The pressure on the working slabs is finally regulated with the ladle vertical. The refractory paste between the nozzle and the socket brick is dried, and the channel of the steel-pouring hole is filled with high-refractory material (2-5-mm fraction of magnesite grit) flush with the bottom of the ladle. The ladle is then preheated to receive the melt.

In carrying out the tests, we assessed the pouring of the melt, recorded the brand of metal, its temperature on discharge, and the pouring time. After pouring we determined the wear of the slabs by means of the state of the contact surface and steel-pouring hole.

If positive results were obtained (satisfactory state of contact surface of slabs, only slight erosion of channel of steel-pouring hole, as found by visual inspection) after a pouring, this served as a basis for pouring a second melt through the same set of refractories.

After two steel melts had been poured, there was practically no erosion of the steel-pouring channel, but the edges of the holes in the slab had been eroded up to 15-20 mm, evidently owing to the throttling action. The contact surfaces of the slabs were also not damaged.

The results of the tests of mullite-corundum refractories with alumina-enriched binder show that their commercial production should be organized at the Ukrogneupornerud works. This will permit an improvement in the reliability and stability of mullite-corundum slabs in pouring steel through slide gates.

CONCLUSIONS

At the Ukrainian Scientific-Research Institute of Refractories, in collaboration with Ukrogneupornerod and the Chasov-Yar Refractories Combine, methods have been developed for improving the service properties of mullite-corundum slabs and increasing their reliability and stability in operation. The commercial production of mullite-corundum slabs has been organized.

The slabs are being successfully used in stopperless steel pouring at the Il'ich Metallurgical Works, Zhdanov, and at the Donetsk Metallurgical Works.

To increase the stability of mullite-corundum slabs to two or three meltings, it is necessary to organize the commercial production of these articles with alumina-enriched binder.

TESTS OF THE PROTECTIVE COATINGS OF THE REFRACTORY LINING OF COPPER-SMELTING CONVERTERS


To increase the working run of copper-smelting converters between maintenance operations, both home and foreign industrial plants allow solidified magnetite to gather on the surface of the refractory lining [1, 2]. The intensification of conversion as a result of the increase in the air flow rate, the use of an air-oxygen lance, and other measures have sharply increased the bath temperature and caused marked wear of the solidified magnetite [3]. The known methods of increasing the durability of the magnetite protective coating by incorporating a limited amount of magnesium, aluminum, and chromium oxides in it [4, 5] do not greatly reduce wear of the solidified magnetite.

During service the protective coating is gradually worn away by solution of matte and iron sulfides in the melts. The solution of magnetite was investigated in [6, 7]. With an
increase in the iron concentration in the sulfide melt the rate of solution of magnetite decreases and takes place under diffusion conditions. Magnetite dissolves in sulfide melts far more rapidly than hercynite [8].

Investigations of the kinetics of solution of Fe₃O₄, MgFe₂O₄, and FeAl₂O₄ in highly ferriferous slag melts, similar in composition to converter melts, were performed by the rotating cylinder method. In these slags of the FeO--Al₂O₃--SiO₂ system the content of iron oxides remained constant at 75%* during the test. The slag composition was varied by replacing part of the SiO₂ by aluminum oxide to the extent of 0-10%. The initial Fe₃O₄, MgFe₂O₄, and FeAl₂O₄ specimens, 12 mm in diameter, were prepared from the pure oxides by the usual ceramic procedure. The spinel was dissolved in a furnace with an inert medium at 1250, 1300, 1350, and 1400°C, the specimens being rotated at a speed ω of 95-690 rpm.

The rate of solution v of all the specimens in iron orthosilicate is directly proportional to ω⁰.⁷ (Fig. 1), indicating the diffusion regime of the process. An increase in temperature greatly increases the rate of solution of the spinels (Fig. 2). The apparent activation energies of solution of Fe₃O₄, MgFe₂O₄, and FeAl₂O₄, calculated from the experimental data, vary in the range 210-260, 200-240, and 140-190 kJ/mole, respectively.

Incorporation of aluminum oxide in the slag reduces the rate of solution of the spinels (see Fig. 1). With an increase in the Al₂O₃ concentration in the slag from 0 to 10%, MgFe₂O₄ and FeAl₂O₄ dissolve 3-4 and 10-12 times more slowly, respectively, than Fe₃O₄. This is probably due to the greater strength of the hercynite crystal lattice and to the physico-chemical properties of the melt and the interaction processes at the phase boundary. The small size of the Mg²⁺ ions and their high mobility in comparison with Al³⁺ in iron silicate melts promote higher solubility of MgFe₂O₄ than FeAl₂O₄.

Thus a preliminary estimate of the corrosion resistance of spinels in iron silicate

*Here and below the contents are in wt. %.