.1**
Australia	–	–	–	0.1	0.0
China	–	–	–	–	1.1
Czech Republic	0.6	0.5	0.4	0.5	0.6
Norway	88.7	82.7	103.2	97.6	81.0
Ukraine	1.9	1.2	1.2	0.7	1.2
Others	0.0	0.0	0.6	0.2	0.2
Exports	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**
Consumption[a]	**91.2**	**84.4**	**105.4**	**99.0**	**84.1**
Ferrotitanium and ferrosilicotitanium CN 7202 91 [t]					
Imports	**199**	**113**	**180**	**197**	**289**
Brazil	–	–	–	5	–
China	7	22	–	–	–
Estonia	7	–	–	–	–
France	–	–	–	2	16
Germany	22	0	1	31	136
Luxembourg	–	–	–	–	6
Netherlands	11	4	10	31	–
Russia	62	23	93	69	80
Spain	–	–	–	–	2
Tadjikistan	–	–	–	7	–
Ukraine	–	5	–	–	1
United Kingdom	82	59	67	52	48
Others	8	0	9	0	0
Exports	**96**	**15**	**6**	**7**	**19**
Consumption[a]	**103**	**98**	**174**	**190**	**270**
Titanium[1] **CN 8108 20 [t]**					
Imports	**41**	**36**	**288**	**1768**	**55**
Belgium	–	–	–	–	24

China	–	–	280	1740	0
Germany	23	6	1	0	12
Netherlands	10	1	4	17	4
Spain	–	–	–	11	15
Ukraine	–	20	–	–	
United Kingdom	7	9	0	0	0
Others	1	0	3	0	0
Exports	**0**	**34**	**0**	–	**1**
Consumption[a]	**41**	**2**	**288**	**1768**	**54**

[1] together with titanium powder

Source: ***The Central Statistical Office (GUS)***

The trade balance in ***titanium concentrates***, ***titanium metal***, ***scrap***, ***waste***, ***powders***, and ***ferrotitanium*** in recent five years has always been negative (Tab. 2). Deficit varied between 50 and 200 million PLN/y, depending mostly on volume of ***titanium ore*** and ***concentrates*** supplies. The unit values of titanium commodities imports to Poland depended on their volume and the market price (Tab. 3). Recently, the average imports unit values of ***titanium ore*** and ***concentrate*** remained at a relatively stable level in the years 2008–2011, but they increased more than twice in 2012. The average imports unit values of ***ferrotitanium*** and ***titanium metal*** varied between 5,000 and 6,000 USD/t.

Tab. 2. Value of titanium commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Titanium ores and concentrates CN 2614 00					
Exports	40	24	1	394	380
Imports	46,140	49,719	63,961	74,248	149,337
Balance	**-46,100**	**-49,695**	**-63,960**	**-73,854**	**-148,957**
Ferrotitanium and ferrosilicotitanium CN 7202 91					
Exports	645	167	87	78	311
Imports	2,728	923	2,601	3,395	5,512
Balance	**-2,083**	**-756**	**-2,514**	**-3,317**	**-5,201**
Titanium[1] CN 8108 20					
Exports	1	435	9	0	15
Imports	1,044	520	2,101	15,486	1,024
Balance	**-1,043**	**-85**	**-2,092**	**-15,486**	**-1,009**

[1] together with titanium powder

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of titanium commodities imports to Poland

Year	2008	2009	2010	2011	2012
Titanium ores and concentrates CN 2614 00					
PLN/t	506	589	607	750	1,775
USD/t	209	188	201	254	545
Ferrotitanium and ferrosilicotitanium CN 7202 91					
PLN/t	13,733	8,185	14,450	17,267	19,046
USD/t	5,978	2,659	4,815	5,915	5,765
Titanium[1] CN 8108 20					
PLN/t	25,460	14,547	7,288	8,759	18,718
USD/t	10,844	4,954	2,518	3,134	5,733

[1] together with titanium powder

Source: ***The Central Statistical Office (GUS)***

Consumption

Ilmenite and ***rutile concentrates*** are processed to ***titanium white*** at the **Police Chemical Plant** by sulphate method. The annual production capacity of this plant is ca. 40,000 tpy, but there are expansion plans to increase capacity up to 65,000 tpy. Recently, the ***titanium white*** production was at the level of 36,400–41,700 tpy (Tab. 4). The titanium white as a pigment (currently above dozen rutile and anatase grades) is consumed mainly in paint and varnish industry (for building and automotive industry), and also in paper (the largest domestic consumer of titanium white for the paper production purposes is **Malta–Cekor S.A.**), plastics, rubber, textile, ceramic, cement, cosmetic and pharmaceutical industry. Moreover, the **Police Chemical Plant** is planning to build installation for the production of **nanophotocatalyst TiO_2** (they can be utilized in water and liquid wastes purification, and in disposal of hazardous substances).

Tab. 4. Titanium white statistics in Poland — CN 2823 00

'000 t

Year	2008	2009	2010	2011	2012
Production	40.4	36.4	41.7	39.4	39.8
Imports	1.3	0.7	1.3	0.9	0.7
Exports	0.1	0.0	0.2	0.0	0.0
Consumption[a]	41.6	37.1	42.8	40.3	40.5

Source: ***The Central Statistical Office (GUS)***

In the years 2008–2012, imports of ***titanium white*** fluctuated between 700 and 1,300 tpy (Tab. 5). The main suppliers were Germany, Finland, China, Belgium, France, and Italy (Tab. 5).

Tab. 5. Polish imports of titanium white — CN 2823 00

t

Year	2008	2009	2010	2011	2012
Import	**1,292**	**699**	**1,277**	**937**	**712**
Belgium	1	48	115	91	105
China	111	46	281	274	139
Czech Republic	82	74	97	0	0
Finland	219	221	242	273	142
France	27	34	52	33	104
Germany	297	167	176	183	146
Italy	419	32	194	36	35
Japan	23	26	20	1	8
Netherlands	–	23	–	0	–
Spain	24	14	11	6	1
Switzerland	–	–	–	–	6
Ukraine	20	–	40	20	–
United Kingdom	63	9	3	10	–
USA	6	5	33	8	25
Others	0	0	13	2	1

Source: ***The Central Statistical Office (GUS)***

The trade balance of ***titanium white*** was negative and the deficit remained at the level 9–11 million PLN in recent years (Tab. 6). The unit values of imported to Poland ***titanium white*** varied between 3,000–5,000 USD/t (Tab. 7).

Tab. 6. Value of titanium white trade in Poland — CN 2823 00

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	402	200	1,675	385	269
Imports	11,150	9,781	12,768	10,328	10,417
Balance	**-10,748**	**-9,581**	**-11,093**	**-9,943**	**-10,148**

Source: ***The Central Statistical Office (GUS)***

Tab. 7. Unit value of titanium white imports to Poland — CN 2823 00

Year	2008	2009	2010	2011	2012
PLN/t	8,621	13,988	10,434	11,016	14,622
USD/t	3,576	4,520	3,321	3,795	4,465

Source: ***The Central Statistical Office (GUS)***

No information is available on the utilization of ***titanium metal*** and ***titanium alloys*** (with Fe, Al, Cr, Mn, etc.). Titanium alloys are valuable construction materials, used by the shipyard, aerospace, electrotechnical, steel and tool-making industries, among others.

Companies involved in titanium materials production in Poland, as of December 2012

- Zakłady Chemiczne “Police” S.A. w Policach (“Police” Chemical Plant Stock Co. of Police), ul. Kuźnicka 1, 72–010 Police, tel. +48 91 3171717, fax +48 91 3173603, www.zchpolice.pl — *titanium white.*

TUNGSTEN

Overview

The primary commodities of **tungsten** (**W**) are mostly obtained from individual deposits of ***scheelite*** and ***wolframite ore***, or from ***complex ore*** of ***W***, ***Sn***, ***Mo***, ***Cu***, and ***Bi***. **Scheelite** and **wolframite concentrates** are transformed into **ammonium paratungstate** (**APT**), currently the main tungsten market commodity, and then processed into **tungsten powder** for metallurgical purposes, and into chemical compounds for the chemical industry. The concentrates can be directly transformed into **ferrotungsten**, whereas **tungsten powder** can be processed into **tungsten carbide**.

Tungsten is characterized by the highest melting point (3,410°C) among metals, as well as by its high density, good corrosion resistance, good thermal and electrical conductivity, and low expansion coefficient, so it is an important component of cutting and wear-resistant steel. **Tungsten carbide**, whose hardness is comparable to that of diamond, is used mainly to produce the highest quality abrasives.

Sources

Poland has one porphyry-type deposit of ***molybdenum ore*** with ***tungsten*** and ***copper***, located near **Myszków**. The resources of the deposit amounted to 550.8 Mt of ore containing 238,000 t *W* (as of 31 December 2012). The deposit has a form of stockwerk with sulfides-oxides veins, connected with granitoid magmatism of Variscian age. The deposit is currently undeveloped.

Production

There is no production of ***tungsten ore*** or ***concentrates*** in Poland. ***Tungsten powder*** and ***alloys***, ***tungsten carbide***, and other products are manufactured on the basis of imported concentrates (see: **Consumption**).

Trade

The demand for tungsten commodities is satisfied by imports (Tab. 1). Recently ***scheelite*** and ***wolframite concentrates*** have apparently been replaced by ***ammonium paratungstate*** (***APT***), which is counted as a concentrate in the statistical reports of the **Central Statistical Office** (item **CN 2611**). Its imports volumes are irregular and marginal in recent years (Tab. 1). Moreover, in 2011 there were recorded huge re-exports, which amounted to almost 314 t and the principal buyer were the Netherlands (Tab. 1).

Tab. 1. Tungsten commodities statistics in Poland

t

Year	2008	2009	2010	2011	2012
Tungsten ores and concentrates CN 2611					
Imports	**0.0**	**0.0**	**–**	**0.0**	**–**
Germany	0.0	0.0	–	–	–
USA	–	–	–	0.0	–
Exports	**–**	**–**	**–**	**313.8**	**–**
Netherlands	–	–	–	313.8	–
USA	–	–	–	0.0	–
Consumption[a]	**0.0**	**0.0**	**–**	**-313.8**	**–**
Tungsten powder and metal CN 8101 10, 8101 94					
Imports	**17.1**	**10.3**	**35.8**	**30.1**	**4.2**
Austria	0.6	0.2	0.3	0.4	0.3
China	0.1	0.0	0.4	0.3	0.3
Czech Republic	11.3	1.3	26.5	26.4	0.3
Germany	1.4	4.1	8.4	1.9	1.4
Italy	0.1	0.0	0.0	0.7	1.2
Netherlands	0.0	0.6	0.1	0.1	0.1
United Kingdom	3.5	4.1	0.0	0.3	0.1
USA	0.1	0.0	0.1	0.0	0.4
Other	0.0	0.0	0.0	0.0	0.1
Exports	**2.1**	–	**0.0**	**2.1**	**0.1**
Czech Republic	0.0	–	–	1.0	0.0
Germany	2.1	–	–	0.7	–
Latvia	–	–	–	0.1	–
Netherlands	–	–	–	0.2	–
Sweden	–	–	0.0	0.1	–
Consumption[a]	**15.0**	**10.3**	**35.8**	**28.0**	**4.1**
Ferrotungsten CN 7202 80					
Imports	**22.0**	**8.5**	**10.0**	**11.8**	**9.8**
Belgium	–	1.0	2.0	–	–
China	8.5	3.0	2.5	5.7	7.4
Germany	2.5	1.0	0.3	1.4	0.1
Netherlands	1.5	–	0.2	1.5	1.5
Romania	0.5	–	–	–	–
South Africa, Republic of	1.0	–	–	–	–
Spain	2.0	–	1.0	1.0	–
United Kingdom	6.0	2.5	–	1.0	–

USA	0.0	0.0	0.0	0.1	0.1
Vietnam	–	1.0	4.0	1.0	0.7
Exports	**132.2**	**–**	**1.2**	**0.5**	**2.6**
Czech Republic	–	–	–	–	0.2
Germany	–	–	0.5	0.3	0.9
Hungary	–	–	–	0.2	–
Slovakia	10.2	–	0.5	–	0.5
Sweden	122.0	–	–	–	–
Ukraine	–	–	–	–	1.0
United Kingdom	–	–	0.2	–	–
Consumption[a]	**-110.2**	**8.5**	**8.8**	**11.3**	**7.2**

Source: ***The Central Statistical Office (GUS)***

Tungsten powder and ***metal*** are imported mostly from the Czech Republic, other European countries, China and the US. Irregular and variable exports of lower grades of ***tungsten powder*** and ***metal*** have also been noted (Tab. 1). ***Ferrotungsten*** is imported in varying amounts (Tab. 1). In 2008, its exports (from overstocks) amounted to 132 t, and its volume exceeded imports, so apparent consumption volume was negative (Tab. 1). The main purchasers in recent years were the Sweden and Slovakia in 2008, but in next four years main buyers were Germany, Slovakia, the Czech Republic, and Ukraine. Ferrotungsten were purchased in the last years mainly from China, Germany, the Netherlands, and United Kingdom (Tab. 1).

The trade balance in ***ferrotungsten*** has been consistently negative in the years 2009–2012, depending on the volume of imports and market price, but in 2008 due to high re-exports volume the trade balance was positive and reached ca. 7.4 million PLN (Tab. 2). The trade balance in ***tungsten concentrates***, as well as in ***tungsten powder*** and ***metal***, had a varying negative value in the recent years, except for 2011 in case of ores and concentrates, when huge re-exports occurred (Tab. 2). The unit values of the imported commodities are much higher than those exported (Tabs. 2 and 3).

Tab. 2. Value of tungsten commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Tungsten ores and concentrates CN 2611					
Exports	–	–	–	413	–
Imports	4	2	–	4	–
Balance	**-4**	**-2**	**–**	**+409**	**–**
Tungsten powder and metal CN 8101 10, 8101 94					
Exports	68	–	5	261	16
Imports	2,972	2,200	4,373	6,100	2,031
Balance	**-2,904**	**-2,200**	**-4,368**	**-5,839**	**-2,015**

Ferrotungsten **CN 7202 80**					
Exports	8,794	–	59	25	215
Imports	1,430	574	730	1,180	1,131
Balance	**+7,364**	**-574**	**-671**	**-1,155**	**-916**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of tungsten commodities imports to Poland

Year	2008	2009	2010	2011	2012
Tungsten ores and concentrates **CN 2611**					
PLN/t	307,692	333,333	–	71,900	–
USD/t	136,538	115,333	–	24,940	–
Tungsten powder and metal **CN 8101 10, 8101 94**					
PLN/t	173,801	213,592	122,240	125,018	483,180
USD/t	74,139	68,702	40,069	44,017	147,502
Ferrotungsten **CN 7202 80**					
PLN/t	65,000	67,529	72,751	100,346	114,964
USD/t	27,358	21,512	24,591	33,171	35,723

Source: ***The Central Statistical Office (GUS)***

Consumption

Imported marginal amounts od tungsten concentrates, mainly ***APT***, are processed into ***tungsten carbide*** and ***sintered carbides*** at the **Institute of Machining** in **Krakow** for the production of special steel and tool steel. They are also used to produce ***tungsten powder*** and ***tungsten products***. Information on production volumes is not available. In the last period, the **Polam-Warszawa High-Melting Metal Smelter** has produced ***welding electrodes*** (made of tungsten and tungsten-lanthanum) and ***tungsten products*** (wires for lightning industry, heaters used for coating surfaces with a thin film of metals, powders, sheets, sections, rods). The production of ***tungsten products*** (excluding scrap and wastes) recorded by the Central Statistical Office amounted to 5,486 kg in 2008, 8,153 kg in 2009, 4,550 kg in 2010, 6,494 kg in 2011 and only 2,340 kg in 2012.

The ***ferrotungsten*** is mainly consumed in the steel and cast iron industry for the production of special steel and tool steel. The apparent consumption has varied in the last years depending on the trade volume and economic condition of domestic steelmaking industry.

URANIUM

Overview

Uranium (**U**) forms many minerals, and occurs in others as an isomorphic element. A number of ***uranium-bearing minerals*** occur in pleiad in individual ***uranium ore deposits***, and in ***phosphates***, for example, from which they are recovered as by-products (see: **PHOSPHATES**).

The career of **uranium** as a strategic element began in 1939, after the first nuclear reaction was carried out. Since the 1960s, uranium has been an important raw fuel for nuclear reactors in power plants.

Sources

In Poland, ***uranium minerals*** occur in many places: in crystalline and metamorphic rock in the Sudety Mountains and the Polish Lowland, in the Świętokrzyskie Mountains, and in the Carpathians. ***Uranium ore*** occurences are known at **Rajsk** in the Podlasie Depression, as well as at **Okrzeszyn**, **Grzmiąca**, and **Wambierzyce** in the Sudety Mountains.

Production

Currently, there is no production of ***uranium ore*** or ***uranium commodities*** in Poland.

Trade

The demand for ***uranium*** (used in the experimental reactors called **"Maria"** and **"Ewa"** at the **Nuclear Institute** in **Świerk** near **Warsaw**) and for ***uranium compounds*** (CN 2844 10) for non-nuclear applications was formerly satisfied by imports from Russia, the Czech Republic, Spain and – in 2008, and in 2011 – from the US. In 2008 imports of uranium commodities amounted to 5 kg, and in 2011 less than 1 kg. In the years of 2009–2010 and in 2012 imports were not recorded by the Central Statistical Office. The trade balance in ***uranium commodities*** has been negative in recent years, reaching 2,500 PLN in 2008, with improvement to 297 PLN in 2011.

Moreover, irregular imports of ***uranium enriched in isotope*** U^{235} (CN 2844 20) were reported. In 2009 and in 2011 imports under this CN item were not reported. In 2008 there were recorded imports of 12 kg from Russia, valued 12.9 million PLN (5.3 million USD). In 2010 imports were less than 1 kg from Belgium, valued 8,130 PLN (2,460 USD), and in 2012 imports amounted to 1 kg from Russia valued 708,197 PLN (208,600 USD).

Consumption

No detailed information about ***uranium*** consumption in Poland is available. Most of it is used in the experimental reactors **"Maria"** and **"Ewa"** at the **Nuclear Institute** in **Świerk** near **Warsaw**.

VANADIUM

Overview

The **vanadium** (**V**) content in the lithosphere considerably exceeds the amount of copper, lead, or zinc, but it rarely forms individual minerals, and in practice deposits are unknown. Vanadium co-exists with many complex minerals, or is an isomorphous additive in other minerals. The basic sources of vanadium are ***vanadium-bearing titanium-magnetite ore***, ***U-V sandstone-type ore***, some ***phosphates***, ***bauxite***, ***bituminous sand***, and ***heavy crude oil***, as well as ***scrap from special-purpose steel*** and worn-out ***vanadium catalyzers***. The secondary raw materials are used to produce **vanadium oxide**, and further processed into **metallic vanadium**, **vanadium alloys**, and **compounds**.

Vanadium is one of the most important steel alloy additives, especially as **ferrovanadium**, in the production of alloyed steel and special steel grades.

Sources

Poland has considerable resources of vanadium only in ***copper ore*** deposits in the **Fore-Sudetic Monocline** (mainly in shale), containing approximately 157,480 t of V, with an average content of 0.01–0.03% V (as of 31 December 2012). Important concentrations of dispersed vanadium are known in the ***hard coal*** of **Upper Silesia**, and in ***Ordovician shale*** in NE Poland.

Production

In spite of the great number of domestic sources, ***vanadium*** has not been recovered in Poland to date, because suitable extraction method has not been developed.

Trade

The domestic market is heavily dependent upon imports of ***vanadium commodities***. The most important is ***ferrovanadium***, purchased on a regular basis at the level of 241–481 tpy (Tab. 1), mainly from the Republic of South Africa, Russia, the Czech Republic, China, but also from Western European countries such as Austria, Belgium, the Netherlands, Germany, United Kingdom and others.

Information on the volume and structure of importation of other ***vanadium commodities*** is incomplete. The ***vanadium oxide*** imports have reached a level of up to 11 tpy in the last five years, and main suppliers were the Netherlands, Belgium and Germany. In the years 2008–2012, there have been reported exports of ***ferrovanadium***, changing in wide range between 69 and 456 tpy (Tab. 3). Moreover, in 2010 exports has exceeded imports, and for the first time in recent years apparent consumption of ferrovanadium in Poland became negative. The main receivers of re-exported ferrovanadium in recent years were the Czech Republic, Slovakia, Ukraine, Hungary and Western European countries.

Tab. 1. Ferrovanadium statistics in Poland — CN 7202 92

t

Year	2008	2009	2010	2011	2012
Imports	417.8	314.8	364.5	241.5	480.9
Exports	68.7	173.0	455.6	162.1	300.6
Consumption[a]	349.1	141.8	-91.1	79.4	180.3

Source: ***The Central Statistical Office (GUS)***

The trade balance of ***ferrovanadium*** in the years 2008–2012 has been negative, except for 2010 when high volume of exports caused that the trade balance became positive (Tab. 2). The unit values of ferrovanadium imports to Poland depend on imports volume and prices on international markets (Tab. 3).

Tab. 2. Value of ferrovanadium trade in Poland — CN 7202 92

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	7,582	8,229	33,701	11,970	23,156
Imports	44,150	18,593	25,961	15,916	29,120
Balance	**-36,568**	**-10,364**	**+7,740**	**-3,946**	**-5,964**

Source: ***The Central Statistical Office (GUS)***

Tab. 3. Unit values of ferrovanadium imports to Poland — CN 7202 92

Year	2008	2009	2010	2011	2012
PLN/t	105,673	59,063	71,233	65,904	60,549
USD/t	47,664	19,471	23,714	21,818	18,469

Source: ***The Central Statistical Office (GUS)***

Consumption

Information on the consumption and application of ***vanadium commodities*** in Poland is not available. Nevertheless, it would be safe to assume that most of them are consumed by the steel-making industry, lesser amounts by the chemical and petrochemical industries (catalysts). Secondary sources of vanadium, such as scrap from vanadium steel, are not available in Poland.

VERMICULITE

Overview

Vermiculite, a mineral similar to clay minerals, is a product of the weathering of ***biotite***, ***phlogopite***, some types of ***chlorite***, and other silicates and aluminosilicates rich in magnesium. Small amounts of vermiculite have been found in sea deposits and soils. A characteristic feature of **vermiculite** is that when heated rapidly at temperature of approx. 900°C or higher, the water flashes into steam, and it expands from 15 to 25 times, forming so-called **expanded vermiculite**, which is very lightweight, chemically inert, fire resistant, and odorless. The expansion process is called **exfoliation**. The physical and chemical properties of vermiculite make it suitable for use as thermal and sound insulating material, both in bulk and as shaped blocks in a cement and gypsum matrix.

Sources

There are no occurrences or deposits of ***vermiculite*** in Poland.

Production

Crude ***vermiculite*** is not produced in Poland, due to the lack of domestic deposits. At the end of 2012, the company **Perlipol Co**. in Belchatów started production of ***expanded vermiculite*** based on raw material imported from Brazil. The plant with a production capacity of 100,000 m^3py in the first year of operation supplied 300 m^3 of expanded vermiculite. The final product was sold entirely on the domestic market. In 90% it was used in agriculture and horticulture, and in animal breeding as a feed additive (carrier for vitamins and minerals), and padding for animals. The Perlipol's production is recorded in the Central Statistical Office statistics in **PKWiU** item **23991900** as "The products of non-metallic mineral products not elsewhere classified".

Trade

The volume of ***vermiculite*** imports is hard to determine, and from 2010 after changes in CN classification almost impossible to present based on available data. Until the end of 2009, according to the official nomenclature, trade data for ***vermiculite*** were not collected as a separate category, but were included within the basket category ***'vermiculite***, ***chlorite***, ***unexpanded'*** under **CN** code **25301090**. Since 2010 it was classified in the position **CN 253010** – it's the same group of raw materials as so far widened by perlite. On the contrary, ***exfoliated vermiculite*** (mainly in form of boards) is recorded under **CN 68062090** together with others products from porous clays, expanding slag and similar materials. Until 2009 the importation of unexpanded materials varied between 140 and

470 tpy, with minimum in 2009. The majority of the material has originated from Germany (above 70–80% of imports in 2006–2007), but in last year also from China, Russia, Republic of South Africa and Belarus. Since 2010, when perlite was included into the same position of CN (the level of its imports in previous years reached over 20,000 tpy), it became impossible to present the volume of imports of the only vermiculite. Vermiculite boards were imported mainly from Germany by **Europolit Ltd.** — the company specializing in production and distribution of asbestos-free heat insulating materials, as well as by other trade-companies, i.e. **Promat Top** from Warszawa, **Graftex** from Bydgoszcz, **Refractory Insulation Plants IZO** of Gliwice. Expanded vermiculite for building and agriculture applications was also imported from Republic of South Africa by **Rominco Polska Ltd.** of Kraków.

Consumption

Vermiculite can be used mainly in building industry in form of vermiculite boards due to its heat-insulating and heatresisting properties. Such boards are applied in industrial and accumulation furnaces, boilers, heaters, fireplaces, as well as working or rear layer of thermal insulation of thermal processing equipment. Moreover vermiculite can be used in gardening to prepare horticultural mixes, as well as in hydroponics and as subsoil for incubation of reptile's eggs. There is no information about the detailed structure of its consumption in Poland.

Companies involved in vermiculite production in Poland as of December 2012

- P.P.H.U. "Perlipol" s.c., 97–400 Bełchatów, ul. Przemysłowa 4, tel. +48 44 6333398, fax +48 44 6332408, www.perlipol.pl — *exfoliated vermiculite, expanded perlite*.

WOLLASTONITE

Overview

Wollastonite — calcium silicate ($CaSiO_3$) — occurs in three polymorphous forms, two of which are natural: ***triclinic wollastonite-T*** and ***monoclinic wollastonite-2M*** (***parawollastonite***). These commonly form deposits in skarns and skarnoids. At temperatures above 1,126°C, they both change into their high-temperature modification, ***pseudowollastonite***.

The main consumer of **wollastonite** is the ceramics industry, but the rubber, polymers, and plastics industries also use it. To a lesser extent it serves as filler for paints and lacquers, as a flux in the foundry and welding industries, and as a substitute for asbestos. Increasing demand and limited possibilities for extracting natural wollastonite have resulted in the production of **artificial wollastonite** (made of ***quartz*** and ***limestone***) for metallurgical applications.

Sources

There are no ***wollastonite*** deposits in Poland, nor any prospects for their discovery. Only occurrences in skarns and metasomatically altered limestones in **Gębczyce** (the **Strzelin Massif**), and also in limestones of the **Szklarka** river valley near **Krzeszowice**, have been recognized. However, they are of no economic significance.

Production

Wollastonite is not produced in Poland.

Trade

Wollastonite is imported, mainly for ceramic applications, by brokers, in amounts difficult to detect, because wollastonite is counted together with other minerals in the official foreign trade nomenclature (**CN 2530 90**).

Consumption

The volume and structure of ***wollastonite*** consumption in Poland are impossible to ascertain. It is sometimes utilized as additive for ceramic glazes to improve glazing properties. Its main advantage is very low thermal coefficient. That is why it prevents cracking of ceramic products and allows for shorter time of firing.

YTTRIUM

Overview

Yttrium (**Y**) belongs to the group of rare earth elements. It occurs in many minerals: fluorides (***gagarinite***, ***yttrium fluorite***), carbonates and fluorocarbonates (***bastnaesite***, ***parisite***, ***synchisite***), oxides (***fergusonite***, ***formanite***, ***pyrochlore***, ***samarskite***, ***euxenite***), phosphates (***xenotime***, ***churchite***), silicates (***allanite***, ***gadolinite***), etc. Unique individual concentrations are known, e.g. complex ores at **Strange Lake** and **Thor Lake** in Canada, and in the **Bokan Mountains** in the US. Nevertheless, other minerals containing yttrium admixtures, e.g. ***apatite*** and ***monazite***, constitute the main source for its extraction.

Metallic yttrium has traditionally been utilized for high-melting alloys and superalloys, and also for jeweler's metals. Since the 1980s, however, when high-temperature superconductivity was discovered and laser technology came to be developed, the demand for yttrium and its compounds (***synthetic yttrium garnets***: ***aluminum YAG*** and ***ferrous YIG***) has increased. The principal uses are in color TV sets and computer monitors, trichromatic fluorescent lights, temperature sensors, and X-ray intensifying screens. Further demand will be dependent upon the development of the electronics industry and optics, which require ***high-purity metal*** (max. 99.99999% Y — **Nippon Mining Co.** Japan) for their high technology products.

Sources

Deposits of ***yttrium minerals*** or ***yttrium-bearing minerals*** are not known in Poland. Potential sources of ***yttrium*** are dumped waste ***phospho-gypsum***, containing 0.007–0.013% Y_2O_3, at the **Police** and **Wizów Chemical Plants**, among others (see: **PHOSPHATES**). The wastes are generated in processing ***apatites*** (imported from the **Kola Peninsula** in Russia) with 0.005–0.04% Y_2O_3.

Production

Yttrium and ***yttrium compounds*** are not produced in Poland.

Trade

Yttrium and ***yttrium compounds*** are imported to Poland, but they are reported together with ***rare earth metals*** and ***scandium***. In 2008 imports of ***yttrium metal***, ***rare earth metals***, and ***scandium***, amounted to 0.6 t. In period of 2009–2010 increased demand on Polish market influenced the imports increase to 2.4 t and to 7.9 t, respectively. In 2011 imports were almost stopped, and amounted to only 67 kg, but in 2012 increased again, up to 1.7 t. Imports of the ***yttrium and rare earth metals compounds*** were changing between 12 and 58 tpy, with decrease to 16 t in 2009 and to only 12 t in 2012, while the highest values were recorded in 2008 – almost 58 t, and in 2010 – 47 t (details – see: **RARE EARTH ELEMENTS**).

The main import sources in recent years were China, Western European countries, the US and in 2012 the Czech Republic. The trade balance of ***yttrium and rare earth metals commodities*** has been consistently negative in the years of 2008–2010 and in 2012. They amounted in 2008 to almost 2.0 million PLN, while in the next two years they varied between 1.0–6.4 million PLN/y, when increased imports influenced on the record value of trade balance in 2010. In 2011 high volume of re-exports of rare earth metal compounds turned the trade balance to positive value, which amounted to 10 million PLN, but in 2012 it was negative again and reached 3.4 million PLN. The trade balance depends on imports volume and the market price, which were influencing the unit values of rare earth elements imports to Poland (see: **RARE EARTH ELEMENTS**).

Consumption

The figures on ***yttrium*** consumption in Poland are not known. They are expected to be similar to world consumption trends.

ZEOLITES

Overview

Zeolites is a common name for approx. 50 hydrated aluminosilicates, containing ions of alkaline metals (Na, K) and alkaline-earth metals (primarily Ca and Mg). The most common are ***analcime***, ***chabazite***, ***clinoptilolite***, ***erionite***, ***ferrierite***, ***heulandite***, ***laumontite***, ***mordenite***, and ***phillipsite***. In nature, these minerals occur in small amounts, but they can sometimes form considerable portions, or even the majority, of ***zeolitic tuff***, ***tuffite***, ***clay rock***, etc.

The low production costs of **synthetic zeolites**, which are characterized by higher purity and wider ranges of channel diameters, have resulted in the development of their production, mainly for household chemical products. Among over 150 types of zeolites synthetized, the most common is ***sodium zeolite***, structurally stable up to 900°C, whereas natural zeolite degrades at much lower temperatures.

Sources

There are no ***zeolite*** deposits in Poland. Extensive investigation in the Rzeszów region have resulted in the discovery of two prospective areas of ***clinoptilolite — montmorillonite clayshales*** with 18–21% of zeolite (in some parts even over 30%) and 50–75% of montmorillonite. The inferred resources in the **Dylągówka** and **Ulanica** localities are estimated at 900 Mt and 600 Mt respectively.

Production

Due to the lack of commercial ***zeolite*** deposits in Poland, there are ***synthetic zeolites*** and ***molecular sieves*** produced, as well as products based on imported natural zeolites. The total production of synthetic zeolites is difficult to establish because they are recorded in the wide group comprising a range of numerous chemicals (**PKWiU 20.59.52-10).** Natural zeolites since 2009 were classified in position **PKWiU 08.91.19**. In this item, production of the **Technical-Industrial Enterprise Certech** in Niedomice is recorded, which is based on material imported from Slovakia. Certech offers ***Zeo-Cats*** cat-litters and granulated product with trade name ***ZM 0–8*** for agriculture and industrial applications.

Synthetic zeolites were supplied until the end of 2010 by the **Soda Polska Ciech Ltd.** of **Inowrocław** offering several types of ***sorbents*** (sodium, and potassium-sodium), in recent years only in the form of sodium and potassium-sodium sorbents. Their supplies after the period of stable production in 2008-2009 at the level of 6,000 t per year, in the year 2010, which was the last year of production, increased to 7,400 t (Tab. 1). The majority of these products has constituted ***sodium zeolite*** sorbent, (ca. 80%), and ***potas-***

sium-sodium zeolite sorbent (20%). They were sold entirely to the domestic customers. In 2000 Polish subsidiary of French company **Atofina** has commenced a new plant called **Atofina Polska Ltd. Manufacturer of Molecular Sieves** also in **Inowrocław**, which changed the name in 2004 for **Arkema Ltd.** Zeolites of A type (with pore size 3–5 Å) in powder form are manufactured there and part of them is granulated. The volume of Arkema production has held constant on the level between 9,000 and 9,500 tpy, while the production capacity has not exceeded 10,000 tpy. The majority of Arkema production is consumed by foreign division of corporation.

Tab. 1. Zeolites production in Poland

t

Year	2008	2009	2010	2011	2012
Zeolites artificial sorbents [1]	**5.9**	**5.9**	**7.4**	**-**	**-**

[1] production from the **"Soda Polska Ciech"** plant only

Source: ***Producer's data***

There is a possibility of artificial zeolites production on the basis of fly ash from power plant. For example, such method of production was patented by **Energomar Nord Ltd.** of **Warsaw**. Industrial production has not been implemented yet.

Trade

Comprehensive trade data are not available for ***zeolites*** — both natural and synthetic — because they are registered in foreign trade nomenclature jointly with others products in **CN** code **25309098** (natural zeolites) and **38249098** (synthetic zeolites). It is known that natural zeolites was imported from Slovakia in amounts of 158-472 t per year by **Certech Co.** for the production of pet litter called ***Zeo-Cats***, as well as granulated sorbent agent for agriculture and industrial applications. Synthetic zeolites commercially available in the form of ***molecular sieves*** under the trade names **Phonosorb** and **Molecular Sive**, are imported by the Poznań branch of the American company **Grace Davison Ltd.**, as well as products under the trade name **Eco-mol** of the company **Ecoin Ltd**. from Warsaw, brought from the manufacturing plant in China - the company's subcontractor. Significant amounts of artificial zeolite are exported by **Arkema** to their foreign divisions, mainly in Europe.

Consumption

The demand for ***synthetic zeolites*** of higher grade is met entirely by imports. They are mainly used for manufacturing household chemical products, as water softeners substituting phosphates. Perspective uses are: water and sewage purification (heavy metals and radioisotopes removal, oil absorbents, etc.)

Almost the entire production of **Soda Polska Ciech** was sold on the domestic market for refrigerating engineering, heat engineering (for deep drying of gasses and liquids), as well as for foundry use. Production of **Arkema,** as well as products imported by companies **Ecoin Ltd.** and **Grace Davison Ltd**., are consumed in the construction sector as moisture absorbent in production of double glazing windows and moreover in air conditioning circuits, refrigerating engineering, and petrochemical sector. Zeolites and molecular sieves of various origin are also consumed in medicine and pharmaceuticals (for the protection of medicines against moisture), optics, agriculture (additives in the fertilizer production), chemical, petrochemical, and energy sectors (decarbonation and drying of gases, dangerous wastes neutralization) etc. The detailed structure of domestic consumption is difficult to ascertain.

Natural zeolites processed by **Certech** are sold mainly in form of pet litters — trade name ***Zeo-Cats***, and as granulated product ***ZM 0–8*** for application in agriculture, water filtration, drying of gasses, and to a lesser extent (approximately 10% of production) as an insulating component for concrete.

Companies involved in zeolites production in Poland as of December 2012

- Arkema Sp. z o.o. Wytwórnia Sit Molekularnych (Arkema Ltd. Manufacturer of Molecular Sieves), Przemysłowa 88, 88–100 Inowrocław, tel./fax +48 52 3555720, www.arkema.com — *synthetic zeolites, molecular sieves*.
- P.T.H. Certech, 33–132 Niedomice, ul. Fabryczna 36, tel./fax +48 14 6458703, www.cer- tech.com.pl — *natural zeolites*.

ZINC

Overview

The most important primary source of **zinc** (**Zn**) is mineral ***sphalerite*** (ZnS), which occurs in deposits of stratoidal, metasomatic, vein, pyritic and other types. Deposits of ***Zn***, ***Zn-Pb***, ***Zn-Pb-Cu***, and other ***complex ores*** are the sources for the production of **sphalerite concentrate** — the main primary commodity for **zinc metal** manufacturing. Relatively small quantities of zinc, when compared to other base metals, are recovered from ***scrap*** and other ***secondary sources***, as main application of zinc (for galvanizing) makes recycling more complicated.

Sources

The exclusive primary sources of zinc in Poland are ***zinc*** and ***lead ore*** deposits of **Mississipi Valley type** in the Triassic dolomites of the **Silesia-Cracow** region. At the end of 2012 total resources of ***zinc*** and ***lead ores*** of ***sulfide type*** were 77.15 Mt (3.42 Mt of Zn). Last year there were three deposits operated in the Olkusz region, i.e. **Olkusz**, **Pomorzany**, and **Klucze I**. They accounted for around 23% of domestic ***zinc ore*** resources.

Zinc and ***lead ore*** contain many accompanying elements, such as ***silver*** (mainly in ***galena***), and ***cadmium*** (mainly in ***sphalerite***). The resources of silver in deposits currently operated were estimated at 1,030 t, and cadmium - 15,780 t.

Copper ore in the **Fore-Sudetic Monocline** deposits, which includes ***sphalerite*** as an accompanying mineral, is potential primary source of zinc, which has not been recovered due to low metal content in the ore (max. 0.3%) and the lack of efficient technology. The only operated deposit, where zinc resources have been estimated (at 250,990 t, as of 31 December 2012) is the **Głogów Głęboki Przemysłowy**.

Secondary sources of zinc, such as ***scrap*** of ***zinc metal***, ***zinc alloys***, and ***zinc products***, as well as various ***zinc-bearing wastes***, have been utilized only to a limited extent. The zinc-containing residues and wastes are converted into ***zinc oxide***, zinc scrap and dust directly into ***metallic zinc***, while scraps of zinc alloys into new ***alloys***.

Zinc-Lead Ores and Concentrates

Production

In recent years the domestic ***Zn-Pb*** mining production has been gradually decreasing, down to 2.3 million tons of ore in 2012. Simultaneously, zinc content in the run-off-mine dropped to 75,200 tons (Tab. 1). This was a consequence of exhaustion of reserves of the **Trzebionka** deposit, the extraction of which was halted in the mid-2009, and the depletion of ore extracted in the Olkusz region by the **ZGH Bolesław**. In 2012 the average zinc content in the output was 3.2%, while in previous years it ranged from 3.6 to 3.9%. It is expected that by 2016 the reserves of these deposits will be exhausted. Nevertheless, some prospects for development of supplies of primary raw materials to domestic zinc smelters have recently appeared, i.e. to the north and west of deposits currently operated in the vicinity of **Olkusz**, including undeveloped deposit of **Laski**, as well as Balkan subsidiary of **ZGH Bolesław** (majority stake 52%), i.e. the **Gradir Montenegro** mine of Zn-Pb-Ag ores at the **Suplia Stiena** deposit with reserves of 20 Mt of Zn-Pb-Ag ore (start of the operation in 2011, possible future production of 30 ktpy of zinc concentrate). In 2011 and 2012 sphalerite concentrates (2,300 and 8,300 tpy respectively) from foreign subsidiary supplemented supplies of domestic raw materials for **ZGH Bolesław** smelter. Furthermore, the company is going to acquire two other deposits in Serbia (possible production of 60-70 ktpy of zinc in concentrate).

Tab. 1. Zinc ore and concentrates statistics in Poland — CN 2608 00

'000 t Zn

Year	2008	2009	2010	2011	2012
Mining output	136.3	116.0	88.5	81.8	75.2
Concentrates production	132.4	115.5	91.9	87.2	76.7
— *oxide concentrates*[1]	*22.2*	*18.8*	*19.4*	*22.0*	*19.0*
— *sulfide concentrates*	*110.2*	*93.3*	*72.5*	*65.2*	*57.7*
Imports[e]	90.5	77.4	68.5	55.3	123.4
Exports[e]	35.8	27.3	0.0	0.0	0.0
Consumption[e,a]	187.1	165.6	157.0	142.5	200.1

[1] zinc oxide recovered from waste materials

Source: ***The Central Statistical Office (GUS), producer's data***

Currently, the only processing unit for ***zinc-lead ore*** beneficiation has been the **Olkusz-Pomorzany** plant operated by the **ZGH Bolesław**. There have been ***sphalerite concentrates*** (55% Zn in 2012) and ***bulk zinc-lead concentrates*** (33% Zn and 15% Pb) obtained. Additionally, ***zinc oxide*** (containing 47-60% Zn and 16% Pb in 2012) have been recovered from various ***zinc-bearing wastes*** at the **Bolesław Recycling Ltd. —** a part of **ZGH Bolesław Capital Group**. The plant has been the only such a plant in Poland, specialized in treatment and neutralizing of waste slimes after zinc electrolysis, zinc-containing metallurgical wastes, steelmaking dusts, Zn-C and Zn-Mn batteries etc. (the processing capacity up to 160 ktpy). In recent years the production levels of ***zinc oxide*** have been 33-40 ktpy (gross weight) with 19-21 ktpy Zn. At the same time, due to the closure of the **Trzebionka** mine and processing plant coupled with depletion of ore extracted from the **Olkusz** and **Pomorzany** deposits, between 2008 and 2012 the supplies of ***sulfide zinc concentrates*** from domestic sources dropped by 42%, i.e. to ca. 77 ktpy of contained zinc (Tab. 1).

Trade

In 2012 the importation of both ***sphalerite*** and ***complex*** (***bulk***) ***sphalerite-galena concentrates*** to Poland more than doubled when compared to its low level in 2011, increasing to 205 kt gross weight (Tab. 2). The large portion of imported concentrates originated from Australia (Mc Arthur) and Canada (Brunswick), and – most recently – also from Germany, Ireland, and Romania, Belgium (Tab. 2). The exportation of ***sphalerite concentrates*** that until 2009 almost exclusively had been sold by the **Trzebionka**, in the following years decayed (according to the **Central Statistical Office**, only 386 kg of zinc concentrate were shipped to South Africa and the US). Previously, the largest Polish concentrates recipients were Bulgaria, Germany, and China (Tab. 3). The balances of zinc concentrates turnover have been usually negative, as the volume and value of importation prevailed over respective figures of exports (Tab. 4). In 2012 the deficit deepened to 420 million PLN.

Tab. 2. Polish imports of zinc and zinc-lead concentrates, by country — CN 2608 00

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Imports	**150.9**	**129.0**	**114.1**	**92.1**	**205.7**
Australia	61.9	37.6	46.2	28.0	81.0
Belgium	0.6	0.4	10.2	–	–
Bulgaria	–	–	–	0.8	–
Canada	46.0	24.8	16.9	8.8	28.4
Finland	3.9	–	–	–	–
France	2.9	2.2	3.6	3.6	7.6
Germany	1.0	14.0	7.2	9.3	19.4
Ireland	4.8	–	–	–	17.1
Kosovo	–	–	–	–	0.7
Montenegro	–	–	0.5	6.5	9.0
Netherlands	3.6	2.0	1.1	0.7	6.4
Peru	9.9	10.9	2.2	–	–
Romania	0.3	10.2	13.7	15.0	14.5
Serbia	–	–	1.3	6.9	8.2
Slovakia	0.3	0.1	–	0.6	1.5
Spain	–	5.1	–	–	–
Sweden	4.6	–	–	3.7	3.6
Turkey	1.7	3.4	0.8	–	0.3
United Kingdom	9.4	17.4	10.0	8.2	7.8
Others	–	0.9	0.4	–	0.2

Source: ***The Central Statistical Office (GUS)***

The unit values of both importation and exportation of concentrates in Poland followed zinc metal quotations in the international markets (LME, American market), depending on exchange rate of US dollar to Polish zloty. In 2012 as the concentrates purchase increased significantly, while the international prices of zinc commodities diminished of 2011, the unit value of importation also diminished (Tab. 5). High unit values of exportation have been a consequence of symbolic quantities purchased.

Tab. 3. Polish exports of zinc concentrates, by country — CN 2608 00

'000 t (gross weight)

Year	2008	2009	2010	2011	2012
Exports	**58.1**	**44.3**	**0.0**	**0.0**	**0.0**
Belgium	1.8	–	–	–	–
Bulgaria	32.4	25.2	–	–	–
China	3.1	11.0	–	–	–
Germany	11.1	5.1	–	–	–
India	–	2.0	–	–	–
Romania	7.7	–	–	–	–
Russia	2.0	1.0	–	–	–
South Africa	–	–	–	–	0.0
USA	–	–	–	0.0	0.0

Source: ***The Central Statistical Office (GUS)***

Tab. 4. Value of zinc and zinc-lead concentrates trade in Poland — CN 2608 00

'000 PLN

Year	2008	2009	2010	2011	2012
Exports	85,124	62,988	0	0	5
Imports	294,298	155,171	215,658	197,729	420,045
Balance	**-209,174**	**-92,183**	**-215,658**	**-197,729**	**-420,040**

Source: ***The Central Statistical Office (GUS)***

Tab. 5. The unit values of zinc concentrates trade in Poland — CN 2608 00

Year	2008	2009	2010	2011	2012
Imports					
PLN/t	1,950	1,203	1,890	2,145	2,149
USD/t	844	376	632	733	661
Exports					
PLN/t	1,465	1,422	-	-	12,105
USD/t	618	425	-	-	3,715

Source: ***The Central Statistical Office (GUS)***

Consumption

Between 2008 and 2011 the apparent consumption of ***zinc concentrates*** has been gradually decreasing, from almost 190 to 140 ktpy (Tab. 1). In 2012 the demand jumped by 41%. ***Zinc concentrates*** and small amounts of ***zinc oxide*** of domestic origin have been predominantly consumed at the **ZGH Bolesław** for the production of ***electrolytic zinc*** (Tab. 3). The **Miasteczko Śląskie Smelter** has used both domestic and imported ***sulfide zinc-lead concentrates*** (***bulk***), as well as ***zinc*** and ***zinc-lead oxides*** coming basically from the **Bolesław Recycling**.

Zinc Metal

Production

Zinc metal in various grades has been manufactured at the following smelters:

- **HC Miasteczko Śląskie S.A. –** since 2010 incorporated into the **ZGH Bolesław Capital Group –** (pyrometallurgy based on the **Imperial Smelting Process** technology, nominal capacity of 85 ktpy); ***raw zinc*** from **ISP** furnace rectified to ***rectified zinc*** in two grades: **GOB – Z5** (98.5% Zn and 1.5% Pb), **SHG – Z1** (99.995% Zn), as well as ***zinc alloy for galvanizing*** (**ZnAl**); the resulting from **ISP** zinc ferrous waste is recycled in the Waelz process; the smelter has processed both domestic and imported ***zinc-lead concentrates*** (40% of the charge), and secondary ***zinc oxide*** (recovered at the **Bolesław Recycling** from steelmaking dust), as well as some quantities of ***scrap*** (***automobile parts***) and ***zinc-containing wastes*** of various origin;
- **ZGH Bolesław Mining and Smelting Plant** (hydrometallurgy, 75 ktpy capacity, including 19 ktpy of zinc galvanising alloys - possible expansion to 130 ktpy by 2015); produces ***electrolytic zinc*** with 99.9975% Zn from its own concentrates; the product meets standards of **SHG** grade (min. 99.995% Zn) and has been registered at the **LME** under the brand name **ZGHZ1**; the plant also offers ***zinc alloy for galvanizing*** (min. 99.3% Zn) with various alloy additives, e.g. Al, Cu, Sn and Ni (so-called ***Wegal*** alloy with 0.1–0.13% Ni), ***pressure alloy ZAMAK***, and ***zinc-based casting alloys*** (***ZnAl*** and ***ZnAlCu***);
- **ZM Silesia** — small quantities of zinc anodes, made of rectified zinc 99.995% Zn, and zinc casting alloys.

Upon the years 2008-2012 total domestic production of ***zinc metal*** ranged from 135 to 144 ktpy (Tab. 6). Its fluctuations have been a consequence of economic problems at the **HC Miasteczko Śląskie** (high prices of coke utilized in the **ISP** furnace) and international zinc prices variations. However, thanks to the implementation of restructuring measures, the performance of the smelter has improved. Since 2010, after the enterprise was incorporated into the structure of **ZGH Bolesław Group**, the expansion and modernization strategy for the whole domestic zinc metallurgy was developed. Following consolidation, the domestic production capabilities increased to 150,000 tons of zinc annually. The strategy of the Group included further expansion of total zinc smelting capacities up to 200-240 ktpy, the increase of zinc oxides share in raw materials charge for zinc metal production, and the switch of the **Miasteczko Śląskie** into the production of 100% ***rectified zinc*** (***SHG***) by 2015 (construction of three additional rectification columns, coupled with termination of **GOB** manufacturing). Currently, **ZGH Bolesław** is a dominant company in the capital group, comprising 7 subsidiaries, including - except **HC Miasteczko Śląskie** - also **Boloil S.A.**, **Bolesław Recycling Ltd.**, and **Gradir Montenegro d.o.o.**

Trade

The demand for ***zinc metal*** and ***zinc products*** has been satisfied mostly by domestic manufacturers (Tab. 6). The principal zinc commodities traditionally imported to Poland have been the following: ***zinc alloys***, and ***zinc wastes and scrap*** (Tab. 10). The importa-

Tab. 6. Zinc metal statistics in Poland — CN 7901 11, 12

'000 t Zn

Year	2008	2009	2010	2011	2012
Production	142.6	139.1	135.1	144.1	138.3
— *electrolytic*	*76.1*	*76.6*	*69.8*	*72.0*	*67.2*
— *rectified*	*66.5*	*62.5*	*65.3*	*72.1*	*71.1*
Imports	26.1	21.7	56.7	41.4	51.0
Exports	78.0	84.3	95.6	105.2	107.3
Consumption[a]	90.7	76.5	96.2	80.3	82.0

Source: ***The Central Statistical Office (GUS), producers' data***

tion of ***zinc metal***, which was reduced to 22 kt in 2009, since 2010 ranged between 41 and 57 ktpy (Tab. 7). In the last three years from among its numerous suppliers the largest were: Spain, Germany, and Finland. The simultaneous exportation of ***zinc metal*** has ranged 96-107 ktpy (Tab. 8). In recent years the largest foreign recipients of zinc from Poland have been: Germany, Slovakia, Italy, and the Czech Republic (Tab. 8). The positive value of the trade balances, which in 2008 dropped by 28% due to reduction in international zinc quotations, in the following two years recovered owing to the increase in the exportation revenue, especially in 2011 when it exceeded 440 million PLN (Tab. 11).

Tab. 7. Polish imports of zinc metal, by country — CN 7901 11,12

'000 t Zn

Year	2008	2009	2010	2011	2012
Imports	**26.1**	**21.7**	**56.7**	**41.4**	**51.0**
Belgium	0.6	1.2	1.5	0.3	0.4
Bulgaria	–	0.1	0.1	0.1	–
Czech Republic	0.1	0.9	2.7	1.9	0.6
Finland	0.6	0.8	5.3	7.5	9.9
France	–	–	–	2.4	3.2
Germany	1.8	3.9	11.7	4.7	7.9
Italy	–	0.4	1.6	0.9	0.3
Kazakhstan	12.7	4.0	7.8	9.3	–
Latvia	–	–	–	0.2	0.2
Luxembourg	–	0.5	0.2	0.6	0.6
Mexico	0.5	–	–	–	–
Netherlands	1.4	0.8	0.9	0.9	4.0
Norway	–	–	–	–	0.2
Romania	4.1	–	–	0.1	–
Russia	–	0.5	0.1	–	–
Slovakia	0.7	4.9	1.4	0.7	0.4
Spain	2.5	2.8	20.4	11.8	21.1
Sweden	–	–	–	–	0.4
Switzerland	–	–	–	–	1.8
United Kingdom	0.3	0.8	2.3	0.0	0.0
Others	0.8	0.1	0.7	–	–

Source: ***The Central Statistical Office (GUS)***

Tab. 8. Polish exports of zinc metal, by country — CN 7901 11, 12

'000 t Zn

Year	2008	2009	2010	2011	2012
Exports	**78.0**	**84.3**	**95.6**	**105.2**	**107.3**
Austria	8.2	5.9	4.0	7.7	6.7
Belgium	3.1	1.7	–	0.3	0.5
Bulgaria	–	1.0	0.2	0.0	0.0
Croatia	–	0.2	0.0	0.1	0.1
Czech Republic	11.4	13.5	22.4	14.9	20.7
Denmark	0.2	–	–	0.0	–
France	7.2	3.3	2.0	3.0	2.6
Germany	19.2	13.7	20.6	23.6	24.8
Greece	–	–	–	0.4	0.4
Hungary	1.2	1.7	2.2	4.1	2.7
Italy	7.9	22.3	18.7	21.5	15.5
Israel	–	0.8	–	–	–
Lithuania	–	–	–	0.5	0.6
Netherlands	1.5	0.9	2.0	1.8	1.5
Romania	0.2	1.6	2.1	1.6	2.4
Slovakia	9.1	13.5	16.9	20.2	23.6
Slovenia	0.2	0.6	0.8	0.0	0.0
Switzerland	–	–	–	0.4	–
Sweden	0.3	0.4	1.1	3.2	4.0
Ukraine	0.1	0.1	0.1	0.1	0.1
United Kingdom	6.7	2.8	1.6	1.4	0.4
Vietnam	–	–	–	0.2	0.2
Others	1.5	0.3	0.9	0.2	0.5

Source: ***The Central Statistical Office (GUS)***

The average unit values of zinc metal exportation from Poland (in USD/t) have followed zinc metal quotations at the LME. Their sharp reduction took place in 2009, however in the following years they show improvement equally to the international prices (Tab. 9). The unit values quoted in the domestic currency depended on the exchange rates. In 2009 they improved slightly due to strengthening of Polish zloty against US dollar, but in the following years they levelled off at around 6,750-6,700 PLN/t despite LME zinc quotations rise.

Tab. 9. The unit value of zinc metal exports from Poland — CN 7901 11, 12

Year	2008	2009	2010	2011	2012
PLN/t	4,872	5,025	6,749	6,756	6,713
USD/t	2,068	1,627	2,253	2,310	2,058

Source: ***The Central Statistical Office (GUS)***

Apart from ***zinc metal***, other zinc products have been traded, i.e. ***zinc alloys***, ***oxide***, ***wastes and scrap***, and also ***zinc dust***, ***powders***, and ***flakes*** (Tab. 10). Since 2009 the exportation of ***zinc oxide*** has been gradually increasing, up to 13,500 t in 2012. However, at the same time its imports grew almost four-fold that resulted in the reduction of the trade financial revenues (Tab. 11). Simultaneously, until 2010, the sales of ***zinc alloys*** have been increasing. That — coupled with reduced importation — has mitigated the deep deficit in its trade balance (Tab. 11). In 2011-2012, owing to rise in foreign deliveries, the deficit deepened. The exportation of ***zinc wastes and scraps***, which in 2009-2011 varied from 1,600 to 1,000 tpy, last year dropped by 53%. That, coupled with increased importation, resulted in worsening of the financial result of these raw materials turnover (Tabs. 10 and 11).

Tab. 10. Trade in selected zinc commodities (other than zinc metal) in Poland

t

Year	2008	2009	2010	2011	2012
Zinc oxide CN 2817 00					
Imports	5,703	6,523	10,601	10,026	25,254
Exports	10,140	7,983	9,335	11,430	13,519
Zinc alloys CN 7901 20					
Imports	10,815	8,319	7,280	9,109	12,356
Exports	3,387	4,577	6,151	6,961	6,541
Zinc wastes and scrap CN 7902 00					
Imports	6,317	3,779	7,068	10,420	11,060
Exports	403	1,593	1,086	1,046	487
Zinc dust, powder, and flakes CN 7903					
Imports	660	250	622	768	993
Exports	1,169	432	130	283	134

Source: ***The Central Statistical Office (GUS)***

Tab. 11. Value of selected zinc commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Zinc oxide CN 2817 00					
Exports	51,059	37,035	54,623	65,048	75,466
Imports	35,150	26,694	57,327	57,339	74,472
Balance	**+15,909**	**+10,341**	**-2,704**	**+7,709**	**+994**
Zinc metal CN 7901 11, 12					
Exports	379,832	423,529	645,005	710,893	719,953

Imports	136,989	114,991	319,125	270,099	327,470
Balance	**+242,843**	**+308,538**	**+325,880**	**+440,794**	**+392,483**
Zinc alloys CN 7901 20					
Exports	18,368	25,591	43,895	51,365	47,558
Imports	68,013	45,190	52,203	62,991	63,022
Balance	**-49,645**	**-19,599**	**-8,308**	**-11,626**	**-15,464**
Zinc wastes and scrap CN 7902 00					
Exports	2,206	5,674	5,146	4,293	1,998
Imports	22,768	13,250	32,613	49,998	52,408
Balance	**-20,562**	**-7,576**	**-27,467**	**-45,705**	**-50,410**
Zinc dust, powder, and flakes CN 7903					
Exports	2,004	858	1,188	2,356	1,448
Imports	4,059	2,475	5,633	7,060	6,765
Balance	**-2,055**	**-1,617**	**-4,445**	**-4,704**	**-5,317**

Source: ***The Central Statistical Office (GUS)***

Consumption

Zinc has been predominantly consumed in the steel-making industry as an anti-corrosive coating. Galvanizing has remained the largest end use of zinc (62% of total consumption), while the automobile and construction industries have been the largest consumers. Zinc has been also utilized in the metallurgy for the production of brass (ca. 20% of total consumption), in the foundry industry (Zn-Al alloys – 9%), and in the chemical industry (zinc white – 5%). Galvanizing, mainly of steel sheets and strips, has been carried out at the former **Sendzimir Steelworks** in **Cracow** and the **Florian Steelworks** in **Świętochłowice**, which both are divisions of the **ArcelorMittal Poland**. In 2010-2011 the total domestic supply of zinc-coated steel was 455-453 ktpy respectively, up from only 396 kt in 2009, while in 2012 it jumped up to 676 kt. In the 2000s, to meet the increased demand for high grade zinc-coated products, numerous galvanizing shops developed production in Poland, including **Galvanizing Shop Śląsk** of Chrzanów (belonging to German **Seppeler Gruppe**), **Stalprodukt-Bolesław** of Bukowno (the shareholders are **ZGH Bolesław** and **Stalprodukt Bochnia**), **Pokój** (the main shareholders are: German **Voight & Schweitzer** and domestic **Pokój Steelworks**), **Polimex Mostostal** (running three plants: **Siedlce**, **Dębica**, and **Częstochowa**), **Mostostal-Met Opole**, **ZinkPower Wielkopolska** (**KOPF Holding**) etc. ***Zinc alloys*** and ***zinc products*** have been manufactured by the **Silesia Metallurgical Works** (basically sheets and gutters made of titanium-zinc alloy for building engineering, zinc and ZnAl wire). The main domestic manufacturer of ***zinc white*** (for the pain, rubber and ceramic industries) and ***zinc oxide*** (in fodder and pharmaceutical grades) has been the **Oława Metalworks** (a division of the **ZM Silesia**). The annual production of ***zinc white*** that previously averaged between 12 and 15 ktpy, in the last five years varied between 9 and 11 ktpy. Last year the domestic supply of ***zinc white*** amounted to 9.9 kt. ***Zinc dust*** (98.5–99.4% Zn) manufactured at the **Zinc Dust Production Plant** of the **Boloil Co.** of **Bukowno**, belonging to **ZGH Bolesław Group**, has been utilised for the production of ***zinc metal*** at the parent company's zinc smelter, as well as by the paint and varnishes industry. The plant has also developed the production of ***cast and rolled zinc anodes*** (based on electrolytic zinc 99,994% Zn from **ZGH Bolesław**) for the galvanizing industry and ***zinc-aluminium alloys*** for pressure foundries.

The consumption of zinc metal has depended on general condition of the domestic economy, in particular of the automobile and construction industries, as well as of the demand for household equipment. In the last five years it ranged from around 80 to 96 ktpy (Tab. 6).

Companies involved in zinc commodities production in Poland as of December 2012

- ZGH Bolesław S.A., ul. Kolejowa 37, 32–332 Bukowno, tel. +48 32 2955100, fax +48 32 2955000, www.zgh.com.pl — *Zn-Pb ore, sphalerite and complex sphalerite-galena concentrates (bulk), zinc oxide, electrolytic zinc, zinc alloy for galvanizing*.
- Bolesław Recycling Ltd., ul. Kolejowa 37, 32–332 Bukowno, tel. +48 32 2955667, fax +48 32 2955550, www.bolrec.pl — *secondary zinc oxide.*
- Huta Cynku Miasteczko Śląskie (Miasteczko Śląskie Zinc Smelter), 42–610 Miasteczko Śląskie k. Tarnowskich Gór, ul. Woźnicka 36, tel. +48 32 2888444, fax +48 32 2851885, www.hcm.com.pl — *rectified zinc*.
- ZM Silesia S.A. — Grupa Impexmetal (Silesia Metallurgical Plant Joint Stock Co. — Impexmetal Group), ul. Konduktorska 8, 40–155 Katowice, tel. +48 32 3587400, fax. +48 32 2598381, www.zmsilesia.com.pl — *zinc anodes*.
- ZM Silesia S.A. — Oddział Huta Oława — (Silesia Metallurgical Plant Joint Stock Co. —Division of Oława Metalworks), ul. Sikorskiego 7, 55–200 Oława, tel. +48 71 3134031, fax +48 71 3134035, www.zmsilesia.com.pl — *zinc white, zinc oxide*.

ZIRCONIUM

Overview

Zirconium (**Zr**) raw materials are obtained primarily from placer deposits of heavy minerals called ***zircon-rich mineral sands***. Recovery from ***waste molding sand*** and from ***scrap zircon refractory materials*** is insignificant.

Zirconium in its pure metallic form is used only as an additive for nuclear reactor cores, and as an alloy constituent with magnesium, titanium, and other metals. Its minerals have many more applications, especially **zircon** $ZrSiO_4$ (for foundry use, refractory materials, abrasives, ceramics), and, to some very small extent, **baddeleyite** ZrO_2, as well as its synthetic equivalent, **zirconia** ZrO_2. Zircon and baddeleyite are the only sources of the ***metallic zirconium***, as well as of ***hafnium*** (see: **HAFNIUM**).

Sources

Zircon mineral occurs in Baltic beach sand (5–9% of heavy fraction) and with other heavy minerals have been found in the **Ławica Odrzańska** and **Ławica Słupska** sandbanks. Investigated resources of zircon there are estimated at 2,000 t. ***Glass sand*** from the **Osiecznica** deposit is a potential source of ***zircon***.

Production

Zirconium minerals and ***zirconium metal*** are not produced in Poland.

Trade

The domestic demand for ***zirconium commodities*** is met by imports, mainly of ***zircon concentrates*** and ***zircon flour***. Their volume varied between 360–840 tpy in recent years. Growth of consumption for zircon flour in the ceramic tiles industry was stopped in the last years due to very high prices of zircon commodities (Tab. 1). It is estimated that currently the volume of ***zircon concentrates*** imports amounted to less than 50 tpy, coming primarily from Ukraine or South Africa, while the remaining imports constitute of ***zircon flour***, which were coming mainly from Germany, France, the Netherlands, Spain, South Africa, Italy, Australia, and the United Kingdom (Tab. 1). Marginal re-exports of ***zircon concentrates*** and ***flours*** have been reported since 2006. In 2010, significant re-exports of ***zircon flours*** to Russia and Belarus were noticed, while in 2012 - to Ukraine and Hungary (Tab. 1).

Imports of ***zirconium metal*** were discontinued after 2000. However, since 2007 some

Tab. 1. Statistics on zirconium commodities in Poland

t

Year	2008	2009	2010	2011	2012
Zircon concentrates and flour CN 2615 10					
Imports	**844**	**364**	**624**	**478**	**670**
Australia	35	31	20	32	23
France	5	48	132	42	61
Germany	56	18	150	229	115
Italy	14	3	3	24	24
Netherlands	85	17	148	124	116
South Africa, Republic of	185	58	29	24	27
Spain	97	94	58	2	287
Ukraine	315	21	8	–	1
USA	40	–	25	0	11
United Kingdom	12	62	24	0	0
Others	0	12	27	1	5
Exports	**3**	**1**	**101**	**3**	**17**
Consumption[a]	**841**	**363**	**523**	**475**	**653**
Zirconium metal and powder CN 8109 20					
Imports = Consumption[a]	**1**	**3**	**2**	**0**	**0**

Source: ***The Central Statistical Office (GUS)***

small imports have occurred again (Tab. 1). Recently they came from various countries: Spain, United States, Japan, France, China and others.

The trade balance in ***zirconium commodities*** is consistently negative, following the varying volume of imports and their prices (Tab. 2).

Tab. 2. Value of zirconium commodities trade in Poland

'000 PLN

Year	2008	2009	2010	2011	2012
Zircon concentrates and flour CN 2615 10					
Exports	11	5	401	51	54
Imports	2,665	2,575	3,344	3,689	6,213
Balance	**-2,654**	**-2,570**	**-2,943**	**-3,638**	**-6,159**
Zircon metal and powder CN 8109 20					
Imports = **Balance**	**-58**	**-43**	**-47**	**-72**	**-32**

Source: ***The Central Statistical Office (GUS)***

Average unit values of imported ***zircon concentrates*** and ***flours*** — in USD/t — were continuously increasing in recent years, except of 2010 (Tab. 3). It was in accordance with tendencies observed in the world market of zircon commodities. Two groups of commodities are reported in the common item: ***zircon concentrates*** having unit value of 2,000-2,500 USD/t, and ***zircon flours***, which have unit values commonly 3,000 USD/t and more (Tab. 3).

Tab. 3. Average unit values of zircon concentrates and flours imports to Poland — CN 2615 10

Year	2008	2009	2010	2011	2012
PLN/t	3,158	7,081	5,361	7,716	9,271
USD/t	1,331	2,395	1,807	2,601	2,848

Source: ***The Central Statistical Office (GUS)***

Consumption

The principal domestic consumers of zirconium commodities were traditionally the foundry and refractory industries (***zircon concentrates***), incidentally — metallurgy (***zirconium***). Since the middle of the 1990s, use of ***zircon flour*** in the domestic ceramic tiles industry rapidly developed. As a result, this industry became the largest consumer of zircon commodities in Poland (over 90% of total consumption), though this consumption was recently distinctly reduced due to high prices of this commodity.

ABBREVIATIONS AND UNITS OF MEASURE

kg	— kilograms	
t	— metric ton	= 1,000 kg
tpy	— tons per year	
m^3py	— cubic metres per year	
‘000 t	— thousand tons	= 1,000,000 kg
Mt	— million tons	= 1,000,000,000 kg
Mm^3	— million cubic metres	= 1,000,000 m^3
1 carat (diamond)		= 200 milligrams
NA	— not available	
[e]	— estimated	
[r]	— revised	
[a]	— consumption apparent = production + export – import	
0	— less than 0.5 of used unit of measure	
0.0	— less than 0.05 of used unit of measure	
ave.	— average	