

WIESŁAW BLASCHKE*, LIDIA GAWLIK**

Coal preparation in Poland in the view of economic reform

Key words

Coal preparation, coal quality, coal preparation equipment

Abstract

The paper discusses the changes that occurred recently in coal mining industry, and especially in coal preparation. The current condition of coal preparation industry is described. The types of existing coal preparation plants are presented and applied equipment. The changing role of coal preparation due to changes in the coal market is noticed.

Introduction

In 1999 coal output in Poland was 109.2 mln tonnes, in 2000 — 102.2 mln tonnes. The percentage of steam coal in the total coal production is about 83.2%, while 16.8% of the total production is coking coal. The amount of coal produced ranks Poland as a second biggest coal producer in Europe. Proved coal reserves in Poland are about 5.8 bln tonnes.

Hard coal is the basic energy source in Poland and it is foreseen to keep its position in a long future. However, in last few years coal sales in the domestic market have decreased significantly. In 1988 domestic sale of coal was equal to 156.3 mln tonnes, while in 1999 only 83.7 mln tonnes. In 2000 coal producers sold only 77.9 mln tonnes of coal in the domestic market. This is a result of the changes towards less energy consumption type of production in Poland, as well as the rising competitiveness of other primary sources of energy.

* Prof. D.Sc. Eng., ** Ph.D. Eng., Polish Academy of Sciences, Mineral and Energy Economy Research Institute, Kraków, Poland.

Poland has always been a significant coal exporter. In 1988 coal export was 32.3 mln tonnes. It has to be said that coals export decreases recently. While in 1997 coal export was still 30.6 mln tonnes, in 1999 it decreased to 25.2 mln tonnes and in 2000 to 23.0 mln tonnes. Coal export decrease is a result of relatively low coal prices in the international markets. In existing conditions of international coal prices and costs of transportation coal producers achieve higher prices in the domestic market than in export.

In the former economic system, before 1990, Polish coal mining industry was functioning in so-called “planned economy”. The quantities of coal supplies were decided centrally, both as concerns domestic and international users. It was important to produce what was planned and costs of production were not an issue as the most important thing was to deliver demanded amount of coal. In those years Poland was forced to build many coal mines. In many cases it was clear that coal production would be more expensive than import of coal of equivalent quality.

The situation has changed after the 1990, when the economic system of the country started to change. The economic effectiveness has become important and at the same time central planning of goods deliveries and distribution also collapsed.

Decrease of domestic use of coal as well as lowering coal export causes the necessity of production decrease in coal mining industry and relevant employment decrease. It occurred that the total capacity of mines exceeds the demand of coal in domestic market and possible export. Poland faced the necessity to adjust coal production capacity and close all uneconomic mines. Costs of mine closures currently burden national economy.

The following numbers can illustrate the scale of the problem. In 1975 coal was produced in 81 mines and raw coal production was 213.7 mln tonnes. In 1978 raw coal production was 240.5 mln tonnes. In 1995 there existed 61 mines, while in 2000 — 49. In July 2001 coal was produced only in 41 coal mines.

Mines closures and decrease of demand for coal caused that the number of coal preparation plants and their production capacity occurred to be too high. In 1975 — 102 coal preparation plants were in operation in Poland. It was a result of the extended program launched after the World War II, when 53 new coal preparation plants were built and further 23 were modernised. In the process of mines closure in 90-ties, the coal preparation plants that existed in mines being closed were also closed. At the same time 12 new coal preparation plants were built. The reason for building new coal preparation plants were depreciation of coal seams quality and demand of domestic and foreign users for better quality coal. Before the new coal preparation plants were built all coking coal was washed, while as concerns steam coal — only coarse coal was washed. Steam coal fines of grain sizes below 20 mm were usually sold as raw coal of ash content up to 35—45%. The new coal preparation plants were generally constructed with the aim to wash steam coal fines.

Hard coal is mined in Poland in underground mines. Mechanisation of exploitation processes causes that raw coal contains substantial percentage of contamination. Quality of raw coal is not easy to control. Therefore an appropriate method of coal preparation is needed to meet users demand for coal quality. It has to be said that still some amounts of coal fines are sold without washing, mainly to those power plants where boilers are built for low quality coal fines. These users prefer unwashed coal, as such coal is cheaper than the washed one. In some coal mines raw

coal is relatively of good quality and in fact it does not need washing. Therefore after separation it into size ranges it is sold at good price.

Currently about 57% of raw coal are washed in Poland.

Coal preparation process depends generally on:

- quality characteristic of coal in seams and the rate of contamination of coal during the exploitation process,
- quality and quantity demands of coal users,
- price relation between coals of different quality.

1. Quality of hard coal

Coal quality in seams is very good. In currently exploited seams coal quality is as follows:

Heat content — 80.4% of reserves is of heat content above 25 MJ/kg, 14.9% in the range of 22—25 MJ/kg and only 1.1% of seams is of heat content below 20 MJ/kg.

Ash content — 47.7% of reserves is located in seams of ash content lower than 10%, 37.2% in the range of 10—15% of ash content and only in 6% of reserves ash content is above 25%.

Sulphur content — 33.4% of reserves is in seams of sulphur content lower than 0.6%, 36.8% of seams has sulphur content between 0.6% and 1.0% and only in 6.9% of seams sulphur content is above 2.0%.

During the exploitation process quality of mined coal becomes much lower than quality in-seam coal and thus heat content of coal directed to coal preparation plants is usually between 14.9 MJ/kg to 24.2 MJ/kg, and ash content in this coal is between 17% and 42%.

High ash coal has to be and usually is washed.

In 2000 out of 139.8 mln tonnes of raw coal, 37.6 mln tonnes of tailings was separated in coal preparation plants. In 1975 the amount of tailings was 42.6 mln tonnes, in 1978 — 47.9 mln tonnes. Amount of separated tailings has decreased only recently. In 1995 it was still very high — 47.7 mln tonnes.

Sulphur content varies from 0.45% to 1.22% in saleable fines of steam coal and the average for the entire production equals to 0.83%.

Ash content in saleable steam coal varies from 8.0% to 24.1% and the average is 19.1%.

Heat content varies from 29.7% to 19.8% and the average is 22.4%.

In coarse coal ash content is seldom higher than 10% and the average in 1999 was 6%. Sulphur content is usually lower than 0.9 (average 6.8%) and heat content is usually higher than 27 MJ/kg.

Saleable products of coking coal are usually of good quality. Sulphur content varies from 0.51—0.87% (average 0.67%), ash content 5.8—8.3% (average 6.8%) and heat content varies from 28.2 MJ/kg to 31.6 MJ/kg (average 29.5 MJ/kg). It has to be said that quality parameters of steam coal are in Poland usually given as received, while coking coal quality parameters are in dry basis.

In 2000 — 85.0 mln tonnes of steam coal was produced, out of which 41.1 mln tonnes of washed coal:

- 8.6 mln tonnes of coarse coal,

- 4.0 mln tonnes of middle size grades and
- 28.5 mln tonnes of coal fines.

3.8 mln tons were middlings from coal preparation plants.

Out of 85.0 mln tonnes of steam coal –40.1 mln tonnes were unwashed fines of steam coal. 17.2 mln tonnes of coking coal was produced in 2000, out of which 14.0 mln tonnes were fines concentrates while 3.2 mln tonnes were flotation concentrates.

Table 1 shows the comparison of the coal production structure in 1999 and 2000.

TABLE I

Coal production structure in 1999 and 2000

TABELA I

Struktura produkcji węgla kamiennego w latach 1999 i 2000

		Production [mln t]		Change [%]	
		1999	2000		
Steam coal		90.3	85.0	-5.9	
Out of which	washed coal	42.1	41.1	-2.4	
	out of which	coarse coal	10.8	8.6	-20.4
		middle size grades	3.0	4.0	33.3
		fines	28.3	28.5	0.7
	coal mixtures	4.5	3.8	-15.6	
	unwashed coal	43.7	40.1	-8.2	
Coking coal		18.9	17.2	-9.0	
Out of which	fines concentrates	14.6	14.0	-4.1	
	flotation concentrates	4.3	3.2	-25.6	
Total		109.2	102.2	-6.4	

Within only one year coal production decreased by 6.4%. The coking coal production in 2000 was lower than in 1999 by 9.0%. Substantial decrease of flotation concentrates of coking coal (25.6%) was observed. Decrease of steam coal productions (in total by 5.9%) comprised in decrease in all grades and type of steam coal, in spite of middle size grades, that is a result of very deep drop in demand for coarse coal.

2. Characteristic of Polish coal preparation plants

Currently in Poland operates 43 coal preparation plants. Their total production capacity is 46.7 thousand tonnes of feed per hour. Plants operate 16 hours per day, so they can wash 186.9 mln tonnes of raw coal during the year.

In all coal preparation plants there exist section for preparation of middle and coarse grains (above 20 (10) mm). Production capacity of those sections was 90.8 mln tonnes of raw coal in 1999. In 38 coal preparation plants there existed sections for preparation fines of grain sizes from 20 (10) mm to 0.5 mm. Sections for slimes flotation worked in 16 coal preparation plants. They treated coals of grain sizes from 1.0 (0,5) mm to 0 and could wash 10.1 mln tonnes of raw coal.

Capacities of coal preparation plants and their sections are not fully used, as they work only to meet market demand. Production capacities of coal preparation plants were used in 2000 in 69.2%, while sections for coarse grains preparation only in 44.4%, fines sections in 77.8% and the flotation sections in 72.4%.

Table 2 shows rate of utilisation of coal preparation sections in 1999 and 2000.

TABLE 2

Utilisation of production capacity of coal preparation plants in 1999 and 2000

TABELA 2

Wykorzystanie zdolności produkcyjnych zakładów przeróbki węgla w latach 1999 i 2000

	% of total capacity utilisation	
	1999	2000
Total production capacity	68.0	69.2
Sections of coal prep. plants:		
Coarse grains preparation	44.3	44.4
Fines	79.2	77.8
Flotation	66.5	72.4

Within one year five coal preparation plants were closed. As a result utilisation of the total production capacity increased from 68.0% in 1999 to 69.2% in spite of decrease of total production by 6.4%. Utilisation of coarse grains preparation sections and flotation sections have increased, while utilisation of fines section in 2000 was lower than in 1999.

Technical and technological schemes of coal preparation plants differ depending on the type of washed coal (steam coal or coking coal) and range of washing (all grain sizes or only some of them). It also depends on the time of construction and modernisation of the plant.

Polish coal preparation plants are generally equipped with modern machines, but some old equipment, built in 50-ties can also be found. When they were constructed, coal preparation plants were equipped with the best possible machines (at current stage of development). These usually were Polish machines and the import was done only if Polish machines could not be found. In the last few years, as the new coal preparation plants were built by foreign companies, the number of foreign machines in the industry have increased. In most cases those imported machines were not cheaper or better than the Polish ones, but the conditions of equipment deliveries were established by the investors.

Generally, steam coal preparation plants can be divided into the following groups:

- I. Two — product washing of grain sizes 200—20 (10) mm in dense media separators or water jigs. Grains below 20 (10) mm are sold as raw coal.
- II. Two — product washing of grains 200—20 (10) mm in dense media separators or water jigs. Two — product washing of grain sizes 20 (10)—2 mm in water jigs or water cyclones. Grains below 0.5 mm are added to coal fines to prepare saleable mixture of steam coal.
- III. Two — product washing of grain sizes 200—20 (10) mm in dense media separators or water jigs. Two — product washing of grains 20 (10)—2 mm in water jigs. Washing of grain sizes 2—0.5 mm in spirals. Two — product washing of grains 0.5—0.2 mm in hydrocyclones.
- IV. Two — product washing of grains 200—20 (10) mm in dense media separators or water jigs. Washing of grain sizes 20—0.5 mm or 12—0.9 mm in dense media cyclones. Washing classes 3 (0.9)—0 (0.2) mm in water cyclones or spirals.
- V. Classes above 0.5 mm are washed in one of above-mentioned schemes. For the class below 0.5 mm flotation is used.
- VI. Three — product washing is used in some coal preparation plants. Separated middlings are re-washed or sold as coal of lower quality.

The following two groups of technological schemes of coking coal preparation plant can be distinguished:

- I. Three — product washing of grain sizes 200—20 mm in dense media separators. Two — product washing of classes 20—0.5 mm in water jigs or in dense media cyclones. Two — product washing of crushed middlings (class 6—0.5) in water jigs or in dense media cyclones. Grains below 0.5 mm are floated.
- II. Selective crushing of raw coal to get grains 60 (50) mm. Three — product washing of class 60(50)—0.5 mm in jigs. Crushing of middlings to below 6 mm and washing of class 6—0.5 mm in water jigs or dense media cyclones. Flotation of grains below 0.5 mm.

Coal preparation plants in Poland were always built as a part of coal mine. To decrease cost of transportation they were located nearby output shafts. Big tanks for raw coal were built to allow continuation of coal mining in case of failure in coal preparation plant. In case of break — down in coal preparation plant raw coal was stored in those tanks.

Raw coal is put from output shaft of mine to the places of preliminary preparation before coal washing. Here there are places where wood, metal, rubber and other rubbish is removed. Too big lumps of coal are crushed. Then coal is put to the preliminary classification, where coal is divided into size classes appropriate to applied technology of washing. Here usually domestic screens (WK, PWK, PWP, PZ, PWE, ZDR, RT) or imported ones (Schenk, Siebtechnik, Don Valley, Livell, Allis) are applied. In Polish coal preparation plants 332 screens are used, out of which 273 are of domestic construction and 59 — from abroad.

Washing of coal sizes above 20 (10) mm is done in Polish dense media separators type Disa (Disa 1, Disa 2S, Disa KU, Disa KR) or in water jigs — also produced in Poland — like (OBZ, OZ, OZL, OS). It has to be mentioned that one separator Drew-Boy from the firm Denver works in one of plants. It washes coal sizes 600—6 mm and is very effective.

There are many types of machines for fine grains washing. Classes 20 (10)—0.5 (0.2) mm are usually washed in Polish jigs (OBM, OM, OS) and domestic hydrocyclones (HWO, HKZ).

In many coal preparation plants foreign machines are installed: Allmineral and Batac jigs, Parnaby and AKW hydrocyclones, Krebs dense media cyclones, Reichert spirals. There are also some concentrators with natural dense media — type Barrel.

Altogether 427 concentrators work in Poland, out of which 351 of Polish production and 76 from import.

Flotation is used to wash coking coal. Also in two of steam coal preparation plants flotation is experimentally used. Polish steam coals are difficult to float. The basic flotation machines are mechanic flotation machines produced in Poland (IZ5, IZ12) and column flotation machines (FLOKOB 12, FLOKOB 24, FLOKOB 40). Also imported flotation machines are used — type Allmineral (Allflot) and Denver.

Many different solutions are used in coal preparation plants for de-watering, as the process is very difficult. De-watering of coarse grains of concentrate takes place in vibrating screens produced in Poland (WP-2, PWP-1, PWE, PWL-Z). Concentrates of grain sizes below 20 mm are de-watered in the set: screen — de-watering sieve (OSO) — vibration centrifuge (WOW) — de-watering machine (Nael). In some plants Humboldt centrifuges (HSG) work, as well as Wemco (H-900) or Humboldt de-watering machines (Konturbex).

Slimes (grains below 0.5 mm) are de-watered in the set: de-watering sieve — hydraulic classifier — radial thickener Dorra — vacuum filter. Vacuum and disc filters are used (FTB, FTC, FTBO), domestic filter presses (PF-570, PF 1.2, PF 1.5) and hydrocyclones HKZ. As concerns imported machines, pressure filters Andritz (HBF-96) and belt filter presses (CPF-2200, PL-2200) can be found. Sieve-sedimentary centrifuges and sedimentary centrifuges are not produced in Poland. They are imported from BIRD, Decanter, Humboldt-Wedag and Wemco. Although they are expensive, they work very well in Polish conditions. Flotation tailings are de-watered in domestically produced filter presses ROW (type PF-570) of the production capacity 10 t/h and in imported presses from Andritz (type CPF-2200) of capacity 15 t/h. Filter presses EIMCO and CENDED 2000 are also used.

Drying of coal concentrates is applied only in coking coal preparation plants. 13 dryers work in Poland, and they are equipped in domestically produced dryer machines (type ROW I and ROW II) and also foreign dryers type Denver and Hoelter. Because of environmental reasons the dryers are to be closed. Decreasing of moisture will be achieved by use of vibration de-watering machines and sieve or sedimentary centrifuges in the technological scheme of the plant.

Coal preparation plants are centrally monitored and controlled from control room. In some parts of the plants the equipment for on-line monitoring of sulphur and moisture content are installed. Some parts of the plants are automated (heavy media, jigs, flotation).

3. Future development of coal preparation in Poland

The current state of coal preparation in Poland is a result of the restructuring of coal mining industry. Closures of mines cause that coal preparation plants that are technologically connected with the mine are also being closed. In many cases these are relatively modern plants. Some of them were bought by private investors, who want to offer services of coal preparation for those

coal mines where the section of coal fines preparation does not exist or the output of mine is higher than the capacity of own coal preparation plant.

Services of coal preparation are the new form of economic operation in Poland. It did not happen by now that coal user (for example — power plant) ordered preparation of coal. The reason is that still in Polish market coal supply is higher than coal demand. Also some system problems of financial nature have not been solved by now. These are level of coal prices and the way of covering costs of the service.

The program of restructuring of coal mining industry includes restructuring of coal preparation in Poland. 47 coal preparation plants have already been closed. At the same time 12 new plants have been built. In the nearest future it is foreseen to build additional 3 new coal preparation and desulphurisation plants and develop 9 existing. Also, if it is needed, all existing coal preparation plants will be modernised. All the developments will be done to add or improve preparation of coal fines (below 20 mm). After all the new investments are finished in 2002, there will be the possibility to produce 28 mln tonnes of washed steam coal fines of a good quality.

When the process of mining industry restructuring is finished and all inefficient mines are closed, the remaining mines will be able to produce coal at low cost. It is essential that they produce coal of the quality that is needed and that the demands of environment are met.

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WIESŁAW BLASCHKE, LIDIA GAWLIK

PRZERÓBKA WĘGLA W POLSCE W ŚWIETLE REFORMY EKONOMICZNEJ

Słowa kluczowe

Przeróbka węgla, jakość węgla, wyposażenie zakładów przeróbczych

Streszczenie

W artykule przedstawiono zmiany jakie zaszły w ostatnich latach w górnictwie węgla kamiennego w Polsce. Szczególną uwagę zwrócono na aktualny stan przeróbki węgla. Omówiono typy funkcjonujących zakładów przeróbczych, opisano pracujące w nich wyposażenie. Zwrócono uwagę na zmieniającą się rolę przeróbki węgla w świetle zachodzących zmian na rynku węgla.