With the introduction of new capacity for the production of fused materials at the Magnesite Combine, a production process has been developed and mastered for producing powders made from fused periclase; tamping masses and articles based on them have been produced for lining the electric smelting furnace aggregates, including induction furnaces for smelting pig iron and steel. The fused periclase powders are made from the highest quality magnesite, e.g., the PPM-96 (TU 14-200-263 - 77) must contain at least 96.5% of MgO,* ≤ 1.5% SiO₂, and ≤ 1.6% Fe₂O₃. The choice of batch and the development of the technology for the production of periclase was done after taking into account the requirements laid down in TU-14-200-263 - 77 and TY 14-8-155 - 75. Normally, for making periclase in accordance with the above specifications, the batch is a sintered powder of fractions 3-0.5 mm, obtained by firing Satkinsk magnesite in shaft furnaces and containing 93-95% MgO, 0.8-1.5% SiO₂, 0.1-0.5% Al₂O₃, 1.5-2.2% Fe₂O₃, 1.4-2.1% CaO, and 0.1-0.3% loss on ignition. The batch is fused into a block in OKB-955N ore-smelting furnaces. The smelting process can be divided into three characteristic periods.

The first period lasts for 30-120 min and begins as soon as the furnace is switched on and continues until the predetermined current (6.6 kA) is reached when intensive melting of the block begins. The form of the volt-ampere characteristics (Fig. 1) indicates that during the first period the furnace operates in a nonarc regime.

The second firing period generally lasts for 15-24 h and includes the portional charging of batch and melting of the portions of the powder. In this period the electrodes are raised up, alternating with a short periodic descent in the interval between the charges at moments when the batch under them is effectively melted (Fig. 2). The furnace operates in the arc regime (Fig. 1a). During this period the main, dense zone of the block is melted; the block cross section is in the shape of a trefoil (Fig. 3) and consists of highest-quality periclase.

The third and final firing period is limited to the moment when the tank is completely filled with batch (end of charging) and the furnace is switched off. The furnace is mainly operated with open arcing which is accompanied by significant heat loss and the formation of a conchoidal zone (Fig. 3) in the upper part of the block.

Judging from the character of the path of the electrodes (Fig. 2), the rate of melting of the block in the vertical direction when firing in the fifth voltage setting of the transformer (84 V) is higher than when firing is carried out in the ninth voltage setting (70.8 V). The block melted at the ninth voltage setting is found to be slightly more evolved in the horizontal section than the block melted at the fifth setting.

The overwhelming majority of firings were carried out at the fifth, ninth, and partly at the seventh (77 V) voltage setting (Table 1). With a change from the ninth to the fifth voltage setting, the duration of firing is shortened and furnace productivity is increased. The melting at the first to second voltage setting (105.2-99 V) at a greater power was accompanied by an even greater shortening of the total firing time. In this case, however, there was a sharp reduction in the size of the dense zone of the block, particularly in the horizontal cross section, and an increase in the size of the conchoidal zone and a deterioration in the quality of the periclase.

In order to increase the dense part of the block in a radial direction on the plan view and to reduce the volume of the conchoidal zone, after carrying out firing at the 1st voltage

*Here and elsewhere mass fractions are given.
Fig. 1. Form of the volt-ampere characteristics when the furnace operates in a nonarc regime (a) in the first period of smelting and in an arc regime (b) in the second and third periods.

Fig. 2. Regime of normal (1) and experimental No. 92 (2) firings: I, II, and III, respectively, are the first, second, and third firing periods; the figures near the arrows indicate the amount of batch charged (in tons) in accordance with regimes A and B, respectively, for the normal (1) and experimental No. 92 (2) firing.

setting we switched off the furnace after the formation of craters and separating the arc and lowered the electrodes 30-50 cm into the melt in order to slow down the emergence of the electrodes on to the surface of the batch and to provide the maximum working time for the furnace in a closed-arc regime. By making trial switching after an interval, we determined the moment when the current through the electrodes was no greater than the nominated values and the furnace was then switched on again for firing with the electrodes at the lower position. As the electrodes are moved down to the lower position, the batch is crumbled and, at the moment the furnace is switched on, the craters are clogged with batch which leads to a decrease in the heat loss. By increasing the added power to 850-1040 kW, the conchoidal zone melts and its height is reduced; the dense zone is increased, and as a result, furnace productivity is increased. The disadvantage of this method is the significant adhesion of batch to the electrodes close to the surface of the solid batch as a result of the liquid being drawn out from under the electrodes at the first instant.

In furnaces with different diameters of housing and electrode breakdown we carried out experimental balance firing at the fifth voltage setting using various portions of loaded batch (Table 2). With normal and balance firing, the highest productivity for the lowest unit consumption of electricity and raw materials was achieved in furnaces with an electrode separation of 1050 mm and a housing diameter of 2500 or 2800 mm when loaded, respectively, with small (1.5 ton) and large (6 ton) portions with an optimal smelting time of 20-25 h.