High-alumina lightweight parts made with a high-alumina chamotte base are clearly superior in spalling resistance and additional shrinkage. This procedure is more promising for the production of lightweight brick. The high-alumina lightweight brick was tested in the lining of the fire-boxes of auxiliary boilers aboard Black Sea Shipping Company tankers. The boilers were the vertical water-tube type.

The fire-box lining is subjected to the following types of action: sudden heating and cooling, a flame temperature of 1500°C or more, mazut ash, and vibration on account of the ship pitching and tossing when the engines are working.

A characteristic type of wear and tear in the refractory lining is local sweating of the brick, sometimes to some depth, particularly in the middle of the side walls, accompanied by considerable thinning of the layer of lining, even down to the metal frame, the burning of which means the danger of the lining collapsing. The life of the lining of the front and rear walls is from 4,000 to 5,000 hours, and up to 500 - 600 hours for the side walls.

The high-alumina lightweight brick made with an industrial alumina base was used on one tanker for lining the side and front walls of the auxiliary boiler fire-box. The lining, 120 mm thick, was made with a high-alumina plasticized mortar with a seam thickness of 2 - 4 mm.

During operation the lightweight lining did not sweat, but after nine months partial spalling began in the middle of the side walls, attaining a depth of 50 mm by the time the lining was dismantled. The residual minimum thickness of the lining at points where the wear and tear were greatest amounted to 60 mm. The high-alumina lining lasted 14 months, including 6000 hot hours of which 1387 were spent at full capacity.

The lining of the second boiler aboard the tanker, made of semi-acid brick, had to be replaced over this period twice in the side walls, and once in the rear wall.

Under the same operating conditions the high-alumina lightweight brick lasted almost three times as long as the one made of semi-acid brick.

High-alumina lightweight brick with a high-alumina chamotte base was used to line the fire-box of an auxiliary boiler in another tanker. The brick was put in the front, side and rear walls. The thickness of the lining was 120 mm. It was made with plasticized high-alumina mortar.

During eight months of operation the lightweight lining worked for 1400 hours at full capacity, i.e., two and a half times as long as the semi-acid lining. At the end of a year it was in a satisfactory condition and continued operating.

A production technique has been worked out for the manufacture of high-alumina lightweight brick by the combustible additive method with semi-dry pressing of the mixtures. These parts can be used for the working layer of the lining at temperatures up to 1550°C.

The long-term advantage of using high-alumina lightweight brick in the lining of fire-boxes for auxiliary boilers aboard ships using liquid fuel has been established. It is possible that this brick may be used in the future for lining the fire-boxes of the main boilers as well.

To satisfy the requirements of the navy we must organize the production of high-alumina lightweight brick at the refractory plants of the South and East.

LITERATURE

MANUFACTURE AND SERVICE OF INDUCTION FURNACE CRUCIBLES MADE OF MAGNESITE WITH SINTERING ADDITIVES

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Induction furnaces are superior to other melting units [1].

One of the difficulties in operating induction furnaces is the low resistance of the lining. Magnesite used for ramming crucibles does not sinter sufficiently in service and has low spalling resistance; magnesite-chrome crucibles [2] have shown themselves to be worthwhile, but are only suitable for melting a limited number of steels on account of the transfer of chrome to the metal [3].
A lining made of pure oxide is not economical. High-alumina, spinel and magnesite-zirconium materials are unsuitable for lining crucibles on account of decreased slag resistance \([4, 5]\).

This article gives the results of tests on experimentally selected magnesite rammed mixtures with ferruginous and titanium-iron additives in 40-, 50-, and 150-kg crucibles for induction furnaces. The nature of the destruction of the crucible lining is also considered.

The characteristics of the charges and the chemical composition of the mixtures are given in Table 1.

As a bond we used sulphite-cellulose liquor with density 1.22-1.24 g/cm³ at 18-20°, or a solution of magnesium chloride of the same density.

The crucibles were rammed in layers in the inductor with a metal sweep. The working layer of the lining, 10-15 mm thick, was made thicker in order to obtain a constant-volume zone. The rest of the crucible lining was of lower thickness in order to make a "buffer" layer which would prevent through sintering of the crucible and which would help the mixture to fill up cracks forming in the working layer.

A great deal of attention was given to drying the crucibles, since if the drying conditions are not correct, cracks appear during the first melt. The drying process in the 40-50 kg furnaces took 2 to 2 1/2 hours, at a generator load of 15-20 kilowatts.

During the first melt the metal temperature was raised to 1600-1700°.

The types of smelted steels and basic characteristics of the experimental crucibles are given in Table 2. The crucibles were worked periodically, producing one melt per 24 hours. The slags were often diluted with fluxespar.

Practice shows that the weak point in the crucible lining is the slag belt, which is eroded during service, and the top of the crucible on account of the fact that at a low temperature magnesite does not sinter. The wear of the crucible averaged 0.26 mm/melt, and that of the slag belt ranged from 1.0 to 5-10 mm/melt. In certain crucibles the eroded slag belt was puttied with a magnesite mixture or joint-ground mixture of magnesite and titanium-magnesite concentrate in the proportion of 4:1.

To protect the non-sintered part of the lining from the mechanical damage it is essential to use a constant charge for the melt, the top of the crucible should be rammed and fired separately outside the furnace, after which it can be fixed to the walls of the crucible and carefully puttied with magnesite, chrome-magnesite or chrome mortar, according to the material of the top and lower parts of the crucible.

Investigation shows that the crucible lining acquires a zonal structure after service (Table 3). As a result of the interaction between the melt reagents there is a reduction in the content of magnesium oxide, compared with the initial content, and an increase in the oxides of silica, iron, manganese and chrome.

The wear and tear of the magnesite crucibles containing additives is due to the sweating of the working zone which