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Global Markets and New Developments in Coke Production: An Analytical Review of the Eurocoke 2015 Summit

V. I. Rudyka and V. P. Malyna
Giprokoks, Kharkov, Ukraine
e-mail: giprokoks@ic.kharkov.ua

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Abstract—The current state of global steel, coal, and coke markets is reviewed, with particular attention to including those in the European Community and other regions. Market trends and fluctuations in coal and coke prices are discussed. New developments in coke production are summarized.

Keywords: iron, steel, metallurgical coal, coke, global markets, prices, coke production
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The Eurocoke 2015 Summit, held on April 14–16, 2015, in Amsterdam, the Netherlands, gathered together 142 participants from different coal, metallurgical, coke, commercial, engineering, research, logistical, analytical, consulting, manufacturing, refractory, energy, and other companies in 27 countries (Australia, Brazil, Britain, Germany, Italy, Spain, Canada, Norway, Poland, Russia, the United States, Turkey, Ukraine, Finland, and others).

The summit was organized by Smithers Apex (based in Britain and the United States), in consultation with a panel of specialists from the United States, Australia, the Netherlands, Germany, and Poland. Eighteen papers were presented in five thematic sessions.

I. Global finances and market forces.

II. Reducing the divide between theoretical and applied research.

III. Stresses in the industry.

IV. Coal reserves, coal utilization, and technical achievements, by regions.

V. Accomplishments in technology and plant operation.

There were also two round-table discussions devoted to derivatives of coking coal and European coking technology.

We now summarize the various presentations.

1. The summit began with a keynote presentation on the competitive use of biomass and clinkering plastic materials in hot-metal production, by a group of Australian researchers [1].

Scientists from New South Wales State University reviewed prospects for the iron and steel production, on the basis of research into the following topics at the university's Research Center on Safe Materials and Technology:

—the evolution of structure as a means of assessing coke as a blast-furnace heat source;

—iron- and carbon-bearing pellets for iron production and the influence of $CaO–SiO_2–Al_2O_3$ oxidative systems on the reducing properties of the pellets;

—plastic waste as a source of carbon for hot-metal production.

Attention largely focused on reducing the blast-furnace consumption of coke and increasing its efficiency.

The behavior of coke in the blast furnace is complex, associated with physical, chemical, and thermal phenomena in different zones. In laboratory research and in a system simulating the conditions within the blast furnace, the crystal dimension L_c has been determined, as a means of determining the thermal behavior of coke in the furnace.

The research has shown that the evolution of structural order (the variation in L_c) and the variation in chemical composition may be used to assess coke as a heat source in the blast furnace.

The blast-furnace use of iron- and carbon-bearing pellets produced by Japanese ITmKZ technology in a rotating furnace has been studied. The pellets consisted of hematite, synthetic graphite, and binding oxidant (SiO_2, CaO, and Al_2O_3). The influence of the oxidant system $CaO–SiO_2–Al_2O_3$ on the reducing properties of carbon-composite pellets was determined. It was found that pellets containing Al_2O_3 are most promising.

According to the estimates of the New South Wales Research Center, global plastics production is 265 million t/yr, of which only 20% (53 million t) is recy-

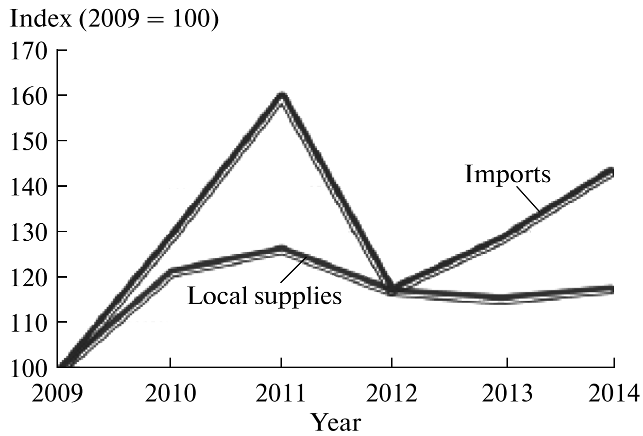

Fig. 1. Supply of metal products to the European market.

cled. Global polymer consumption is 1.475 billion t/yr, of which 302.6 million t (20.5%) is recycled. Some metallurgical companies already have experience with plastic waste as a blast-furnace fuel. For example, Bremen Steel Company (Germany) has successfully replaced the fuel oil added to the furnace batch with plastic waste (50000 t). Japan and Korea have also demonstrated the possibility of such plastics use.

The Research Center has explored the following uses of plastics and polymers:

—rubber tire casings in polymer injection to induce slag foaming within arc furnaces;

—plastic wastes as reducing agents in carbon-bearing pellets (low-pressure polyethylenes, rubber tires, high-pressure polyethylenes, Bakelite);

—plastic wastes as carburizing agents for iron (compact disks, light reinforced carbon polymer, Bakelite, etc.). For example, Bakelite has a high content of $CaCO_3$, which may act as an oxidizing element.

2. According to estimates by the Eurofer European Associated of Metal Producers, the European market for metallurgical coke remains closely tied to steel production and the macroeconomic situation, which markedly improved between 2009 and 2015 [2]. Recently, this has been affected by the drop in spot prices at Rotterdam for BRENT petroleum, as well as the euro's loss in value with respect to the United States dollar. Further economic growth of the European Community is envisaged both by the European Central Bank (ECB) and the Investment Plan of the European Investment Bank (EIB).

The ECB hopes to stimulate credit flows, restore capital, and take other measures to revive the economy of the euro zone and counter inflation.

The EIB's Investment Plan (the Juncker plan) calls for the release of 21 billion euros between 2015 and 2018 as a guarantee for state and private investments, increase in funds in the private capital market, and investment in development projects.

Further increases in steel production are expected in the European Community in 2015 and 2016. In 2014, its growth was 2%; financing and credit become more readily available, with improvement in the investment climate. In particular, demand for steel grew in construction and in the auto industry.

European demand for steel is expected to grow slowly but stably. In 2014, it rose by 3.9%, with a 12% increase in imports. Demand for final products rose by 19%; demand for flat sheet by 15% (40% in China), and demand for long rolled pieces by 33% (by 172% in China). European nations continue to rely on imports. The market share of locally produced and imported metal products is shown in Fig. 1. Imports remain the main burden on Europe's balance of supply and demand.

In 2015 and 2016, demand for steel is expected to grow by 2 and 2.5%, respectively.

Converter production of steel is growing more dominant in Europe. With a total steel output of ~59 million t in 2014, converter steel accounted for ~61% (Fig. 2). Although it still lags the 2007 level by 26 million t, the proportion of converter steel grew by 2.9% in 2014, with expected gains of 2–3% per year in 2015 and 2016. However, precrisis levels of converter production and overall iron production will not be restored.

Coke consumption in iron production will fall on account of increases in pulverized coal, fuel oil, gas, and tar.

3. Wood Mackenzie (the United States) presented information regarding the market dynamics for metallurgical coke [3].

Global Steel Market

World steel production is expected to rise at 1.2% per year up to 2035, reaching more than 2.0 billion t/yr; the corresponding figures for iron are 0.7% and ~1.4 billion t/yr. Demand in India and China will have a profound influence on those markets.

Indian steel production is growing annually and continues to meet domestic demand. However, with adequate reserves of iron ore, India lacks coal for coking. Therefore, it remains to be seen how India will implement its ambitious plans for growth in iron and steel production.

China will dominate global iron production, with peak output in 2023. However, the situation may change, since India also intends to expand its production.

Demand in China will grow more slowly than elsewhere; exports of finished metallurgical products from China will be around 65 million t in 2020. The construction is a major consumer of steel, but demand will grow more rapidly in the auto industry. Total steel demand in China will peak in 2028: ~800 million t.

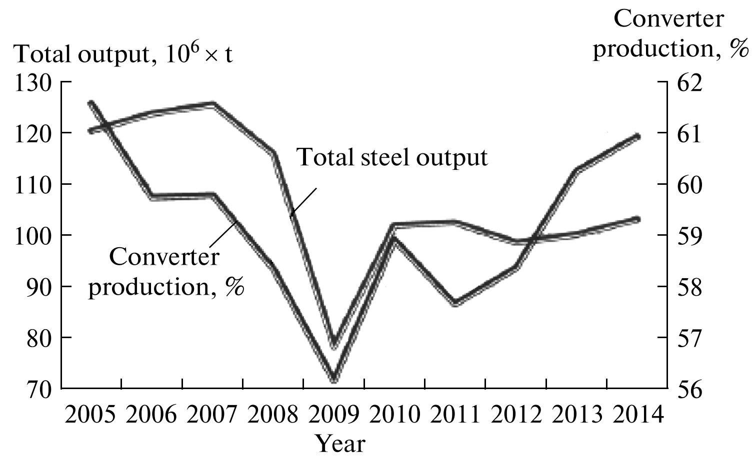

Fig. 2. Total steel production and share of converter production in the European Community.

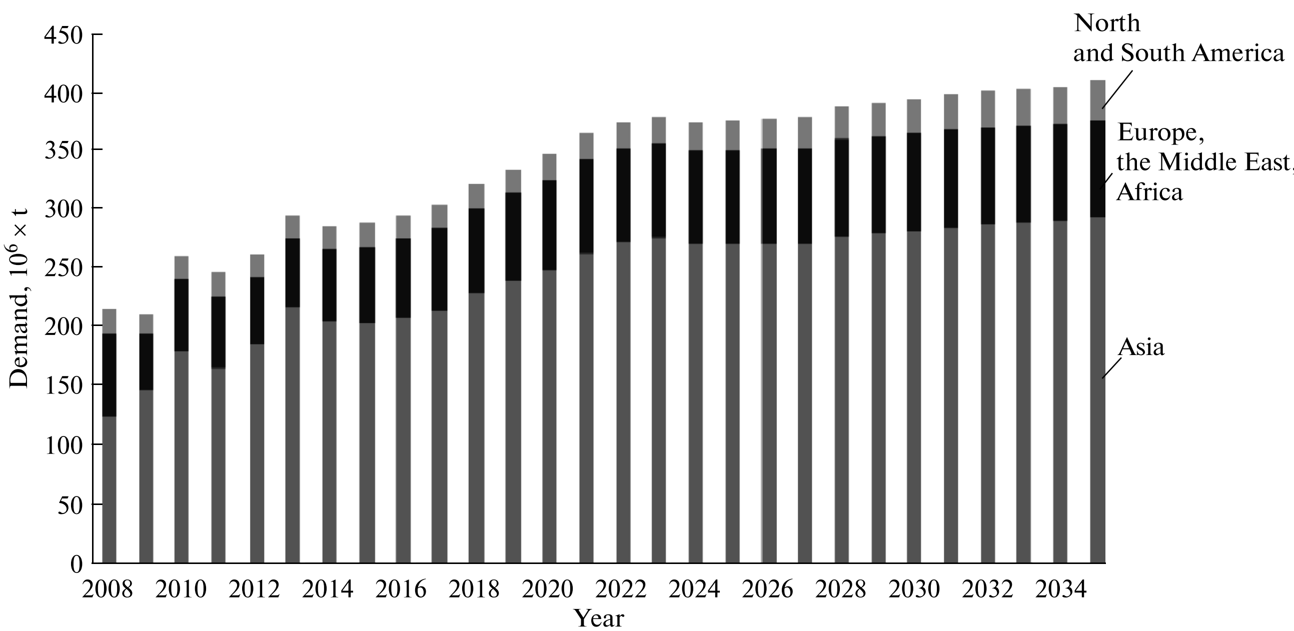

Fig. 3. Global demand for metallurgical coal.

Global Market for Metallurgical Coal

Despite the current lull in global demand for metallurgical coal, Wood Mackenzie expects considerable growth until 2035, with faster economic growth in India and some slowing in China. The total global demand for metallurgical coal will rise to 120 million t in 2035 (Fig. 3). Asia will have a considerable share of this total.

Coal imports to China by sea will reach a peak of 114 million t in 2023; in the case of India, imports by sea will double by 2035.

Regions with good access to the Pacific Ocean will increase their coal supplies to the global market, with an expected total increase of 100 million t/yr by 2035. The largest suppliers of metallurgical coal will include Australia, Indonesia, Canada, Columbia, Mozambique, Russia, and the United States.

Pricing Factors

The next turning point in terms of price will be 2018, on account of growing demand and shrinking coal reserves. In January 2015, the mean spot price for hard coking coal was \$106/t.

In the near future, there will be an excess of hard coking coal. Demand for new projects will appear by 2018 and may be partially met by the restoration of mines. Therefore, prices may strengthen in 2019. The

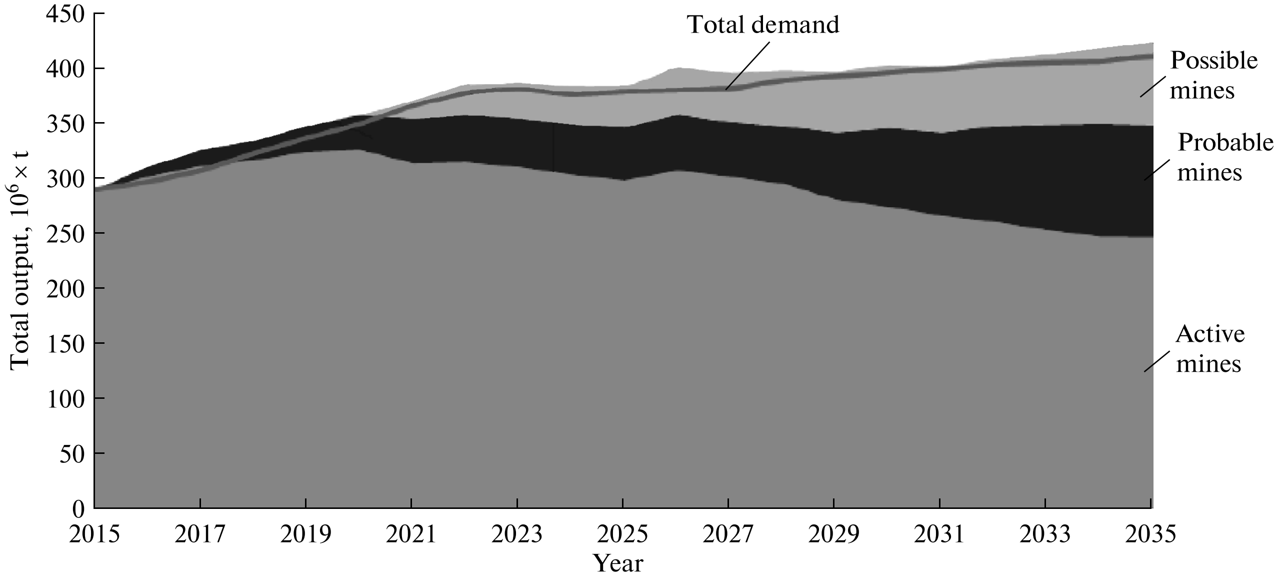

Fig. 4. Predicted output of metallurgical coal.

predicted output of metallurgical coal is shown in Fig. 4.

With constraints on new projects, prices must rise considerably so as to stimulate investment in the extraction of metallurgical coal—especially Australian hard coking coal.

Other presentations addressed the global supply of adequate-quality coking coal.

4. A paper by H & W Worldwide Consulting (Australia) discussed Australia's potential role as a swing producer of coal [4]. In this case, a swing producer (or free producer) is a supplier of coal capable of switching from metallurgical coal to fuel coal and back as the market demands.

Comparison of Australia and the United States, which excels as a swing producer, indicates that Australia is not able to compete with the United States as a swing producer.

5. The coal division of Vale (Brazil) produces coal in Australia and Mozambique and is a shareholder in two coal producers in China. Its largest investments are in Mozambique, as discussed in its presentation at the summit [5].

6. In an analysis of structural changes in the Russian coal industry in 2014 and 2015, Ignatov & Company Group (Russia) touched on the following topics [6]:

—the Russian coal industry up to 2014 and in 2014 and 2015;

—Russian metallurgy up to 2014;

—new factors affecting Russian industry in 2014 and 2015.

7. In a review of the market for metallurgical coke, CRU (Britain) noted that not all regional markets are in a satisfactory state [7]. In 2013–2015, the European market exhibited instability in output and in EBITDA (the profit before taking account of costs for credit, taxes, and amortization).

Steel production in Europe is expected to increase between 2014 and 2019; beginning in 2016, the growth rate will exceed that in other regions. Steel output in Asia will also grow. Global growth in electrosteel production will outstrip the growth in blast-furnace and converter production.

In recent years, prices for metallurgical coal have fallen. For example, the spot price for Australian hard coking coal dropped from \$220/t in January 2012 to ~\$100/t in January 2015, since the balance of supply and demand has not improved. That calls for active efforts by producers to reduce costs and increase profits.

In 2015, costs for coal extraction are expected to be less by \$21/t (by ~17%) than in 2014, on account of reduced amortization, increased labor productivity, the closure of surplus mines, and reduction in capital costs and in labor costs (in China). The drop in oil prices will be a further stimulus here. According to predictions, the weighted mean price for metallurgical coal will be \$100/t (cfr).

CRU identifies the following recent trends in the market for metallurgical coal:

—price stability in 2014;

— stable demand for coal, especially in India (but a decline in China);

—constant transport of coal by sea;

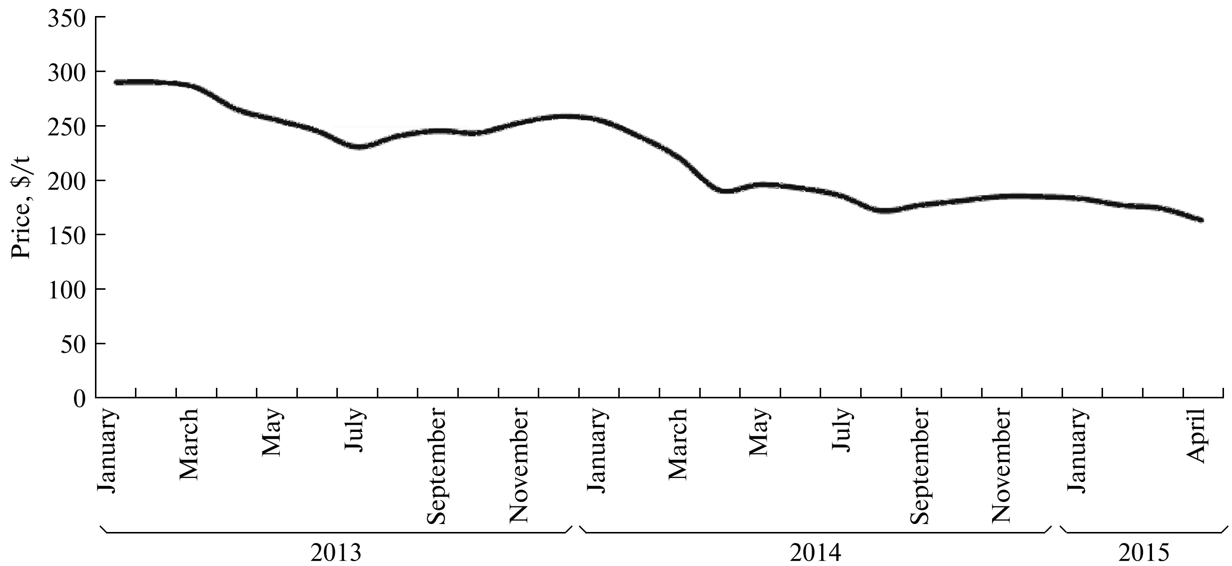

Fig. 5. Dynamics of coke prices.

—reduced prices and increased profits for companies shipping coal by sea, thanks to reduced production costs, reduced oil prices, and reduced amortization costs.

CRU expects a better balance of supply and demand in 2015 (except in China). The completion of planned projects in Australia and Mozambique will increase coal supplies in 2016–2018. Significant increase in profitability of Russian coal production is expected as a result of reduced costs, in part because of the falling ruble.

In 2014, the mean contact price for hard coking coal was $125/t (fob). According to predictions, it will rise to $135/t in 2016 and remain stable.

CRU's predictions for the next five years in the market for metallurgical coal are as follows.

• Exports by sea from Australia, the United States, and Canada will fall in 2015 on account of reduced supplies.

• As a result, prices will rise slightly in 2015.

• Over the course of five years, supplies of Australia and Mozambique, which have been falling, will begin to increase.

• Russian exporters will considerably reduce their prices and therefore gain greater market share.

CRU identifies the following recent trends in the market for metallurgical coke.

—Coke prices fell significantly in the past five years, partially on account of declining coal prices, and reached a minimum. Since the second quarter of 2014, they have been consistently below $200/t (Fig. 5).

—Increased supplies of Chinese coke have boosted overall global sales, especially for coal shipped by sea. European exports remained stable.

—Global prices for coke fell as a result of the decreasing price of Chinese exports. Therefore, many operators preferred to purchase coke rather than coal for its production.

—Chinese coke exports have continued their stable growth. In January 2015, they reached the maximum mean monthly level (~1 million t) since March 2012.

CRU predicts the following conditions in the global coke market over the next five years.

—Even with the slowdown in China, Asian demand for coke will remain considerable. Elsewhere, it will be weaker.

—Demand for coke will be partially met by imports in some countries (Germany, India, South Korea, and Taiwan).

—Coke prices will bottom out and may rise on account of increasing coal prices.

—Chinese exporters will not easily penetrate the European and United States markets, on account of the dominance of long-term contracts with local suppliers (such as Poland) and also on account of fluctuations in the quality and reliability of supplies and differences in freight costs.

—Global output of metallurgical coke will rise to around 800 million t in 2019, including more than 500 million t in China. Global utilization of coke capacity will be ~81%.

—Coke exports will rise to ~32 million t in 2019, mainly thanks to China. Other exporters will be the Americas, Asia, and Europe (mainly Poland). At that point, coke demand will again rise in Europe (Britain, Germany, Italy, Poland, and Turkey) and also in Kazakhstan, Russia, and Ukraine. The largest coke consumers will be Japan (~40 million t), India (~40 million t), Russia (~31 million t), South Korea (~21 million t), Ukraine (~20 million t), the United States (~15 million t), Brazil (~15 million t), Germany (~12 million t), and Taiwan (~7 million t).

—The increase in global coke prices will be slight.

Summit participants also addressed *coke quality* and its influence on coal costs and stable blast-furnace operation.

8. A presentation by specialists from ArcelorMittal was devoted to the assessment of coke quality and its influence on the consumer cost of coal [8].

The consumer cost of coal expresses the influence of a new material (with particular physical or chemical properties) on the production costs (the cost of the product). For example, it may characterize the following:

—the influence of energy and gas consumption and the profit from tar production on coke-plant economics;

—the influence of the coke cost on the production costs of hot metal and its derivatives.

The Nippon Steel coke-strength index *CS*R is important in determining the consumer cost of coal. Attention is paid here to the factors taken into account in determining *CSR* (the sampling of the coke, the heterogeneity of the coke, and the quality of the coal batch). The characteristics on which *CSR* depends (the characteristics of coal and the coke-production technology) and the blast-furnace characteristics (reaction temperature, mass loss of coke, etc.) are presented.

Analysis indicates that not only the tests in which *CSR* is determined but also the coking conditions must be standardized, so that the buyer and seller are speaking the same language. It is necessary to specify the width of the coke oven, the coking rate (mm/h), the density and granulometric composition of the charge, and the minimum heating surface.

9. Tata Steel Europe (the Netherlands) presented a discussion of the influence of coke quality on the stability of blast-furnace operation with low coke consumption [9]. The monitoring of coal and coke quality at all stages from supply of the coal batch to coke delivery to the blast furnace was considered. Stable blast-furnace operation and low coke consumption require consistent high quality of the raw materials (sinter, pellets, coke, and pulverized coal).

According to Tata Steel, the high quality of the coke supplied to the enterprise is characterized by the following values: mechanical strength I_{40} = 46–50% and M_{40} = 83–88%; wear rate I_{10} = 18–20% and M_{10} = 5–7%; hot strength *CSR* = 63–67%; reactivity *CRI* = 23–27%; and moisture content in coke with wet quenching 4–6%.

These figures are based on operational experience in coke shops 1 and 2 at Ijmuiden coke plant (the Netherlands), with the following characteristics:

	Shop 1	Shop 2
Coke output, 10^6 t/yr	1.15	0.98
Number of furnaces	238	108
Furnace height, m	4	6.5
Furnace width, mm	450–470	420
Year of construction (reconstruction)	1980–1984	1972
Designer	Didier/Otto	Still

The characteristics of blast furnaces 6 and 7, which went into operation in 1967 and 1972, respectively, are as follows:

	Furnace 6	Furnace 7
Hearth diameter, m	11.0	13.8
Coke consumption, kg/t hot metal	280	220
Output, t/day	8000	10500
Productivity, t/m^3 day	3.2	2.7

At the plant, coal samples are taken automatically from the intake store and in the coal-preparation shop and tested (approximate analysis, chemical composition of the ash, petrography, dilation, fluidity, and coking pressure). The coke strength (I_{40}, I_{10}, *CSR*) is preliminarily determined. The expansion force of the coke and the final coking temperature are monitored. A pyrometer on each quenching tower measures the coke temperature prior to quenching. The coking temperature is monitored.

Samples of the coke produced are taken and tested to determine I_{40}, I_{10}, *CSR*, the moisture content, and the chemical composition. A new testing technology is employed: the granulometric composition of the coke is determined in real time by optical means (more than 50 measurements per day).

10. The presentation by DMT (Germany) described its new processing systems for coke-oven gas, which are used around the world [7]. These systems were designed within the framework of the following considerations:

—environmental constraints: the need to reduce SO_2 and NO_x emissions, effective wastewater purification, etc.;

—economic requirements: reliability, minimal maintenance, reduced energy and labor costs, and the value of the captured byproducts (tar, benzene–xylene–toluene fractions, ammonium sulfate, and sulfur);

—customer requirements: high safety levels, automation, and flexible production.

Typically, the coke-oven gas processed at DMT contains 6–12 g/m^3 NH_3, 3–12 g/m^3 H_2S, 20–

40 g/m^3 benzene–xylene–toluene fractions, and 60–125 g/m^3 tar.

Typical captured products are elementary sulfur (>99% purity), raw tar with <4% water, benzene–xylene–toluene fractions, ammonium sulfate, and sulfuric acid. At DMT, the purified coke-oven gas contains ≤0.03 g/m^3 NH_3, ≤0.5 g/m^3 H_2S, ≤0.1 g/m^3 naphthalene, ≤5% benzene–xylene–toluene fractions, and ≤0.02 g/m^3 tar.

11. Improvement in the preparation of coal batch for coking was discussed in the presentation by the Material Processing Institute (Britain) [10]. The conclusions of the Institute's specialists may be summarized as follows.

—Given the shortage of high-quality coking coal and the expediency of using numerous suppliers so as to ensure reliable operation, it is expedient to understand the principles of batch blending. By combining different coal ranks, high-quality coke may be obtained at minimal cost.

—The conditions of coal preparation must be adapted to conform to changing market conditions.

—Battery life may be extended by appropriate selection of the coal and additives and the coking pressure.

—All types of coal are not equally suited to furnaces with top charging and furnaces for rammed batch.

—Batch preparation by laminar storage in heaps and transfer using special devices and bunker-based systems may ensure good operating conditions.

—In each specific case, a particular crushing system must be selected so as to obtain optimal batch density. The crushing system must be optimized so as to ensure the best contact and coalescence of the coal particles and hence the production of strong coke. In top-loading furnaces, optimal coke quality is obtained with the following granulometric composition of the batch: 7–10% of the >4 mm class; 78% of the <2 mm class; and 44–45% of the <0.5 mm class.

Summit participants devoted much attention to environmental protection and safe working conditions.

12. The Institute of Chemical Processing of Coal (IChPW, Poland) presented a paper on environmental protection as a stimulus to improvements in coke production [12].

The author listed European Community requirements regarding environmental protection, relating to air pollution, wastewater, solid wastes, noise, odors, and electromagnetic waves.

The adoption of best available technologies (BAT) is of great importance. BAT principles are essential for coke production. According to specialists at numerous Polish coke plants, the most critical requirements are as follows:

—limiting the duration of visible emissions to 30 s;

—determining the percentage of unorganized emissions;

—the removal of sulfur from coke-oven gas;

—emissions from wet quenching.

The main air pollutants from coke plants are as follows:

—gases (NO_x, SO_x, CH_4, CO, H_2S);

—micropollutants: polycyclic aromatic hydrocarbons, heavy metals, and organic volatiles (benzene, ethanol, formaldehyde, etc.);

—dust.

In meeting the European Community standards, coke-plant operators encounter the following problems:

—the determination of pollution levels is complex and expensive;

—the results of calculations based on literature data are unreliable;

—existing models take no account of the specifics of coke production, and therefore the calculation results may be unsatisfactory.

The author made proposals for improving current procedures by continuous monitoring of unorganized emissions and software for determining the scattering.

In particular, the EmiBAT emission-monitoring system was proposed. It should be ready for industrial introduction in 2015.

The COPDIMO system, a model of the scattering of coke-plant emissions, permits precise simulation of the emissions over short distances and takes account of the specifics of the coke battery as a source of emissions. Economic factors are also taken into account, such as the attainment of the required environmental impact at minimum cost and the production of maximum environmental benefit with the best use of liberated financial resources.

13. Specialists from Tata Steel showed the possibility of ensuring safe working conditions when working with polycyclic aromatic hydrocarbons, for the example of Ijmuiden coke plant (the Netherlands) [13].

Some polycyclic aromatic hydrocarbons are genotoxic carcinogens, especially those containing more than five benzene rings. An example is benzo(*a*)pyrene (BaP).

The limiting BaP emissions required in various European countries are as follows:

—Belgium: 0 (since 2009);

—Finland: 10000 ng/m^3 (since 2007);

—Austria: 2000–8000 ng/m^3 (since 2007); for coke ovens, 5000–20000 ng/m^3 (since 2007), with a mean sampling time of 15 min;

—Sweden: 2000–20000 ng/m^3 (since 2005), with a mean sampling time of 15 min;

—Switzerland: 2000 ng/m^3 (since 2009);

—the Netherlands: 550 ng/m^3 (since 2008); the recommendation of the country's national-health committee is 5.7 ng/m^3 (since 2006).

Strategies preventing pollutant emissions within coke plants must meet the following requirements:

—reduction in the number of emissions sources;

—both collective and individual measures (dispersal of workers, special clothing and gloves, etc.).

The process should meet the following requirements:

—the use of new coke-oven doors with flexible seals;

—appropriate transition to the lining at the top of the ovens;

—timely frame replacement;

—retention of damage fragments at the top of the ovens;

—vacuum retraction of the oven roof;

—daily monitoring of leaks at the oven doors;

—minimization of the staff required at the top of the furnaces;

—double doors in the cabin of the coal-charging machine and optimization of the cabin climate.

Another innovation is a safety helmet with a fresh air supply (225 L/min). Its use reduces the BaP content in the air breathed by the operating staff from 445 to 2.2 mg/m^3 in coke shop 1 and from 864 to 4.2 ng/m^3 in shop 2.

14. The presentation by Thyssen Krupp Industrial Solutions (TKIS, Germany) concerned recent improvements in the EnviBAT^{TM} pressure-regulation system, which is intended to limit uncontrolled emissions in charging the coke furnaces, in planning, and throughout coking [14]. Emissions are due to unsatisfactory pressure regulation in the gas holder, unsatisfactory pressure levels created by steam or water injection, and gassing of the coke ovens.

This system has been patented by DMT (Germany) as the PROven. The PROven system was used by TKIS (formerly Uhde GmbH) under an exclusive license from DMT. While covered by the license, TKIS has improved the system and developed a pass-through regulator in place of the drainage controller. This system is employed by coke batteries at the Schwelgern plant and elsewhere (36 batteries in all).

At the end of the licensing agreement between TKIS and DMT, TKIS has continued to market the system as EnviBAT^{TM} Pressure Regulation. This system reduces coke-plant emissions and leaks and is categorized as a best available technology.

15. The presentation by Lotus Wireless (India) concerned a radar system based on furnace identification, automatic positioning and interlocking, and a second level of the battery's thermal control system [15]. Known as the EAGLE COKE^{TM} system, it includes the following components:

—a radar sensor array for identifying the furnace and the position of the machines;

—a system for data collection and transmission;

—an automatic interlocking system for the machines.

The system consists of the following modules:

—control of the heating, with monitoring of the temperature and gas flow rate;

—a human–machine interface;

—interlocking and automatic positioning of the machines;

—automatic monitoring and correction of the execution of the operational protocols.

The introduction of the EAGLE COKE^{TM} system was preceded by serious disruptions of battery operation (problems with furnace charging, coke ejection on the coke side with a closed door, imprecise positioning of the quenching car, etc.). Several coke batteries at Indian plants are now equipped with this system.

16. Specialists from Pearson Coal Petrography (the United States) reported on the company's use of modern research methods and equipment to study coke microstructure.

17. The presentation by Mayan Global Consultants (India) discussed improvements in the correlation between the properties of metallurgical coal and thermogravimetric plots. Specifically, the authors considered the assessment of metallurgical coal on the basis of thermogravimetric parameters such as the weight loss (TG) and the temperature of maximum weight loss (DTG).

18. The Global Forum of Freight Carriers presented a paper on overcoming macrostressors in transportation and logistics. The Forum was organized in 2011 and represents 23 organizations of freight carriers within the UN transportation and commercial councils. It is mainly concerned with sea and air transport.

CONCLUSIONS

According to predictions, world steel production will rise at 1.2% per year up to 2035, reaching more than 2.0 billion t/yr; the corresponding output for iron is 1.4 billion t/yr.

Coke demand will grow considerably, especially in Asia. In 2019, world coke output is expected to be around 800 million t/yr. Exports of Chinese coke are steadily continuing to grow. In January 2015, they reached the maximum mean monthly level (~1 million t) since March 2012.

In the past three years, coke prices have declined considerably, mainly on account of falling coal prices. The coke price has been below $200/t since the second quarter of 2014. Future increase in coke prices may be observed on account of rising coal prices.

The European market for metallurgical coke remains closely tied to steel production and the macroeconomic situation, which markedly improved between 2009 and 2015. European demand for steel has been slowly but steadily rising. Coke consumption in iron production is falling on account of the increased use of pulverized coal, fuel oil, gas, and tar.

Increasing global demand for coking coal is expected up to 2035, especially in Asia. In recent years, prices for metallurgical coal have fallen. In January 2015, the mean price for Australian hard coking coal was $100/t.

In the near future, there will be an excess of hard coking coal. The completion of planned projects in Australia and Mozambique will increase coal supplies in 2016–2018.

Improvement in the preparation of coal batch for coking is of interest so as to produce coke of specified quality from cheaper coal ranks. Research is underway on the assessment of coke quality and its influence on the consumer cost of coal. Monitoring of coke quality ensures stable blast-furnace operation with low coke consumption. Research is underway to improve coke production, to ensure safe working conditions, and to minimize the influence of production on human health and the environment.

New automation systems for coke production and the monitoring of emissions are being introduced.

REFERENCES

1. Ko, K., A competitive application of biomass and plastic chars for the ironmaking process in the future, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
2. Vermey, J., Metallurgical coke market dynamics in the EU, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
3. Warder, M., Metallurgical coke market dynamics: A focus on coking coal supply, *Proceedings of the Eurocoke 2015 Summit,* Amsterdam, Netherlands, 2015.
4. Bristow, N., Australian swing producers, *Proceedings of the Eurocoke 2015 Summit,* Amsterdam, Netherlands, 2015.
5. Scholes, O., Mozambique coal, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
6. Ignatov, O., Structural shifts in the Russian steel, coke and coal markets in 2014–2015, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
7. Orhan, B., Metallurgical coke market dynamics: A focus on coke trade and import/exports, *Proceedings of the Eurocoke 2015 Summit,* Amsterdam, Netherlands, 2015.
8. Vogt, D., Coke quality evaluation and its impact on coking coal value in use, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
9. Van der Molen, S., Consistent coke quality for stable and low coke rate blast furnace operation, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
10. Poultney, R., Coal blending for metallurgical cokemaking, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
11. Otten, B. et al., Case studies: Worldwide installed new COG treatment plants, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
12. Sobolewski, A., Environmental protection as a driving force for cokemaking technology improvement, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
13. Rijbroek, C., Working safety with PAH: That is possible! *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
14. Kuhn-Gajdzik, J., Upgrading of existing coke oven plants with the pressure regulation system EnviBAT, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.
15. Singh, M. et al., Radar technology based on oven identification, automachine positioning, interlocking and level 2 coke oven battery heating control management system, *Proceedings of the Eurocoke 2015 Summit*, Amsterdam, Netherlands, 2015.

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