THE REFRACTORY LINING OF ELECTRIC ARC FURNACES IN WEST GERMANY

Abstract by Zh. N. Demidova

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Between 1963 and 1973, steel production in electric arc furnaces in West Germany rose from 2.6 to 5.15 million tons. Differences in the furnace lining between different plants and the divided opinion of the specialists about the best methods of producing the lining made necessary a comparative analysis of the useful life of the linings at the various steel plants. The inquiry resulted in the collection of performance data for 54 of the 93 furnaces in operation in 1972.

The furnaces are divided into three groups in accordance with the steel grade produced in them.

The furnaces of group I (22 furnaces varying in capacity from 2.5 to 120 tons) are used mainly for smelting run-of-the mill steels under a single slag. In this group, 16 furnaces are lined predominantly with dolomite brick and the remaining six with magnesite and chromomagnesite brick. The average consumption of dolomite brick is 9 kg and that of magnesite brick 1 kg per ton steel. Using magnesite or chromomagnesite refractories entails high gunite consumption, the brick:gunite ratio is 1:1. A dolomite lining lasts for 83.4 melts on average and a magnesite lining for 214 melts. The wall thickness of the upper part of a lining of dolomite brick is 300-500 mm but only 250 mm if the lining is of magnesite brick.

The furnaces of group II (23 furnaces varying in capacity from 4 to 100 tons) are used mainly for smelting structural and tool steels under two slags. In this group 18 furnaces are lined with dolomite brick. The average life of the linings is 99 melts and refractories consumption varies 2.8-14.7 kg/ton steel for an average of 8 kg/ton. The lower limit is achieved with copious use of gunite, and the upper limit (over 10 kg/ton) occurs in furnaces for smelting steel for subsequent vacuuming. The average life of the magnesite linings of four furnaces is 147 melts. The average brick consumption is 5.88 kg/ton steel and the average gunite consumption 9 kg/ton.

The furnaces of group III (nine furnaces varying in capacity from 10 to 80 tons) are used for smelting stainless, acid-resisting, and heat-resisting steels. The useful life of the lining of these furnaces varies 70-250 melts. The average consumption of dolomite bricks and blocks is 6 kg/ton and that of magnesite brick 3 kg/ton. The consumption ratio of brick and gunite is 1:2 on average for dolomite linings and 1:5 and 1:6 for magnesite linings. Guniting, mainly in the slag zone, is carried out after every melt. The wall thickness is 300 mm in the upper part of small furnaces and a maximum of 350 mm in the larger furnaces.

The linings of the walls and wells of the furnaces of all groups are often a combination of dolomite, magnesite, chromomagnesite, and dolomite — magnesite bricks and blocks, or consist of ramming or guniting mixes of dolomitic or magnesian composition.

In 24 of the 54 West German furnaces concerned, the roof is lined with dinas brick in combination (in six zones) with alumina brick. In 28 furnaces the roof is constructed of high-alumina brick or a ramming compound, and in two furnaces of dolomite brick. The average durability of the dinas roofs is 65.9 melts for a brick consumption of 5.7 kg/ton steel. The corresponding figures for high-alumina roofs are 136.5 melts and 5.2 kg/ton, and for dolomite roofs 88 melts and 4 kg/ton.

An evaluation was carried out of the durability indices of the refractory linings of these 54 furnaces. In 1971, 49 furnaces were lined with dolomite brick. In three of these furnaces the slag zone and the zone exposed to arc radiation were lined with magnesite brick. In 1972, 10 other furnaces were changed over

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to magnesite linings. This change-over process was continued during 1973. In 1971 the useful life of a dolomite lining was 93.7 melts on average and in 1972 it had increased to 99 melts as a result of more generous applications of gunite. In 1972 the useful life of magnesite and chromomagnesite linings in the electric arc furnaces was 223 melts on average.

Differences in operating conditions made it almost impossible to draw comparisons between these groups of furnaces and no rules could be established.

Automation was introduced as one of the methods of increasing the durability of the lining of electric arc furnaces. Computer methods gave the voltage and current for a given total consumption of electric power. A computer controlled electrical supply system was installed on two 76-ton furnaces and yielded a 30% increase in the durability of the lining.

LITERATURE CITED

1. H. W. Kreutzer, K. W. Langner, H. Lutz, et al., Stahl U. Eisen, No. 6, 223-229 (1974).