The stepping up of open-hearth production has created the need for wear-resistant refractories for the lower structure of the furnaces. The use of forsterite brick in air regenerator checkers has made it possible to obtain a wear-resistance in the basic arch of two or three runs.

Although they lost a similar period, the use of forsterite refractories in gas generator checkers is inadvisable on account of the fact that they crumble to a great extent in a gas-variable medium and the checkers do not heat as well.

Research has established that the reason for the intensive crumbling of forsterite refractories in gas generator checkers is the volumetric variation experienced by the iron oxides making up the charge bond (particularly in the magnesite component), during the transition of $\text{Fe}^{2+}$ to $\text{Fe}^{3+}$ and back in a gas variable medium.

Figure 1 shows that compared with standard forsterite parts, the coefficient of linear expansion of specimens with a small iron oxide content (pure magnesite parts and synthetic forsterite) varies only slightly. It is considerably increased when the magnesioferrite content is increased, particularly at service temperatures in regenerator checkers (more than 800°C). We considered it was therefore advisable to carry out tests on magnesite brick in checkers, first and foremost in gas generators.

It should also be taken into account that magnesite has a higher thermal conductivity factor (Fig. 2) and greater heat capacity (Fig. 3) than chamotte or dinas. Magnesite parts also have a greater bulk density, hence the total heat transfer factor of these refractories is considerably higher than for chamotte or dinas.

The Ukrainian Institute of Refractories (A. S. Frenkel' and K. M. Shmukler) tested magnesite brick in regenerator checkers. Bricks 380 x 150 x 75 mm in size were prepared at the UNIIO experimental plant by pneumatic tamping. The charge consisted of metallurgical magnesite containing 90.8-91.9% MgO; 35% fraction less than 0.088 mm and 65% fraction 3-0 mm. As a bond we used sulphite-cellulose base (up to 2% dry weight). Some of the parts were sent for testing without being fired. The characteristics of the parts prior to service are given in Table 1, and after service in Table 2.

The tests were carried out in the regenerator checkers of two 200-ton furnaces working on oxygen. The number of melts per run was 498 and 467. The checker bricks in the gas regenerators showed a high wear resistance. On account of the slighter saturation with ferruginous melted metal and low iron oxide content in the initial charge, the brick underwent less bulk change and loosening than the forsterite brick next to it. A high degree of wear resistance was also shown by the non-fired brick, which for practical purposes did not crumble. Both types of brick remained exactly the same size after service, even in the first row of the checker, and showed no structural defects. There was 5-10 mm of skull on the horizontal surface of the bricks.

Parallel tests on magnesite brick in air regenerator checkers showed no differences in principle in the nature of the change in the spent refractories compared with standard forsterite parts. The upper row of bricks (like the forsterite ones) had cracks right through them. Saturation with ferruginous melts usually occurred in the cracks to a depth less than in forsterite by a factor of 4-4.5. At the same time as this reduction in saturation there is an increase in thickness and degree to which the skull adheres to the brick. On the vertical surface the skull was 5-6 mm thick. No substantial differences in the behavior of fired and non-fired parts was observed. The use of non-fired parts should be considered more effective, taking into account the possibility of increasing their production and the smaller cost.

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In order to test the magnesite brick more extensively, the Pantoeleymonovo Plant manufactured a batch of 120 tons of fired and non-fired bricks according to a UNIIO specification, taking into account the specific conditions of the plant. The brick was small in size, 182 x 150 x 65 mm.

The same magnesite powder used for standard chrome-magnesite brick with a content of 90.24% MgO, 2.54% CaO and 2.60% SiO₂ was used to make the experimental brick. The grain composition of the powder is given in Table 3.

The charge for the magnesite brick consisted of 60% 0.5 mm grains and 40% finer than 0.088 mm. The proportioning was carried out by semi-automatic scales. The mixture was mixed in a tempering rrdll for 10-15 minutes. The charge was moistened with sulphite-cellulose liquor with a density of 1.24 g/cm³; the content in the mixture being calculated as 2.4% per dry weight. The properties of the mixtures and bulk density of the green material are given in Table 4.

The bricks were pressed in an 8-mold rotary press. The depth to which the mold was filled was 105 mm in the case of non-fired brick and 104 mm for fired brick. The dimensions of the green material were 182 x 150 x 65 mm for non-fired and 185 x 155 x 66 mm for fired brick.

The green material was dried in tunnel-type driers under normal conditions for roof and for forsterite parts. To avoid crack formation, wooden linings were placed between the metal frame and green material.
Fig. 1. Coefficients of linear expansion of brick in a (a) reducing and (b) oxidizing medium: I — magnesite; II — synthetic forsterite; III — magnesite with addition of 10% magnesioferrite; IV — magnesite with addition of 20% magnesioferrite

Fig. 2. Coefficient of thermal conductivity of refractories: 1 — magnesite; 2 — synthetic forsterite with addition of 25% magnesite; 3 — synthetic forsterite; 4 — dinas; 5 — industrial forsterite; 6 — chromite with addition of 10% magnesite; 7 — chamotte

Fig. 3. Thermal capacity of refractories: 1 — magnesite; 2 — industrial forsterite; 3 — chamotte; 4 — dinas