

TADEUSZ SMAKOWSKI*, KRZYSZTOF GALOS**

Evolution of mineral aggregates market in Poland

Key words

Natural aggregates, crushed aggregates, sources, domestic production, aggregates market

Abstract

The paper presents sources and production of mineral aggregates in Poland in recent years, as well as characterise developments of their domestic market in the 1990s. Relationships between various groups of aggregates are discussed. Importance of foreign trade of aggregates is also taken into account. As a summary, future outlook of domestic market of aggregates is anticipated.

Introduction

Mineral aggregates are divided into: *natural aggregates* — received from loose sedimentary rocks (sand and gravel), *crushed aggregates* — obtained from compact rocks, *aggregates from secondary materials* — e.g. made of metallurgical slag or of self-burnt coal shale, and *artificial aggregates* — produced by thermal processing of clays, fly ashes, etc.

Natural aggregate is a loose mixture of pebbles, gravel, and sand. Depending on the degree of processing and grain size, the following their classes are distinguished: 1. non-crushed aggregates: common sand 0—2(4) mm, gravel (fractions from 2 to 31.5, rarely to 63 mm), and classified or non-classified sand and gravel mixes (from 0—4 to 0—63 mm); 2. natural crushed aggregates: mainly crushed sand 0—2 mm, and grits of pebbles (fractions the same as gravel).

Rocks for the production of crushed stone (crushed aggregates) are crushed and classified as required. The shape of aggregates may be modified by granulation, and thus crushed aggregates

* M.Sc. Eng., ** Ph.D. Eng., Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Cracow.

are divided into “common” and “granulated”. The most important types of common crushed aggregate products are crushed stone (63—250 mm), breakstone (31.5—63 mm), key aggregate (4—31.5 mm), and rock dust (0—4 mm), whereas granulated aggregates include primarily grits in five grain size classes (2—63 mm), crushed sand (0—2 mm), and classified mixes of crushed aggregates (0—63 mm). Aggregates from secondary sources, as well as artificial aggregates, have similar granulation as crushed aggregates, but it depends also on their final application.

Two main groups of mineral aggregates — natural and crushed ones — have in general different scopes of applications. Only some part of crushed aggregates finds application in the concrete production, where natural aggregates dominate. On the contrary, crushed aggregates dominate in road, railway, and civil construction, with only limited use of natural aggregates e.g. as road underlayer components. Aggregates from secondary materials, especially on the basis of metallurgical slag, have applications similar to crushed aggregates, while artificial lightweight aggregates find use primarily in lightweight concrete and concrete products.

Mineral aggregates industry experienced a strong 60% drop of domestic demand in the beginning of the 1990s due to the overall crisis in construction sector. However, since 1994 continuous growth of production was reported, initially as a consequence of increasing exports, but since 1996 primarily due to reviving domestic demand. It is anxious that this growth of demand was practically stopped in 2000, while in 2001 — according to some market reports — it even dropped by 20—30%, being a consequence of slowing down of industrial investment, as well as residential and road construction. Total domestic production of aggregates amounted to ca. 110 million t in 2000, including over 75 million t of natural aggregates, ca. 28 million t of crushed aggregates, 7—8 million t of aggregates from secondary materials, and under 0.5 million t of artificial aggregates.

1. Domestic supplies of mineral aggregates

1.1. Natural aggregates

Natural 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 reserves occur in the river valleys of the Carpathian and Sudeten mountains (the latter being of the highest quality among domestic aggregates). There are over 4,100 natural aggregates deposits in Poland, containing over 14 billion t of reserves. The largest deposits occur in Lower Silesia and the Carpathians, as well as in the NE Poland.

Domestic natural aggregates extraction was exceeding 120 million tpy in the 1970s, being the second only to the production of hard coal. In the 1980s, output amounted to 80—100 million tpy, but in 1990—91 it suddenly dropped by 60% to only 43 million tpy, as a result of the overall crisis in civil engineering projects, as well as in residential construction. Visible and continuous growth of natural aggregates output and production have been noted since 1994, being doubled in 2000 (Table 1, Fig. 1). The main reasons of this increase were initially growing exports, but since 1997 increasing domestic demand has been the main driving force. As a consequence, mining output of natural aggregates achieved the level of 88 million t in 2000. Official

TABLE 1

Natural aggregates statistics in Poland ('000 t)

TABELA 1

Gospodarka kruszywami naturalnymi w Polsce [tys. t]

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Mining output	107 550	56 411	43 089	43 069	46 575	52 823	53 072	61 241	67 856	71 935	84 839	88 437
Production	72 927	37 951	31 881	31 227	29 726	3 2334	33 795	38 393	43 281	44 510	49 121	50 595
— non-crushed n.a.	64 560	34 342	27 966	2 6811	27 813	29 660	30 832	35 513	40 189	40 850	45 068	45 954
— crushed n.a.	8 367	3 609	3 915	4 416	1 913	2 674	2 963	2 880	3 092	3 660	4 054	4 641
Imports	—	—	0	12	16	5	19	5	57	28	53	12
— gravel and mixes	—	—	0	9	15	4	16	3	53	21	29	10
— sand	—	—	—	3	1	1	3	2	4	7	24	2
Exports	264	134	623	3 340	4 384	4 513	4 340	4 051	2 372	1 073	849	1 558
— gravel and mixes	•	•	•	2 417	3 255	3 873	3 679	3 555	2 043	848	667	1 317
— sand	•	•	•	923	1 129	640	661	496	328	225	182	241
Consumption ^a	72 663	37 817	31 258	27 899	25 358	27 827	29 474	34 347	40 966	43 465	48 325	49 049

• — lack of data; ^a — apparent.

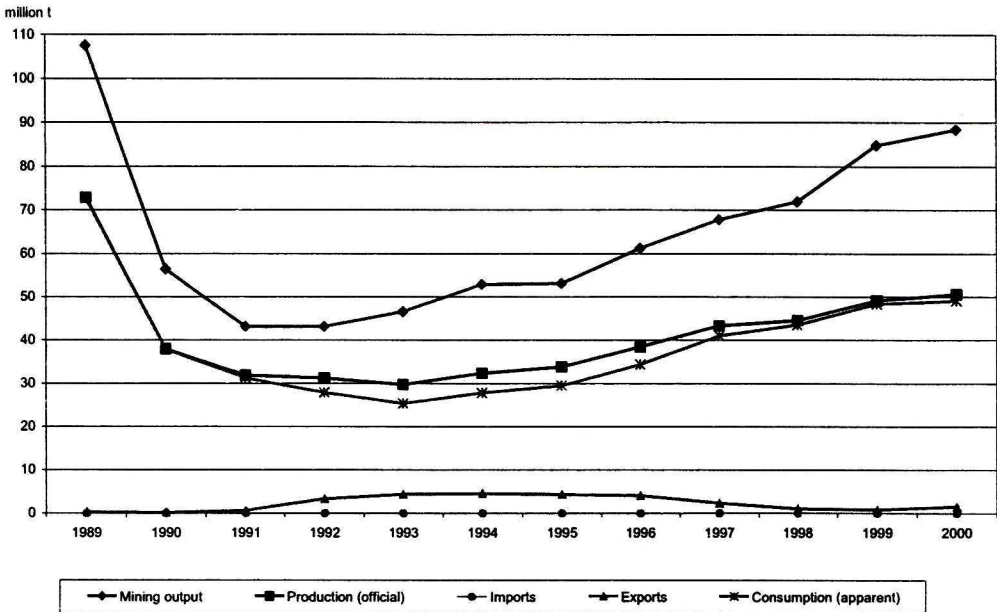


Fig. 1. Natural aggregates statistics in Poland

Rys. 1. Gospodarka kruszywami naturalnymi w Polsce

production — according to the Central Statistical Office — amounted to 50.6 million t in 2000 (Table 1), but small producers employing under 10 workers are not included in this statistics. Such suppliers deliver — according to our estimates — even over 20 million tpy of natural aggregates. So, in sum, the actual production of natural aggregates reached possibly 75 million t or slightly more in 2000. The balance between this figure and mining output figure consists of processing losses and not sold sand being dumped.

There are currently over 1,000 active natural aggregates mines in Poland. However, in a few of them mining output exceeds 1.0 million tpy, in ca. 15 mines it varies between 0.5—1.0 million tpy, while in 85 mines it amounts from 0.1 to 0.5 million tpy. Three fourths of the total number of aggregates mines produce less than 50,000 tpy, most often only a few thousand tpy. The largest mines are located in northeastern Poland (mainly in the Podlaskie and Warmińsko-Mazurskie voivodeship, as well as in the northern part of Mazowieckie voivodeships), western Poland (Zachodniopomorskie, Lubuskie and Dolnośląskie voivodeships), southern Poland (Opolskie, Śląskie, Małopolskie, and Podkarpackie voivodeships), with a small number of larger mines in central Poland (Fig. 2).

The changes in the structure of domestic demand and its increased level, coupled with the competition among producers and export requirements, have forced a considerable improvement in the quality of the aggregates produced, as well as in the assortment offered. As a result, the share of gravel in the total production of natural aggregates has been increasing until 1996. A sharp decline in aggregates exports in the years 1997—98 resulted in a reduction of gravel's share from 32% to 27%, and it has been sustained in 1999—2000 at 26—28%, though gravel

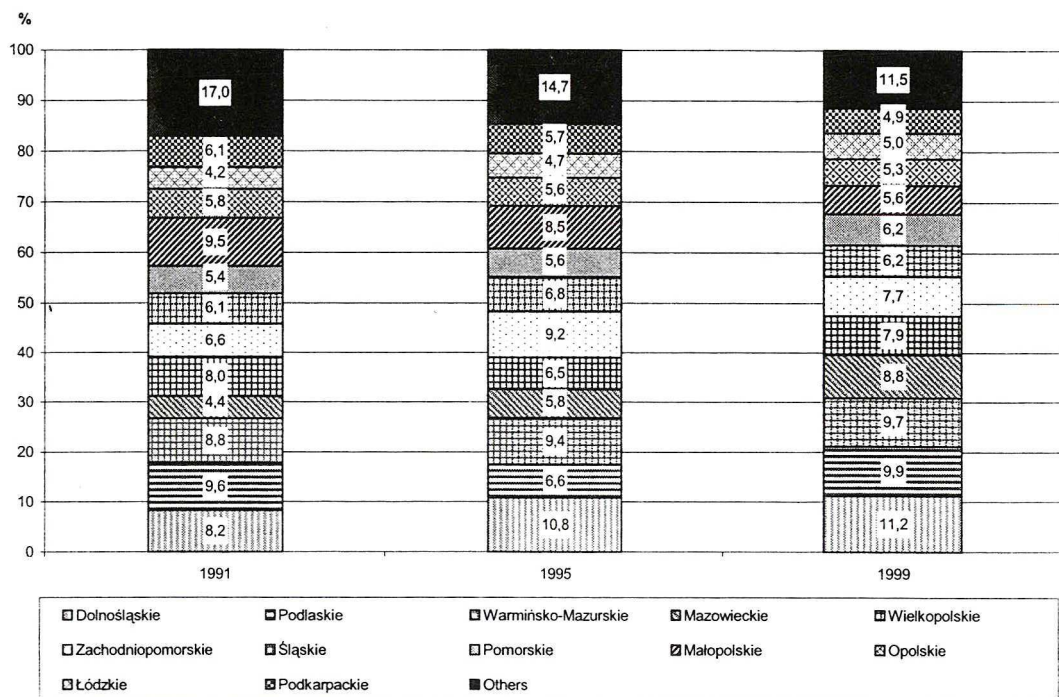


Fig. 2. Shares of leading voivodeships in total mining output of natural aggregates

Rys. 2. Udział czołowych województw w łącznym wydobywaniu kruszyw naturalnych

exports increased again in 2000 (Fig. 3). Assortment structure of natural aggregates production is very variable in different regions of Poland, depending on possibilities of gravel and grits of pebbles production, as well as demand for each group of aggregates. For example, a large share of gravel is reported in western voivodeships (e.g. Lubuskie), where a large portion of production is exported, as well as in the Northeastern Poland (Podlaskie and Warmińsko-Mazurskie voivodeships), where significant amounts of gravel are sold on external markets having deficit of gravel (e.g. Warszawa area). Regions around large cities (e.g. Mazowieckie, Małopolskie, Wielkopolskie, Pomorskie) have more less balanced production structure (Fig. 4), as they serve mainly these metropolies. Of course, there are some differences between them, resulting mainly from the possibilities of coarse fractions production (they are limited for example in Mazowieckie, Wielkopolskie, and Małopolskie voivodeships).

Natural aggregates in Poland are delivered by about 1,000 companies. However, about 43% of the total supply comes from the 13 largest companies, extracting 1—8 million tpy each (Table 2). These most important producers, as well as six smaller ones, are commonly multi-plant companies, which deliver together 50% of natural aggregates supply in Poland. Many of these enterprises have been privatized; some have become joint stock companies (e.g. Wrocław, Szczecin, and Zielona Góra Mineral Mines, “Kruszgeo” Rzeszów, Kraków Aggregate Extraction Works) or limited liability companies (e.g. Olsztyn and Opole Mineral Mines,

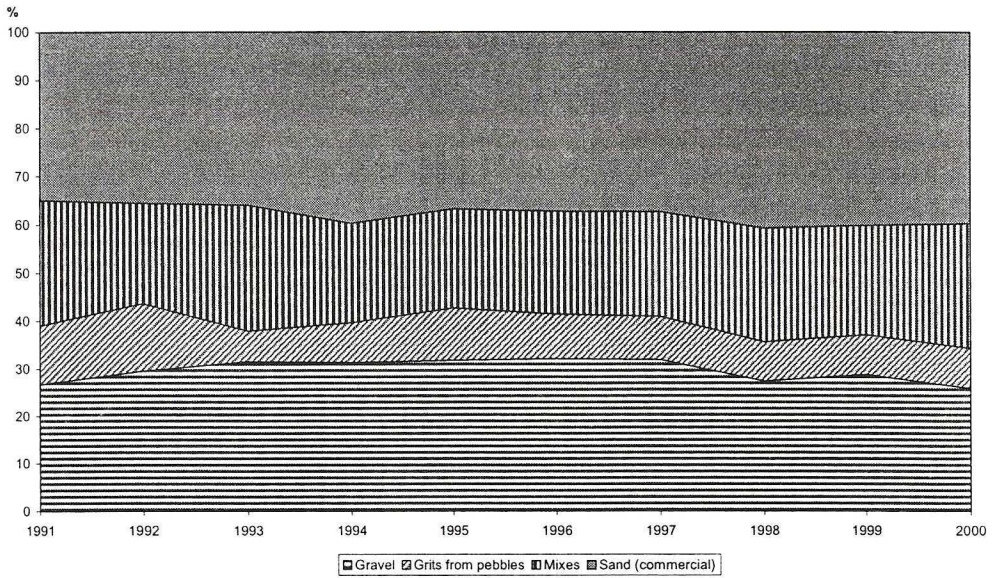


Fig. 3. Shares of particular assortments in total production of natural aggregates

Rys. 3. Udziały poszczególnych sortymentów w łącznej produkcji kruszyw naturalnych

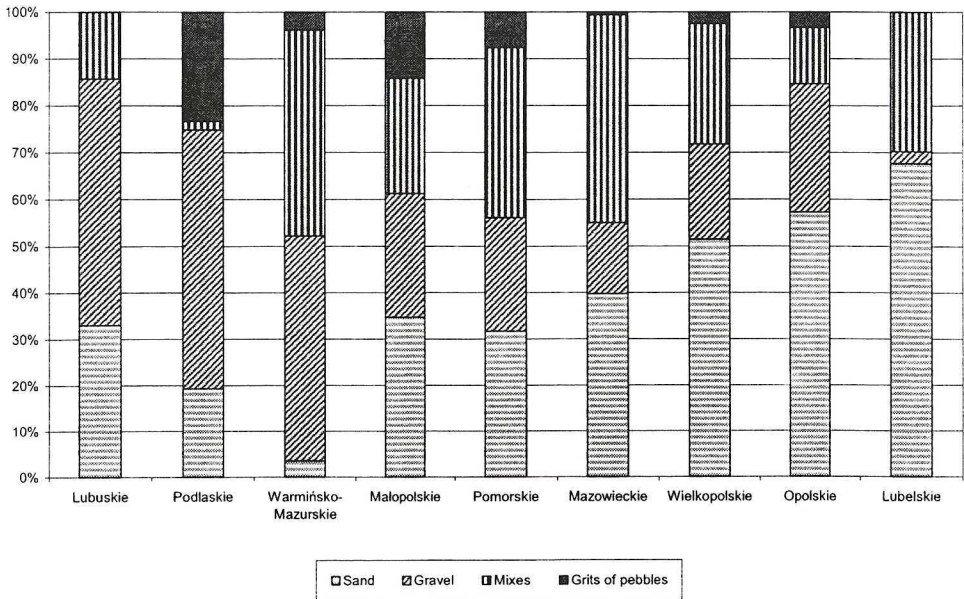


Fig. 4. Shares of assortments of natural aggregates in total production in selected voivodeships

Rys. 4. Udziały poszczególnych sortymentów kruszyw naturalnych w ich łącznej produkcji w wybranych województwach

“Kruszgeo” Poznań). Some of them were sold to foreign investors, e.g. Zielona Góra and Opole Mineral Mines to Belgian/German concern CBR/Heidelberger, Wrocław Mineral Mines to British company Tarmac, Olsztyn Mineral Mines to Finnish company Lohja Rudus (currently owned by Irish company CRH). Other became workers’ companies (“Kruszgeo” Poznań, “Kruszgeo” Rzeszów, Kraków Aggregate Extraction Works, Mineral and Light Aggregates Production Enterprise of Katowice). The number of private one-plant companies, producing

TABLE 2

Leading natural aggregates producers in Poland

TABELA 2

Czołowi producenci kruszyw naturalnych w Polsce

Producer	Voivodeships	Approximate share in domestic production [%]
Olsztyńskie Kopalnie Surowców Mineralnych Sp. z o.o., Olsztyn	Warmińsko-Mazurskie, Kujawsko-Pomorskie, Mazowieckie	8
Suwalskie Kopalnie Surowców Mineralnych, Suwałki	Podlaskie	6
PPKiUG „Kruszgeo” S.A., Rzeszów	Podkarpackie, Małopolskie	5
Zielonogórskie Kopalnie Surowców Mineralnych S.A., Zielona Góra	Dolnośląskie, Lubuskie	4
„Kruszgeo” Wielkopolskie Kopalnie Sp. z o.o., Poznań	Wielkopolskie	3
Szczecińskie Kopalnie Surowców Mineralnych S.A., Szczecin	Zachodniopomorskie, Lubuskie	3
Opolskie Kopalnie Surowców Mineralnych Sp. z o.o., Opole	Opolskie	2
Wrocławskie Kopalnie Surowców Mineralnych S.A., Wrocław	Dolnośląskie	2
Krakowskie Zakłady Eksploatacji Kruszywa „Kruszywo” S.A., Kraków	Małopolskie, Śląskie	2
Kopalnie Surowców Mineralnych „Kosmin”, Łódź	Łódzkie	<2
Białostockie Kopalnie Surowców Mineralnych Sp. z o.o., Białystok	Podlaskie	<2
Przedsiębiorstwo Produkcji Kruszyw Mineralnych i Lekkich, Katowice	Śląskie	<2
Group of mines Szczepański-Danielewicz-Durał	Zachodniopomorskie	<2

Moreover, “Polgravel” Sp. z o.o. Gdańsk, “IMG Gryzyce” Sp. z o.o., Przedsiębiorstwo Produkcji Materiałów Drogowych S.A. Suwałki, “Bonitex” Sp. z o.o. Chełm Góry, Bydgoskie Kopalnie Surowców Mineralnych Sp. z o.o. Bydgoszcz, and KP “Kotłarnia” S.A. Kotłarnia deliver over 1% of domestic natural aggregates production each.

100,000—1,000,000 tpy of aggregates and established in the last decade, is also significant, especially in western and northern Poland. The large and medium companies deliver a wide range of products: many fractions of gravel, mixes, sand, sometimes grits from pebbles. The small companies' offer is usually limited only to non-classified mixes or sand.

1.2. Crushed aggregates

Rocks for the production of crushed and dimension stone occur mainly in Lower Silesia (52% of domestic reserves, mainly granite, basalt, melaphyre, gabbro, porphyry, gneiss, amphibolite, serpentinite), in the Świętokrzyskie Mountains (22%, limestone, dolomite, sandstone, and chalcodonite.), in the Silesia-Kraków region (11%, dolomite, limestone, porphyry, diabase), and in the Carpathians (13%, sandstone). The total reserves of crushed and dimension stone deposits amount to over 8 billion t in over 500 deposits.

The mining output of crushed and dimension stone in Poland reached its peak of ca. 35 million tpy at the end of the 1970s. Later, until 1989, the figure remained in the vicinity of 30 million tpy. In 1990—91, output volume abruptly dropped by 55% to less than 14 million tpy in 1992—93, as a result of crisis of road, railway, and civil construction industries. However, since 1994 gradual increase of both mining output and crushed aggregates production have been noted, to 23—24 and 28—30 million tpy, respectively (Table 3, Fig. 5). The most significant growth was reported in case of crushed aggregates made of melaphyre, diabase, granite, limestone, and dolomite. This increasing tendency has been stopped in the last two years. It is well observed that the most important rocks used for crushed and dimension stone are: basalt, melaphyre, limestone, dolomite, sandstone and granite. The growing importance of melaphyre is noticed, while especially importance of sandstone decreased, comparing to the 1980s (Fig. 6).

TABLE 3

Crushed aggregates statistics in Poland ('000 t)

TABELA 3

Gospodarka kruszywami łamanymi w Polsce [tys. t]

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Mining output ¹	29 430	18 530	14 809	13 979	13 842	16 312	17 513	18 180	20 618	23 113	23 877	24 105
Production	30 602	16 254	13 404	10 008	12 033	15 829	19 809	20 601	23 175	28 006	30 324	27 661
Imports	0	20	—	50	101	219	187	91	162	352	514	1 050
Exports	0	29	273	1 076	1 147	1 308	1 281	858	578	243	122	269
Consumption ^a	30 602	16 245	13 131	8 983	10 986	14 740	18 715	19 834	22 759	28 115	30 716	28 442

¹ — from deposits of crushed and dimension stone; ^a — apparent.

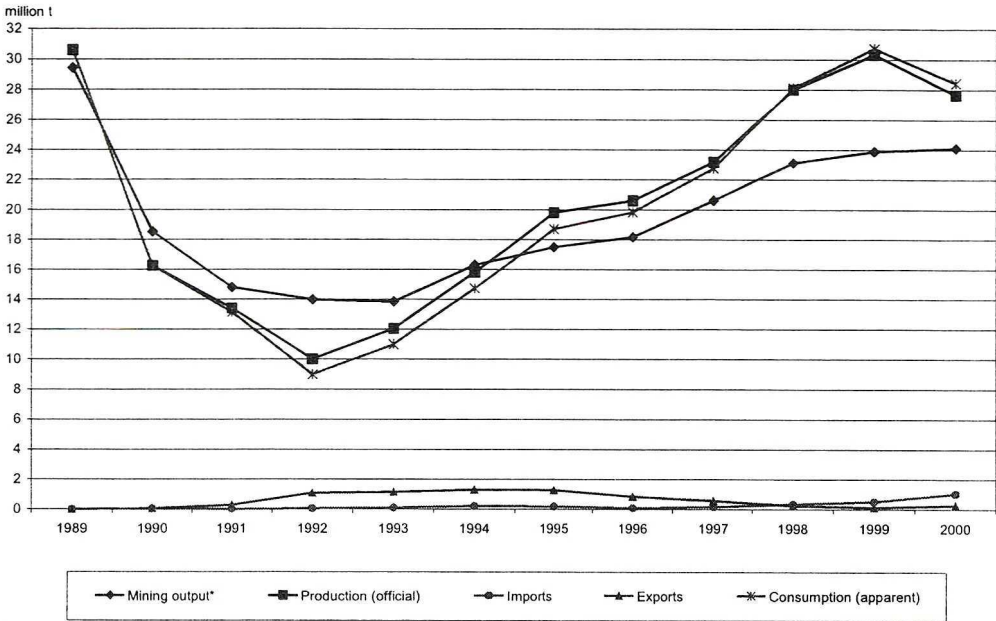


Fig. 5. Crushed aggregates statistics in Poland
 Rys. 5. Gospodarka kruszywami łamanymi w Polsce

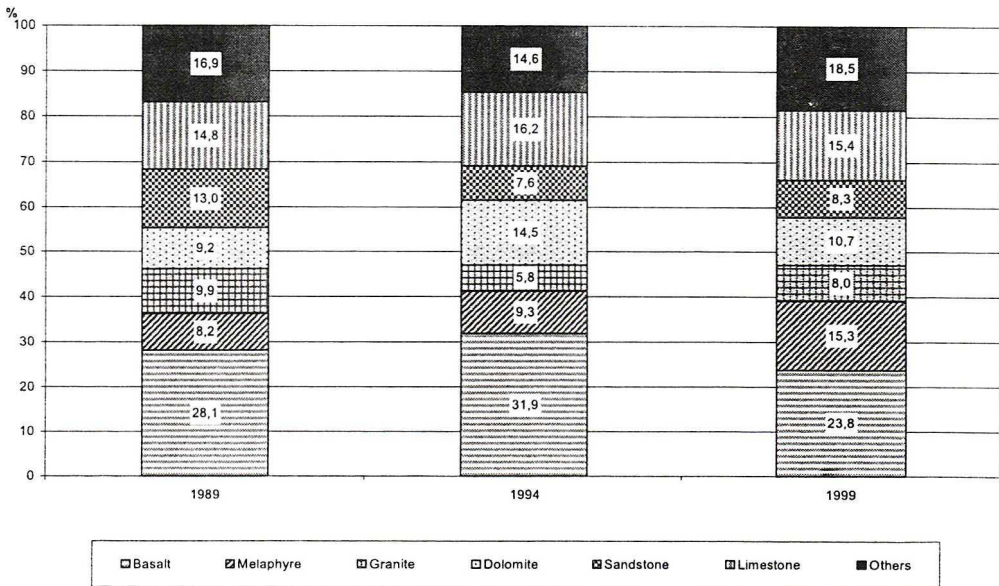


Fig. 6. Shares of different rock type in total crushed and dimension stone output
 Rys. 6. Udział różnych typów skał w łącznym wydobyciu kamieni budowlanych i drogowych

Most of the extracted rock material is crushed and the main products are various fractions of breakstone, key aggregate, and grits. Only a small portion of the rock is extracted and dressed into dimension blocks suitable for the production of slabs, pitcher, curbs, etc. Production of crushed aggregates was over 30 million tpy in the 1980s, but it dropped to only 10 million t in the early 1990s. However, since 1993 it was climbing back up, exceeding 30 million t in 1999 (Table 3, Fig. 5). In 2000, due to slowing down of industrial investment, increase of competition of aggregates from secondary materials, as well as growing imports, production has been reduced to under 28 million t. Official production of crushed aggregates since 1995 is much higher than official mining output of crushed and dimension stone deposits, though some part of this output is used as dimension stone. This is because rocks from other groups of deposits are also partly used for the production of crushed aggregates, for example: limestone from deposits recognized for the lime and cement industry (ca. 2 million tpy), waste dolomite rock in zinc-lead mines (ca. 1 million tpy), and dolomite rock from deposits recognized for smelters and refractories (ca. 1 million tpy).

The main rocks used for crushed aggregates continue to be basalt, melaphyre, granite, and gabbro/diabase among magmatic rocks; amphibolite among metamorphic rocks; and dolomite, limestone, and sandstone among sedimentary rocks. Among the magmatic rocks the most intensively exploited are: basalt (ca. 5.4 million tpy) in 18 mines of various size, melaphyre (ca. 3.2 million tpy) in four large mines, granite (over 2.0 million tpy) in over 20 quarries of different size, gabbro/diabase (ca. 1.9 million tpy) in three quarries. Single quarries of porphyry, and syenite are of minor importance. The whole output of basalt, melaphyre, porphyry, diabase, and gabbro is used for crushed aggregates production, while in case of granite and syenite this share amounts to 60—70% (the rest is mined and used as dimension stone). All quarries of magmatic rocks are located in Lower Silesia, except 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 of metamorphic rocks used for crushed aggregates production: amphibolite, serpentinite, gneiss, and — recently — hornfels (total output of 700,000—800,000 tpy). There are also a few quarries of marble and dolomitic marble with total output of 500,000—600,000 tpy, but they are used primarily as dimension stone (marble) or for the production of flours and grits for glass industry (dolomitic marble). Only some portion of output is utilized for the production of grits for terazzo. All quarries of metamorphic rocks are located in Lower Silesia.

The predominant types of sedimentary rock extracted for crushed aggregates are limestone, dolomite, and sandstone. Limestone crushed aggregates production is concentrated in the Świętokrzyskie Mountains region (over ten 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, e.g. Nordkalk-Miedzianka and Trzuskawica in the Świętokrzyskie Mountains region, and Kujawy in the northern Poland. Total limestone crushed aggregates production is to be around 4.5 million tpy, including ca. 2.0 million tpy from lime plants. Dolomite crushed aggregates production is concentrated in Upper Silesia-Kraków and the Świętokrzyskie Mountains regions. Their total production is estimated to be

TABLE 4

Leading crushed aggregates producers in Poland

TABELA 4

Czołowi producenci kruszyw łamanych w Polsce

Producer	Voivodeships	Type of rock	Approximate share in domestic production [%]
Kopalnie Surowców Skalnych w Bartnicy Sp. z o.o., Bartnica	Dolnośląskie	Melaphyre, diabase	10
Kopalnie Melafiru w Czarnym Borze Sp. z o.o., Czarny Bór	Dolnośląskie	Malephyre	7
Przedsiębiorstwo Górniczo-Produkcyjne "Bazalt", Wilków	Dolnośląskie	Basalt	5
Kopalnia Wapienia „Morawica”, Morawica	Świętokrzyskie	Limestone	3.0—3.5 each
Kopalnie Dolomitu S.A., Sandomierz	Świętokrzyskie	Dolomite, limestone	
„Boloil” S.A., Bukowno	Małopolskie	Dolomite	
Kieleckie Kopalnie Surowców Mineralnych, Kielce	Świętokrzyskie	Limestone, dolomite	
„Nordkalk Miedzianka” S.A., Pickoszów	Świętokrzyskie	Limestone	
Zakład Wapienniczy „Kujawy” S.A., Białawy	Kujawsko-Pomorskie	Limestone	2.0—2.5 each
Kopalnie Odkrywkowe Surowców Drogowych w Rudawie S.A., Rudawa	Małopolskie	Dolomite, sandstone	
Kopalnie Porfiru i Diabazu Sp. z o.o., Krzeszowice	Małopolskie	Prophyry, diabase	
Przedsiębiorstwo Surowców Skalnych „Bazalt-Gracze” Sp. z o.o., Gracze	Opolskie	Basalt	
Zielonogórskie Kopalnie Surowców Mineralnych S.A., Zielona Góra	Dolnośląskie	Basalt, granite	
Kopalnia i Prażalnia Dolomitu „Żelazowa” S.A., Chrzanów	Małopolskie	Dolomite	1.5—2.0 each
Łużyckie Kopalnie Bazaltu „Księginki” S.A., Lubań Śląski	Dolnośląskie	Basalt	
Kopalnie Odkrywkowe Surowców Drogowych, Kielce	Świętokrzyskie	Limestone	
Kopalnie Odkrywkowe Surowców Drogowych S.A., Niemodlin	Opolskie	Basalt, greywacke	
Kopalnie Odkrywkowe Surowców Drogowych Sp. z o.o., Wrocław	Dolnośląskie	Serpentinite, gabbro	
Kopalnie Surowców Skalnych S.A., Złotoryja	Dolnośląskie	Basalt	
Kopalnie Surowców Skalnych „Klęczany” Sp. z o.o., Klęczany	Małopolskie	Sandstone	

about 4 million tpy, including over 1.5 million tpy in eight quarries in Upper Silesia-Kraków region, ca. 1.0 million tpy from waste dolomite rock in zinc-lead mines (Boloil Co.), and ca. 1.5 million tpy from seven deposits in the Świętokrzyskie Mountains region. The mining output of sandstone amounts to ca. 2.0 million tpy, with ca. 90% of output used for crushed aggregates production. This production is concentrated in the Carpathian Mountains, where four large mines and over 15 smaller quarries are in operation. The only large producer of sandstone aggregates outside the Carpathians is Wiśniówka quartzite sandstone quarry in the Świętokrzyskie Mountains. Other small sandstone quarries in Lower Silesia, the Carpathians and Szydłowiec area (central Poland) deliver mainly dimension sandstone. Among mines of other sedimentary rocks used for crushed aggregates production, three greywacke quarries (two in Opole region, one near Kłodzko), as well as one chalcedonite quarry near Tomaszów Mazowiecki, are worth mentioning.

Crushed aggregates in Poland are delivered by almost 130 companies. However, 39% of the total supply comes from eight largest companies, extracting over 1 million tpy each (Table 4), next 13% from six large companies delivering 0.6—1.0 million tpy each (constituting 2.0—2.5% of domestic production each), while 10% from 6 medium companies with production in the range 0.4—0.6 million tpy (1.5—2.0% share each). The majority of companies possess one or two plants, while multi-plant companies (3—5 mines) are rather rare.

The ownership structure of the Polish crushed and dimension stone industry has changed significantly in the 1990s. The scope of privatisation was on companies delivering dimension stone (granite and sandstone), while percentage of privatised crushed aggregates producers is much smaller. Nevertheless, growing number of Lower Silesian crushed aggregate producers, as well as some producers in other regions, are currently private entities. However, some important crushed aggregates producers, especially those operating basalt and limestone deposits, are still state-owned enterprises, or currently privatized.

1.3. Aggregates from secondary materials and artificial aggregates

Aggregates from secondary materials are obtained in Poland from metallurgical slag, and from self-burned coal shale (shale gravelite aggregates). Among metallurgical slag, blast furnace slag is the most important, but converter slag has also importance. Though figures on their production are not available from the Central Statistical Office, it is estimated that their production amounts to ca. 5 million tpy. "Slag Recycling" Ltd. of Kraków, utilizing the slag dumps of the Sendzimir Steelworks, is the most important producer of this type of aggregates (2.2 million t in 2000). The other operate primarily near Upper Silesian steelworks, e.g. "HK Eko-Grys" in Dąbrowa Górnicza, "Łabędy" Smelter in Gliwice, "Ehazet" in Katowice, "Behatex" in Ozimek, and many others. Shale gravelite aggregates are currently manufactured by several companies in Upper Silesia, e.g. "Renova" Pszów, "Renobud" Bytom, "Gwarex Ryan Poland" Katowice, "Haldex" Katowice, "Tercharpol" Czeladź, and many others. Their combined production probably exceeds 2 million tpy.

Artificial aggregates are currently produced by thermal processing of clays and fly ashes. First type of such aggregates, i.e. gravelite from clays, is currently produced by two companies:

“Optiroc Gniew” Ltd. in Gniew near Gdańsk, and “Keramzyt” Lightweight Aggregates Enterprise Ltd. in Mszczonów near Warszawa. Their combined production currently amounts to ca. 160,000 tpy (ca. 310,000 m³py). Second type — ash gravelite — is manufactured by “Pollytag” S.A. of Gdańsk, which bases on fly ash from the nearby “Wybrzeże” Power Plant. It sells over 100,000 tpy of such aggregates under trade name “pollytag”.

2. Analysis of mineral aggregates market in Poland

Value of domestic aggregates market is estimated to be over 1.6 billion PLN in 2000, of which over 1.0 billion PLN falls to natural aggregates market, over 600 millions PLN to crushed aggregates and under 100 million PLN to other aggregates. 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 (Table 5), while ca. 50% of natural aggregates sales and over 10% of crushed aggregates sales falls to smaller companies. However, this official data well illustrate the fact, that this market started to be stagnant in 2000. Such stagnation on the

TABLE 5

Value of domestic minerals aggregates market¹ (million PLN)

TABELA 5

Wartość krajowego rynku kruszyw mineralnych

	1993	1994	1995	1996	1997	1998	1999	2000
Natural aggregates:								
Total sales of domestic producers	121.6	162.4	202.4	285.0	391.0	427.5	510.4	525.1
— Sand	28.1	42.9	52.9	79.9	107.0	125.8	148.2	151.9
— Gravel	58.3	74.3	89.5	123.6	166.1	177.9	228.3	225.8
— Mixes	22.7	25.9	32.5	44.2	66.3	65.9	64.8	62.0
— Grits from pebbles	12.5	19.3	27.5	37.3	51.6	57.9	69.1	85.4
Exports of domestic producers	60.3	75.6	82.9	85.9	49.3	24.2	19.6	22.5
Imports	0.8	1.4	2.3	2.9	3.1	4.4	4.7	3.8
Total sales on domestic market	62.1	88.2	121.8	202.0	344.8	407.7	495.5	506.4
Crushed aggregates:								
Sales of domestic producers	73.4	117.0	169.2	227.9	308.0	441.1	513.5	512.9
Exports of domestic producers	11.7	13.4	15.3	13.4	9.8	4.3	3.0	3.7
Imports	1.3	2.7	2.9	3.5	6.6	13.4	21.5	37.8
Total sales on domestic market	63.0	106.3	156.8	218.0	304.8	450.2	532.0	547.0

¹ — excluding small producers (<50 employees).

domestic aggregates market is also illustrated by the average unit values of main aggregate assortments, which also stabilized in nominal terms (and even decreased in real terms) in 2000 (Table 6), after a few years of consecutive increase. 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. 6 PLN/t in western and NE Poland to 18 PLN/t in Kraków region, while average price of gravel from under 20 PLN/t in Upper Silesia to over 35 PLN/t in Łódź and Gdańsk area.

TABLE 6

Unit values of main mineral aggregates assortments (PLN/t)

TABELA 6

Wartości jednostkowe głównych sortymentów kruszyw mineralnych [zł/t]

	1993	1994	1995	1996	1997	1998	1999	2000
Sand	3.4	4.2	5.5	7.2	8.7	9.5	10.0	9.8
Gravel	7.5	9.0	10.7	12.6	15.5	18.2	21.0	22.8
Mixes	4.0	5.1	5.9	7.5	8.7	9.6	10.4	10.5
Grits from pebbles	6.5	7.0	9.2	12.9	17.0	19.0	22.1	21.7
Crushed aggregates	6.6	7.8	9.8	12.7	15.3	18.0	19.4	21.2

The main areas of aggregates consumption in Poland are connected with a few large cities. The most important aggregates markets in Poland are assumed to be as follows: Warszawa region — 20—21% of the domestic market, Upper Silesia — 12—13%, Kraków, Poznań, Wrocław, Gdańsk regions — 6—7% each, Łódź region — 5—6%, Szczecin region — 4%. These markets comprise almost 70% of domestic aggregates consumption. The rest, i.e. ca 30%, is consumed in smaller regional markets. In case of natural aggregates, a large part of these regional markets is almost “self-sufficient”, i.e. supplied primarily from local sources. The important exceptions are Warszawa and Łódź region, with significant share of natural aggregates deliveries coming from SW, SE and NE Poland. 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. Warszawa 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, imported crushed aggregates started to compete seriously with aggregates delivered by e.g. Lower Silesian producers.

Share of external (foreign) suppliers in domestic natural aggregates market has marginal importance (up to 1%). In terms of volume, imports of natural aggregates are generally not

exceeding 50,000 tpy (Table 1), coming mainly from the Czech Republic. Other situation takes place on crushed aggregates market. Deficit of local sources of such aggregates in the northern and eastern Poland and geographic bonus of foreign supplies to these markets — comparing to supplies from Lower Silesia — results in growing crushed aggregates imports from Sweden, Norway, Finland and the United Kingdom to northern Poland market, Ukraine, and Belarus to eastern Poland market, and even the Czech Republic and Slovakia to southern Poland market. Total imports exceeded 1.0 million t in 2000 (Table 7), and may continue to increase in the next few years. As a result, share of external suppliers in domestic crushed aggregates is continuously increasing, achieving 7% in 2000 (Table 5).

The particularly favorable location of rich deposits in Lower Silesia and the deficiency of aggregates in the eastern Lands of Germany, as well as good transportation network, stimulated aggregates exports from Poland to Germany in the first half of the 1990s. The record volume of these deliveries — ca. 4.3 million t of natural aggregates and 1.3 million t of crushed aggregates — was recorded in 1995 (Tables 8, 9). However, in the years 1996—99 total mineral aggregates exports decreased to under 1.0 million t, due to the reduced demand for aggregates in eastern Lands of Germany, as well as the increase in the aggregates production there.

TABLE 7

Imports of crushed aggregates to Poland ('000 t)

TABELA 7

Kierunki importu kruszyw łamanych do Polski [tys. t]

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Imports, total	50.2	100.8	221.3	186.7	90.7	162.2	352.0	514.2	1 050.4
Austria	0.0	—	2.2	—	—	0.0	—	—	—
Belarus	14.6	23.6	43.0	23.7	5.4	1.6	2.5	37.9	93.0
Czech Republic	6.5	0.0	—	0.5	0.7	13.5	45.9	31.0	53.3
Finland	—	—	—	—	—	—	—	—	15.4
Germany	0.9	1.2	1.5	—	—	3.3	2.3	0.2	0.3
Lithuania	7.6	—	—	—	—	—	0.3	—	—
Norway								20.6	114.8
Russia	5.5	—	—	—	—	5.6	24.8	—	—
Slovakia		—	—	3.1	0.4	2.7	22.8	24.8	95.1
Sweden	—	0.0	2.7	8.6	52.0	74.9	176.4	286.8	414.0
Ukraine	15.1	38.8	30.5	33.4	31.7	60.3	75.7	89.9	182.8
United Kingdom	—	—	—	—	—	—	—	22.9	75.6
Custom warehouses	—	37.0	138.0	117.0	—	—	—	0.1	—
Others	0.0	0.2	0.7	0.4	0.5	0.3	0.3	0.0	6.1

TABLE 8

Exports of natural aggregates from Poland ('000 t)

TABELA 8

Kierunki eksportu kruszyw naturalnych z Polski [tys. t]

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Exports, total	2 417.3	3 255.1	3 872.3	4 339.9	4 051.1	2 371.8	1 073.0	849.4	1 558.2
Czech Rep.	0.5	13.7	58.0	311.2	162.5	101.2	56.7	75.5	26.5
Germany	2 413.0	3 240.4	3 812.8	4 015.5	3 868.8	2 252.1	1 010.8	773.4	1 529.2
Others	3.8	1.0	1.5	13.2	19.8	18.5	5.5	0.5	2.5

TABLE 9

Exports of crushed aggregates from Poland ('000 t)

TABELA 9

Kierunki eksportu kruszyw łamanych z Polski [tys. t]

	19932	1993	19954	19965	1996	19987	1998	1999	2000
Exports, total	1 075.7	1 147.4	1 307.9	1 280.7	858.4	578.5	242.9	122.2	269.3
Czech Rep.	—	1.5	0.2	0.0	1.1	4.2	—	0.0	2.5
Germany	1 075.5	1 145.4	1 306.4	1 279.9	857.1	573.9	242.6	122.0	266.4
Others	0.2	0.2	1.3	0.8	0.2	0.4	0.3	0.2	0.4

TABLE 10

Value of natural and crushed aggregates trade in Poland ('000 PLN)

TABELA 10

Wartość obrotu kruszywami naturalnymi i łamanymi w Polsce [tys. zł]

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Natural aggregates:									
Exports	40517	60 277	75 557	82 936	85 912	49 264	24 178	19 588	22 466
Imports	784	818	1 416	2 347	2 874	3 113	4 375	4 705	3 757
Balance	+39 733	+59 459	+74 141	+80 589	+83 038	+46 151	+19 803	+14 883	+18 709
Crushed aggregates:									
Exports	11 097	11 678	13 398	15 279	13 401	9 824	4 283	3 044	3 742
Imports	368	1 289	2 693	2 885	3 506	6 582	13 361	21 525	37 838
Balance	+10 729	+10 389	+10 705	+12 394	+9 895	+3 242	-9 078	-18 481	-34 092

In 2000, first signs of revival of exports to Germany occurred (exports doubled 1999 figures). The majority of natural aggregates (over 90%) is exported to Germany, the remainder to the Czech Republic. Crushed aggregates are almost exclusively shipped to the eastern lands of Germany. Export sales amounted to over 20% of total sales of domestic natural aggregates producers in the mid-1990s, while in case of crushed aggregates this share was around 10%. Currently, these shares went down to ca. 2% and under 1%, respectively.

The trade balance in natural aggregates was highly positive in the mid-1990s, up to over 80 million PLN in the years 1995—96. However, due to the significant decrease of exports in the last two years, the trade balance was also reduced to under 20 million PLN in the last three years (Table 10). The trade balance in crushed aggregates was traditionally positive, but due to declining exports and rapidly increasing imports, it turned negative in 1998 (for the first time) and reached 34 million PLN in 2000 (Table 10).

3. Trends in domestic consumption of aggregates

The consumption of natural aggregates is closely related to the level of civil engineering work in residential construction, industrial construction, transport infrastructure, etc. Domestic demand for natural aggregates has been continuously increasing since 1994 as a result of visible growth in the industrial construction and — at a slower rate — other sectors of construction. “Official” domestic consumption of natural aggregates (calculated on the basis of official production data) has been continuously increasing, from the level of ca. 25 million tpy to 49 million t in 2000 (Table 1). However, it is estimated, that “real” domestic consumption — taking into account the production of small producers — rose from 38—39 million t in 1995 to as much as 75 million t in 2000.

The construction industry remains the main consumer of aggregates. It is assumed that, depending on the region of Poland, from 60 to 95% of natural aggregates are consumed by the construction industry for the production of ready-mix concrete and concrete prefabricates, 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. These sectors use predominantly classified mixes and gravel (fractions 2—16 and 8—16 mm, mainly for concrete of mark B25 and higher). On the other hand, sand is used for the production of building mortar, construction chemistry products, but some quantities also for concrete. Only a small portion of natural aggregates are used for road building as underlayers.

The most important rock materials for road and railway construction in Poland (mainly for foundations) are crushed aggregates (crushed stone, breakstone, key aggregate, grits), made of basalt, melaphyre, gabbro/diabase, porphyry, granite, amphibolite, gneiss, 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.

Consumption of crushed aggregates, after a threefold decrease to less than 9 million tpy in the years 1990—1992, has rebounded to 28—30 million tpy recently, mainly due to significant investments in the railway and industrial construction. However, this increase was stopped in 2000 (Table 3), due to slowing of national economy development, as well as increasing competition of aggregates from secondary materials, especially in Upper Silesia and Kraków area.

4. Future outlook of domestic aggregates market

The increasing tendency of aggregates production and demand in Poland, which was reported since 1993, was halted in 2000. Supply and demand for natural aggregates yet increased — by 3 and 1.5% respectively, however in case of crushed aggregates they dropped by almost 10% (production) and 8% (demand). First 2001 estimates indicate 20—30% decrease of these figures, comparing to 2000. It is parallel to 6—8% decrease of cement sales and 16—20% decline of ready-mix concrete production. It also means that figures for mineral aggregates came back to 1996—1997 levels. It is a result of slow down of national economy growth (GDP growth decreased from over 5%/y to 1.5%/y), and start of recession in construction sector, reported since 1999. Large reductions in investments occurred in housing and industrial building, as well as in road building too. Improvement of world and Polish economy is expected to occur not earlier than in the second half of 2002, but most probably in 2003 or 2004. In Poland, GDP growth is expected to amount to ca. 2—3% in 2002, and to 5—6% in 2004—2005. If these predictions will come true, real improvement on domestic aggregates market will occur not earlier than in 2003.

Significant changes will occur on this market, especially in respect to the assortment structure and sources of supply. They will be less important in case of natural aggregates, but more serious in crushed aggregates sector. Since the late 1990s, aggregates from secondary materials have become very important competitors of domestic crushed aggregates, similarly as imported crushed aggregates, which utilize geographic bonus in northern and eastern Poland. Moreover, use of limestone aggregates will be diminishing as a result of their weak quality parameters and lower subsidies to limestone fertilizers manufactured together with these aggregates.

As a consequence of the above presented conditions, real chance of aggregates market growth — comparing to 2001 figures — will occur in 2003 or even later. In the next years, there is a chance for further growth of domestic aggregates production and consumption, if growth of national economy will accelerate. In case of natural aggregates, it is probable that 1999/2000 figures will be achieved again in 2005 (Table 11). Depending on overall situation in construction industry, on level of funds for construction investments (especially in road-building), as well as on technological trends in road construction (wider use of concrete pavements), demand for natural aggregates can be increasing at 3—5%/y rate in 2006—2010 (Table 11). Balance between mining output and production figures will diminish, as increasing amounts of sand will be utilized in dry mortars.

Growth rate of demand for crushed aggregates would be similar as for natural aggregates, but it will be restricted by further increase of importance of aggregates from secondary materials

TABLE 11

Predictions of domestic market of mineral aggregates in 2005 and 2010 (million t)

TABELA 11

Prognozy krajowego rynku kruszyw mineralnych w 2005 i 2010 r. [mln t]

	2005	2010
Natural aggregates:		
Mining output	85—86	100—110
Production	71—73	92—101
Consumption	69—71	90—98
Crushed aggregates:		
Mining output ¹	24—25	30—31
Production	27—28	32—33
Consumption	29—30	34—35
Aggregates from secondary materials:		
Production = Consumption	8—10	10—12
Artificial aggregates:		
Production = Consumption	<1	1—2

¹ — from deposits of crushed and dimension stone

(especially from metallurgical slag). As a result, it can achieve the level of 29—30 million t in 2005 and up to 35 million t in 2010 (Table 11). Growing foreign deliveries will also influence this market, taking even 10% share (if it will be competitive by price and quality), so domestic supplies of crushed aggregates will amount to 27—28 million t in 2005 and 32—33 million t in 2010. The share of carbonate aggregates (especially limestone ones) will be diminished. The majority of crushed aggregates will still be produced on the basis of deposits recognized as crushed and dimension stone deposits, with probable slight decrease of significance of other sources (limestone aggregates from the lime and cement industry, dolomite aggregates from zinc-lead mines and from deposits recognized for smelters and refractories).

Supplies of aggregates from secondary materials can grow from current level of 7—8 million tpy to even 10—12 million t in 2010, but further growth is rather not probable, as amount of such secondary material having appropriate quality is limited. Level of artificial aggregates obtained by thermal processing will probably not exceed 1 million tpy.

Consolidation processes in this industry will be continued. The importance of large and medium companies, offering a wide range of aggregates representing appropriate quality, will be still increasing. Their share in the domestic market will grow to 2010 from 50% to 70—80% in case of natural aggregates, as well as from 60% to 70—80% in case of crushed aggregates. The role of small producers will be diminished, because they cannot compete with large companies due to technical and economic reasons. Their number will be reduced by 50—70%, and they will

primarily supply only very small local markets. Some of them, possessing large deposits of good quality aggregate, can consolidate themselves into larger companies of regional importance. If not, they can be bought out by large aggregate companies, operating often in the structure of larger construction or mineral companies.

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TADEUSZ SMAKOWSKI, KRZYSZTOF GALOS

EWOLUCJA RYNKU KRUSZYW MINERALNYCH W POLSCE

Słowa kluczowe

Kruszywa naturalne, kruszywa łamane, źródła, produkcja krajowa, rynek kruszyw

Streszczenie

Artykuł prezentuje źródła i produkcję kruszyw mineralnych w Polsce w ostatnich latach, jak również charakteryzuje rozwój ich krajowego rynku w latach dziewięćdziesiątych. Przedstawione są także relacje pomiędzy poszczególnymi grupami kruszyw, a także znaczenie obrotów międzynarodowych tą grupą surowców. W podsumowaniu przed- stawiono przewidywany rozwój krajowego rynku kruszyw w najbliższych latach.