Coke-Battery Reconstruction at OAO Zaporozhkoks


Abstract—In preparing for the reconstruction of coke battery 1A at OAO Zaporozhkoks, the expected availability of Ukrainian coking coals between 2009 and 2012 is analyzed. Experimental coking of alternative coal batches is undertaken at battery 1A.

COAL,
COKE

Between 1978 and 1988, Zaporozhe coke plant (now OAO Zaporozhkoks) underwent radical reconstruction. In 1980, coke battery 1A went into operation (41.6-m³ furnace chambers; design coke output 910000 t/yr). In 1982, similar battery 2A went into operation. In 1983 and 1984, coke batteries 5 and 6 were reconstructed, so that the output of each was 440000 t/yr. After reconstruction, the plant’s total design output of coke (6% moisture content) was 2700000 t/yr.

Coke battery 1A went into operation in February 1980, with a standard life of 20 years. It has now been operating for more than 28 years and has produced ~21 million t of coke (6% moisture content).

It is increasingly difficult to run the battery in accordance with Operational Rules PTE-2002, on account of the condition of the furnace refractories. (In many of the chambers, the walls are deformed.) This has prompted interest in options for reconstruction of battery 1A.

Options for reconstruction are being considered by the management of OAO Zaporozhkoks, with the participation of UNPA Ukrkoks, the State Research and Design Institute of the Coke Industry, the Coal-Chemistry Institute (CCI), and the State Coke-Chemistry Station. The options differ mainly in terms of the provision of coal to the plant and decisions regarding coke (and byproduct) production, including the construction of a dry-slaking system for the battery.

Attention focuses primarily on the coal supplies for coking, which largely determine the coal-preparation and coking technology, as well as the required coke quality.

To determine trends in Ukrainian coking batch, we consider the prospects for the period 2009–2012.

The initial data adopted are as follows: the condition of the furnaces as of January 1, 2008; the expected production of coke (6% moisture content) in Ukraine, 24–25 million t/yr; and the demand for batch with the actual moisture content (9.5%), 33–34 million t/yr.

Table 1 presents the expected balance of resources and demand for enriched coking coal at Ukrainian plants in the period 2009–2012. Taking account of the blast-furnace requirements on the mechanical strength of coke ($M_{25} = 88.0\%$, $M_{10} = 7.0\%$), the demand for coal is calculated from the following rank composition: 15% G, 38% Zh, 32% K, and 15% OS.

With the given initial data, the shortage of coking coal will be 12–17 million t. The reserves of gas coal in the balance then exceed the demand. If we also consider the resources not included in the balance, the difference may be 3–5 million t.

On that basis, in planning the reconstruction of battery 1A at OAO Zaporozhkoks, we consider batch based on briquetting (compacting) without binder, with corresponding batch preparation, so that a higher content of low-metamorphic gas coals may be used.

Table 2 presents the rank composition of the projected coal base for battery 1A in two cases: 1) for bed coking of ordinary batch; 2) for compaction without binder.

It is evident that batch 2, subjected to compaction without binder, contains 50% G and GZh coal (as against 32% in batch I) and 50% Zh, K, and OS coal (as against 68% in batch 1). This is associated with increase in the yield of volatiles and decrease in clinkering properties of batch 2 by 2.9% and 0.6 mm, respectively, relative to batch 1.

Batch compaction without binder for the reconstructed battery 1A was proposed on the basis of research by CCI specialists at Kharkov coke plant (now A0ZT Kharkovskii Koksovyi Zavod) [1].

In coking batch briquetted without binder (moisture content 10.5%; composition: 50% G, 20% Zh, 10% K,
15% OS, 5% T), its packing density increases by 9% (with a pressure of 20 MPa or 200 kgf/cm²). The packing density of the wet compacted batch in the charging car is 800 kg/m³, as against 734 kg/m³ for the unbriquetted batch. There are three drops between the briquetting press and the charging car. In coking this batch, the mechanical strength $M_{25}$ is improved by 0.9%, while the wear index $M_{10}$ is reduced by 1.2%. The gross coke yield for a single furnace is increased by 4%.

With 10% increase in batch density, $M_{10}$ declines by 1%, according to [2].

To confirm the expected results of batch compaction without binder, specialists from CCI and Zaporozhkoks conducted experiments on the test bench of Freiberg Mining Academy at Koppern (Germany) manufacturing plant.

For the research, coal batch of the required composition is prepared at OAO Zaporozhkoks and supplied in an amount of 1500 kg to the Freiberg test bench.

Table 3 presents the granulometric composition of the batch sent to the test bench. Analysis shows that the experimental batch contains 81.1% of the <3.15 mm class, including 33.3% of the <0.5 mm class. Experimental briquetting is undertaken on a press with rollers whose diameter is 1000 mm. The roller surface consists of cells with a rated volume of 20 cm³ and a working width of 140 mm.