

## THE COKE PRODUCTION IN POLAND AND IN THE WORLD DURING LAST TEN YEARS

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### Abstract

In this paper, the production, export, import of coke in Poland and in the world during last ten years are presented. There are also shown the reasons of changes in coke production and price. An analysis of changes in the prices of this material in recent years was conducted. It was pointed out that in the coming years, the trend in the market of coking coal and coke should be profitable. Increasing steel production will be accompanied by an increase in demand for coke and coking coal.

**Keywords:** coke, coke production, price, demand

### 1. INTRODUCTION

The global growth in steel production, which in 2004 exceeded 1 billion Mg, and in 2012 - 1.5 billion Mg, can be a determinant of the demand for coke in metallurgical processes. The increase in the steel production entails the need to secure adequate quantities of input materials, such as coke, at the level of 350 million tonnes per year. Only in China the demand for coke in 2002 increased by 15%. As in China, the upward trend has been observed in Brazil and India.

The continuing market conditions and deficit of coke caused the price fluctuations in international markets of coking coal and metallurgical coke [1]. In the global market of the coal and coke from the third quarter of 2003 to the second quarter of 2004, an increase in price by 63% was observed. The coal price ranged from 61 to 71 USD per 1 Mg and was at the highest level in Poland since the 80s [2].

The average price of coke in 2003 amounted to 98 USD per 1 Mg, in 2004 increased to 280 - 310 USD. In the third quarter of 2004, the coke prices have reached a record level of 340 - 400 USD per 1 Mg [2], while the average price for 1 Mg of coke in 2005 dropped to 220 USD. So sharp decline in prices was not expected by anyone. This sharp decline was related, among others, with a decrease by 20% in the production of pig iron in Poland in the first half of 2005. However, in 2007 (December) the prices of the metallurgical coke in the global market increased to 430 USD per Mg, which entailed a change in the price of coke in Poland to the level of 400 USD, and in 2011 increased to 470 USD per Mg [3]. After a huge increase in prices for Mg of the coke, there was a drastic fall in the prices. Currently, the price of the metallurgical coke is maintained at 230 USD.

The reasons for increase in the prices of coal and coke in the world in the years 2003-2004 were following: freight price increase, for example, from 10 USD to 27 USD from the direction of South Africa, growth in demand for steel in the world, decrease in the export of coal and coke from China, reducing the production of electricity in nuclear power stations in Europe (extremely hot and dry summer 2003) and hydroelectric power plants - turning to conventional sources, low investment in the field of manufacture of coke (many coke oven batteries were turned off in Europe), planned limit of coal production in many countries - the result of speculative purchases.

The global economic crisis also contributed to the slowdown in steel production, which also affects Polish coke industry. Consecutive reconstruction of the market in 2010 indicates the dynamics and economic recovery, signals a growth of the steel production, and at the same time presages well for future production and sale of steel and increased demand for raw materials, materials and energy [4].

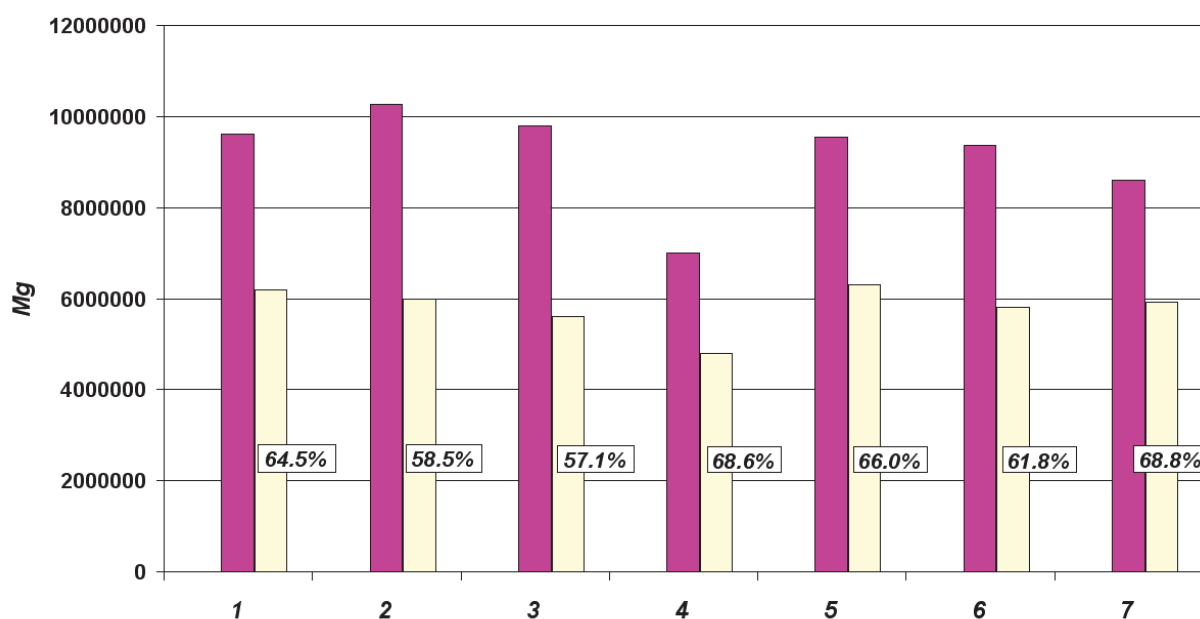
## 2. COKE PRODUCTION IN POLAND

Polish coke industry was necessary industry for the reconstruction and development of the economy in the 50s and the 70s of the last century, reaching maximum production in 1979, i.e. 20 million tonnes of coke. During the reconstruction of the Polish steel industry 7 obsolete coke oven batteries were closed and 30 used coke oven batteries were stopped, and the production decreased. In recent years, production has been stabilized at around 9 million tonnes of coke [5].

Enough constant demand in the domestic market allowed the coking plants to grow exports, which increased from 31% in 1999 to about 50% in 2003, now exports stands at 65%. Variable economic conditions in the international markets of coking coal and coke allowed using production capacity of Polish coking plants in 80%, reaching the level of production of 8.6 million Mg of coke in 2012. Coke production volume and share of exports of this material in the years 2006 - 2012 are shown in **Table 1** and in **Fig. 1**.

**Table 1** Coke production in Poland in 2006 - 2012, Mg [6]

Year	2006 (1)	2007 (2)	2008 (3)	2009 (4)	2010 (5)	2011 (6)	2012 (7)
Coke	9 613 000	10 261 000	9 800 000	7 000 000	9 538 000	9 377 000	8 600 000



**Fig. 1** Percentage share of exports of coke produced in Poland in the past seven years (own study based on [7])

Comparing the production of coke in the years 2006 - 2012 it can be seen that a general stabilization of the production of this material was established.

In Poland at present 8 coking plants work, including 2 steelworks coking plants, with 25 coke oven batteries [8]. The three biggest coking plants, e.g. Zakłady Koksoownicze Zdzeszowice Sp. z o.o., Koksownia Przyjaźń Sp. z o.o., Kombinát Koksochemiczny Zabrze S.A., produce about 80% of the total coke produced in Poland (see **Table 2**).

**Table 2** Production capacity in coking plants in Poland as at 31.12.2011 [8]

	Production capacity, million Mg	Number of coke oven battery	2010		2011	
			production, million Mg	export, million Mg	production, million Mg	export, million Mg
ArcelorMittal Poland SA Department in Zdzeszowice	4.30	8	4.2	2.6	3.83	2.58
Koksownia Przyjaźń Sp. z o.o.	3.30	5	2.60	2.20	2.65	1.95
Kombinat Koksochemiczny Zabrze S.A.	1.30	3	1.20	1.0	1.09	0.89
ArcelorMittal Poland S.A. Department in Cracow	0.66	1	0.66	0.00	0.6	0.00
Wałbrzyskie Zakłady Koksownicze Victoria S.A.	0.62	5	0.50	0.30	0.52	0.34
Koksownia Częstochowa Nowa Sp. z o.o.	0.65	2	0.20	0.10	0.28	0.07
Carbo-Koks Sp. z o.o.	0.24	1	0.20	0.02	0.20	0.03
All together	11.07	25	9.50	6.2	9.2	5.9

Prospective sales markets force from Polish coke industry the necessity of the quality requirements meet. In addition, the crisis also forced the sector to verify the investment plans. In recent years the following projects were implemented:

- in Koksownia Przyjaźń Sp. z o.o. modernization of the coke oven battery No. 1 with a capacity of 740 thousand. Mg coke per year was completed and the investment process of construction of new power unit with approx. 65 MW of power has been started;
- in ZK Zdzeszowice Sp. z o.o. the construction of two coke oven batteries and modernization of the by-products division;
- in ArcelprMittal Poland S.A. D/Cracow modernization of the by-products division and chemical department;
- in KK Zabrze S.A. modernization of the coke oven battery in Dębieńsk;
- in WZK Victoria S.A. modernization of the by-products division and preparatory works for the construction of coke oven battery No. 6;
- in Koksownia Częstochowa Nowa Sp. z o.o. construction of coke oven battery No. 1 with a capacity of about 400 thousand. Mg of coke per year.

### 3. COKE PRODUCTION IN THE WORLD

Today coke production capacity in the world is estimated at over 825 million tonnes per year, of which 80% is concentrated in Asia. It is forecasted that in the coming years the global production capacity will increase, with the greatest growth in China. In Europe, the growth will be limited.

Volume of the global consumption of coke in 2012 amounted to about 600 million tonnes and was slightly lower than in 2011. Marginal decline in the consumption of coke per 1 Mg of the produced pig iron and the growth of share of coal dust in blast furnace production have the little effect for the total demand for coke in the world.

In 2012, in particular in the second half of the year, the markets of coal, coke and steel have been affected by economic slowdown, which resulted in lower production, growth of the inventory and reduced production capacity utilization rate of the coking plants. In the supply chain: coking coal - coke - steel, lower demand for steel resulted in a fall in prices and income from the sale of coke and coking coal. This was particularly noticeable in the European market, where crude steel production in the European Union in the third quarter of 2012 was over 10% lower than in the second quarter of 2012, and in the fourth quarter of 2012 about 2% lower than in the third quarter of 2012. In the entire 2012 in the European Union countries (27 countries) steel

production amounted to 169.4 million tonnes, it means 4.7% less than in the previous year. With the exception of crisis in 2009 it was the worst result in the past decade.

Apparent consumption of steel in Europe in 2012 decreased by 8% compared to 2011, and counting from 2007, the decrease amounted to almost 30%. The only region where in 2012 there was a significant increase in the production of steel was Asia, including China. In other regions the decreases in production was recorded. The production capacity utilization rate of crude steel in the world in the second half of 2012 systematically decreasing (in July: 79.4%, in September: 77.7%, in December: 73.2%). In Europe, nearly one-third of the installed blast furnaces were turned off.

The situation in the steel market has fundamentally affected the coke market. There has been a decrease in sales market of coke in the world from 21.7 million tonnes in 2011 to around 18 million tonnes in 2012. In Poland, the coke production in 2012 was approximately 8.6 million tons, which is 5% lower than in 2011. Polish exports of coke decreased by 7% and amounted to about 5.4 million tonnes. A significant decrease in the demand for coke affected a deeper than expected drop in prices. For example, in November 2012, the price of coke in the European market was around 270 USD per Mg and was about 135 USD per Mg (33%) lower than in November 2011.

The economic slowdown in Europe also influenced the foundry coke market. The decrease in sales in the automotive industry, a major recipient of the foundry coke, up 6.2% compared to 2011, resulted in lower orders and lower prices. In 2012, there was also smaller demand for coke fuel in favour of coal, eco pea coal and other bio fuels and also smaller demand for the industrial coke, which is also exposed to fluctuations. There was a similar situation in case of the coking coal market. In the fourth quarter of 2012, the prices of the coking coal compared to the fourth quarter of 2011 decreased by 115 USD per Mg (40%) [9].

The position of Poland in the world in the field of manufacturing of coke is well established for years. About 2.5% of world production belongs to Poland, which puts this country in ninth place among manufacturers of coke. While in exports in recent years Poland is on the first place [6] (see **Table 3**). However, it must be taken into account the possibility of reduction of the production capacity. An example may be the United States, which in 2003 began to enforce recommendations of the Clean Air Act, which resulted in the liquidation exploited coking plants.

**Table 3** Export volume of coke in years 2010 - 2011 million Mg [10]

Exporter	Export volume, million Mg		Main recipients
	2010	2011	
Poland	6.2	5.9	Germany, Austria, Finland
Russia	5.2	5.5	Finland, countries of West Europe
China	3.3	3.5	countries of West Europe, USA, Brazil, Japan, India
Ukraine	1.5	2.0	Turkey, countries of West Europe
Colombia	1.7	1.5	Germany, countries of West Europe
Other countries	4.8	4.9	USA, India, countries of West Europe, Brazil
All together	22.7	23.3	

The increase in coke production in early 2013 compared to the same period in 2012, is a response to greater demand for this product in the markets. In January 2013 533 thousand. Mg of coke was exported from Poland, which is up to 39% more than in January 2012, and 11% more than in December 2012. The demand for coke in the EU market, where Poland exported in January 2013 30% of coke more than in December 2012, .increased. This was related to the closure of the coke oven batteries in Italy (Steelworks Taranto) and the announcement of further closures in Europe, in ArcelorMittal Group, as well as increase of the demand for steel mills in Brazil and India and increase of the production of pig iron by about 10% in January 2013 compared

to December 2012. Furthermore, the coke inventories accumulated in the previous year by European buyers became used up [11, 12, 13, 14].

Release of Chinese coke from export barriers in the form of customs duties and license did not result in the expansion of this commodity in the global market. In January and February 2013, China exported a total of only 160 thousand. Mg of coke, which would indicate an annual export volume of less than 1 million Mg, which is the same as in 2012.

The biggest recipients of coke in the global markets are: Germany, Brazil, Kazakhstan, India, Austria, United States of America and Romania (see **Table 4**).

**Table 4** Importers of coke in the world in the years 2010 - 2011 w million Mg (own study based on [10])

Importer	Import volume, million Mg	
	2010	2011
Germany	4.1	4.3
Brazil	1.8	2.3
Kazakhstan	1.7	1.7
India	1.4	1.5
Austria	1.3	1.3
USA	1.1	1.0
Romania	1.1	1.0
Iran	0.9	0.9
Serbia	0.8	0.8
Czech Republic	0.7	0.7
Other countries	7.8	7.8
All together	22.72	23.3

## CONCLUSION

The market of coking coal and coke depends on the economic conditions in the steel industry. All long-term forecasts for steel markets are optimistic. In the coming years, the trend in the market of coking coal and coke should be positive. The increase in the steel production will be accompanied by an increase in demand for the coke and coking coal.

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