At the end of the 1990s, the conveyer-type roasting machines within the Commonwealth of Independent States were outdated and could not match current requirements on energy consumption, environmental impact, and pellet quality. Therefore, radical reconstruction of the machines to reduce the consumption of energy and materials and to improve pellet quality was essential for survival in a market economy. In 1994, the management of OAO Lebedinskii GOK (LebGOK) solicited the assistance of OOO NPVP TOREKS, an engineering company with experience in thermal engineering and equipment for iron-ore pelletization.

Between 1999 and 2001, step-by-step modernization of all the OK-306 roasting machines at OAO LebGOK resulted in marked increase in productivity, considerable reduction in heating and energy costs, and considerable reduction in environmental impact. In addition, means of ensuring adequate supply of oxidized pellets of the required quality to the GBZh unit producing briquetted porous iron at OAO LebGOK were implemented. Detailed accounts of this modernization may be found in previous articles (Stal, no. 4, 2002; no. 1, 2003). In recognition of this work, a team of specialists from OAO LebGOK, OOO NPVP TOREKS, and the Institute of Metallurgy, Ural Branch, Russian Academy of Sciences was awarded the Russian government’s prize for science and engineering in 2002.

In 2002 and 2003, the focus was on industrial inspection and testing of the technological lines and equipment for preparation and dosing of the batch components, the production of raw pellets, and their supply to the roasting machines. The use of high-quality bentonite and polymer additives in the pellet batch was investigated in industrial experiments [1–3]. Pelletization lines equipped with roller screens and reconstructed pelletizers were tested [4, 5]. The results permitted the development of a batch composition [6] and a production technology for the raw pellets, as well as reconstruction of the pelletization lines.

In the same period, thermal measurements were made on the roasting machines, and tests were conducted on the thermal and gas-dynamic state of the pellet bed over the length of the machine, the temperature and filtration conditions of heat treatment over the technological zones, the parameters of the gas–air flows, and the working characteristics of the burners, pumps and fans, and gas-purification equipment. On the basis of the results, the conditions of pellet heat treatment were corrected in 2004, taking account of the change in physicochemical properties and quality of the raw pellets, and plans were developed for step-by-step modernization of the thermal system and reconstruction of the technological zones, collectors, and gas lines [7, 8].

The integrated engineering approach developed by NPVP TOREKS between 1993 and 1996 was applied to the modernization of the conveyer-type roasting machine, which is a complex system consisting of various technological zones, an overall thermal system, and a system of gas and air fluxes. This approach is based on physical and mathematical models of all the physicochemical and heat- and mass-transfer processes within a single granule of specified composition, within the pellet bed, and within the metal structure of the
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The goal of modernization, as at OAO LebGOK, was to increase the productivity and reduce the energy consumption. However, the priorities were different at OAO Mikhailovskii GOK: increase in output was the primary consideration. Nevertheless, the integrated approach was equally applicable in this case. Again, two stages of modernization were undertaken.

In the first stage (2004–2005), a three-section drying zone was introduced, which considerably intensified the process; drying was practically completed within this zone. The consumption of primary low-temperature was reduced. The parameters of pellet heat treatment were changed, with the preparation of performance charts. The relative areas of the roasting, recuperation, and cooling zones were adjusted, with appropriate reconstruction of the gas system. The cooling zone was also reconstructed.

In addition, the utilization of high-temperature air from the cooling zone was improved by reducing the gas-dynamic drag of the gas lines and by more efficient operation of the pumps and fans. The automation system was modernized (on the basis of Siemens components). Measures were taken to improve the quality of the raw pellets. The vibrational screens in the pelletization line were replaced by roller screens, and a rubber lining was introduced in the pelletizers. The unit for loading raw pellets into the roasting trucks was redesigned, with the installation of a broad conveyer. The composition and dosing of the binders was optimized.

Preparations for the second stage began in 2006. The goal of this stage was to boost pellet output to 10 million t/yr, with an hourly productivity of no less than 615 t per machine. This involved further reduction in drag of the gas lines, more effective use of thermal energy, and modernization of the drying zones and the flow collector. In particular, the GO-5 gas line was reconstructed at the OM-1 machine; the area of drying zone 1 was increased, with the replacement of wet gas purification by dry purification; and the charging unit was reconstructed. The modernization and debugging of machine 1 was completed in December 2007. Fuel supply to drying zone 1 in a mixing chamber was also incorporated in the modernization of machine 2, which ended, along with the debugging phase, in June 2008. The table also shows the results of the second stage.

The reconstruction shows that the Uralmash roasting machines produced in the 1960s and 1970s have considerable scope for performance enhancement. The modernized machines match the characteristics of their best counterparts anywhere in the world. In particular, the performance of the OK-520 machines at OAO Mikhailovskii GOK is comparable with that of Lurgi machines (produced by Outotek) in analogous conditions, as seen in the table.

**REFERENCES**


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