With six to seven melts per day and a lining temperature of not less than 600°C, wear takes place by fusion of the working zone, not by cracking, as noted above. In this connection the lining structure is monolithic with a glazed surface. With this intensity of operation the variation of the lining wear is determined by the chemical composition of the slag.

With six to seven melts per day (46% of the campaigns) the ladle lining durability after hot patching was 28 melts, with a maximum of 37 melts, as compared with 17.1 for ladles without hot patching and from one to two melts per day. Thus the use of a refractory dressing for patching local sectors of wear reduces the number of intermediate maintenance operations.

Over a test period of 2 months with 1.58 hot patchings per ladle campaign, the durability was increased on average from 19.1 to 23.3 melts, with a refractory consumption of 5.4 kg/ton of steel as against 6.3 kg/ton without hot patchings. Figure 3 shows the variation of the lining durability over a period of years.

CONCLUSIONS

The use of 70-75% of silica artifacts to line steel-teeming ladles, accompanied by routine hot patchings, has permitted an increase in the lining durability by from four to five melts.

With an increase in the ladle throughput from 1-2 to 6-7 melts per day, accompanied by hot patchings, the maximal lining durability was 37 melts (average 28 melts) and the refractory consumption was reduced by 2.1 kg/ton of steel.

The saving obtained by the use of a silica lining was 332,200 rubles.

INTERACTION OF PERICLASE AND CORUNDUM REFRACTORIES WITH IRON AND IRON—MANGANESE MELTS

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In the sliding gates of steel-teeming ladles, periclase and corundum plates are used in preference to other types, because they are the most durable. However, prediction of the durability and the effective use of refractories are possible only on the basis of an investigation of their resistance to metal, which has not yet been adequately investigated. Experience gained in the use of plates shows that the intensity of the action of molten steel on them is related to its degree of deoxidation. Of the total amount of steel smelted, the proportion of rimmed steel with a high oxygen content is still high. This article deals with the action of rimmed steels on periclase and corundum refractories.*

* The investigation procedure was described in [1].

![Fig. 1. Microstructure of periclase (a) and corundum (b) refractories. a) x 40; b) x 110. Reflected light.](image-url)
Specimens measuring 200 × 20 × 20 mm were cut out of periclase and corundum industrial artifacts with an open porosity of 8-12%. Of the microstructure of the initial periclase refractories (Fig. 1a), 94-96% consisted of irregular aggregate periclase grains measuring 0.1-0.7 mm. The remaining 4-6% belonged mainly to monticellite veinlets 0.2-0.25 mm thick. The size of most of the pores ranged from 0.05 to 0.1 mm.

According to the results of mercury porometry, 75% of the overall pore volume lies within the size range 0.0005-0.05 mm [2]; however, in this case the size of the "mouth" of the open pores is estimated, not the pore size.

In the corundum artifacts (Fig. 1b) the corundum content is 92-94%, the remainder is mainly alumino-silicate glass. The corundum crystals are prismatic; their size ranges from 0.01 to 0.05 mm. Most of the pores are of the same size as the crystals. According to the results of mercury porometry, their size is 0.0005-0.05 mm.

The procedure for making periclase refractories provides for sintering for 3-4 h at 1680-1730°C, and in the case of corundum refractories sintering for 1-1.5 h at 1560-1630°C. The steel-pouring time is 0.5-2.0 h and the metal temperature is 1590-1690°C, accounting for the marked thermal attack by the metal on the refractory. It is known that the grain length increases in proportion to the square root of the duration of thermal attack. In fact, even immersion for 10 min in the melt has an effect on the refractory structure: We observe an increase in the size of the crystals and of the pores (mainly at the expense of the very smallest); there is a corresponding influence on the surface area, the firecracks and cracks become larger and new ones are formed, often larger than the pores.

The impregnation of different sectors of the periclase and corundum specimens by oxidized melts is nonuniform (Fig. 2), despite the fact that the initial specimens are fairly uniform. The depth of penetration of a melt, X(m), is usually characterized by the equation [3]

$$X^2 = \frac{\sigma \cos \theta}{2\eta} \tau,$$

where $\sigma$ is the surface tension at the melt/gas boundary (mJ/m$^2$); $\theta$, contact angle of wetting (deg); $r$, capillary radius (m); $\eta$, viscosity (Pa·sec); and $\tau$, contact time (sec).

The proportionality of $X^2$ and $r$ explains the observed difference. On average the pore inlet radius is several thousandths of a millimeter but the width of the firecracks and cracks formed is several tenths of a millimeter. Owing to the random geometry of the cracks, neither the mean nor the maximal depth of