The Romelt process for the liquid-phase reduction of iron is one of the most important Russian innovations in the production of iron outside the blast furnace. This technology is especially important for use in the recycling of iron-bearing wastes from metallurgical operations, and conversion pig iron is a by-product of this application.

Key words: liquid-phase reduction of iron, iron-bearing wastes, slag.

The introduction of innovative technologies in metallurgy is encountering significant obstacles due to the high capital costs that are now involved.

One of the most important innovations in the treatment of iron outside the furnace is the Romelt process developed by the Moscow State Institute of Steel and Alloys (MISiS) for the liquid-phase reduction of iron. This technology was introduced at the Novolipetsk Metallurgical Combine (NLMK), and preparations for its commercial use were made at the beginning of the 1990s [1]. However, the market for this furnace dried up as the demand for iron dropped sharply and stagnated.

Interest in the Romelt process revived in the period before the economic crisis, mainly as a way to resolve the problem of managing iron-bearing waste products from metallurgical operations. The process also began to be seen as a possible new source of iron for mini-mills.

Thanks to certain unique circumstances (a lack of raw materials and coal suitable for blast-furnace smelting), a commercial Romelt furnace is now being built in the Republic of Myanmar to produce iron.

An experimental Romelt furnace has been built in Kazakhstan, where the National Fund for Innovation provided support for an initiative undertaken by a group of entrepreneurs. For Kazakhstan, it is especially important that the Romelt process can recycle iron-bearing slags formed in nonferrous metallurgy operations. Large quantities of such slags are created in the production of copper, lead, and zinc in that country. The Romelt unit, with a production capacity of 3 tons of pig iron an hour, was built in 2009 in the town of Balkhash. The client was the AB Metals Company (M. A. Omarov is its director). The plans for the furnace, including the technological part, were prepared by specialists at Stal’proekt Institute (in Moscow). The auxiliary equipment and the systems that service the furnace were designed by Kazakhstan personnel. The construction cost of the unit was roughly 5.5 million U.S. dollars.

The unit obtains its oxygen from the available capacity of the oxygen plant owned by the Kazakhmys Corporation (also in Balkhash). The unit was built in one of the shops of the Nonferrous Metals Processing Plant (NMPP).

The unit is equipped with a line that delivers charge materials to the furnace (the line includes batching devices and bins for concentrate, coal, flux, and granulated slag), a belt conveyor, a gas flue and gas-cleaning system, and a system for discharging the slag and metal from the furnace.

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Charge materials are dispensed from the bins by belt-type weighing batchers and are delivered to the furnace by the conveyor (Fig. 1) through an opening in the roof. The slag bath is injected with an oxygen-air blast through four tuyeres. Four lances are positioned above the melt to supply oxygen for burning off the fuel gases (H₂ and CO) released from the molten bath. The flue gases leave the furnace through a gas flue and are directed to a slag chamber that is supplied with fan-driven air to allow complete combustion to occur. Water is also supplied to the chamber, to lower the temperature of the flue gases to 1000°C. The gases are then sent to a scrubber to remove dust before they are discharged through a smoke stack. The forming slag is discharged into an organic-glass slag pot as it accumulates. The iron, discharged from a siphon combined with a slag settler, is cast into pigs (Fig. 2).

Fuel oil is used as an additional fuel to help start the furnace and to preheat the troughs and siphons for tapping the metal and slag.