Calcium oxide in the pure form is rarely used for making refractories. Reports have appeared on the use of calcium oxide for lining oxygen converters and vacuum induction furnaces. The oxygen content of the steel melted in vacuum furnaces with lime crucibles was minimum, and equaled 0.004-0.005%, while in an acid crucible it was 0.038%, and in a magnesite crucible 0.015% [1]. In contrast to MgO, SiO₂ and other oxides, calcium oxide, like alumina, shows a very low volatilization in vacuum at high temperatures [2]. Calcium oxide like other refractory materials can be evaluated in particular with regard to the properties of the fired specimens made by dry or semidry pressing methods with high specific pressures or by slip casting [3]. Therefore calcium oxide deserves serious attention as a refractory material.

Ordinary calcium oxide has a high porosity and is readily hydrated. A maximum density (close to theoretical) can be obtained by fusing the material. However, the production of fused calcium oxide in arc furnaces with graphite electrodes is accompanied by carburization, resulting in the formation of calcium carbide. Calcium carbide sharply impairs the resistance of fused calcium oxide in moist atmospheres, and prevents its use for lining vacuum furnaces, when especially low-carbon steels and alloys are being melted.

High-quality fused calcium oxide can be obtained by plasma heating, which is now extensively used in various technologies. In plasma fusion it is possible to apply a lot of power to unit area (more than 400 kW /cm²), and to exclude carbide formation. Plasma fusion apparently is promising for producing other fused refractories. The temperature involved in plasma heating in the fusion zone will be much higher than with arc fusion, and this favorably affects the density, homogeneity, and structure of the fused refractories, and also facilitates the application of fusion not only "in the block" but also "at discharge." To obtain fused refractories, including lime, it is possible to use a furnace with cylindrical or triangular housing and

![Fig. 1. Microstructure of fused calcium oxide (x180). Transmitted light without analyzer. a) White and gray areas indicate grains of calcium oxide of polygonal outline (octahedra and dodecahedra form); black areas indicate microcrystals of brownish color of calcium oxide and pores; b) grains of fused calcium oxide of polygonal outline; c) dendritic form of crystals of fused calcium oxide.](image)
Fig. 2. Cracking pattern passing into the twinning on the cube, in the mass of calcium (×320). Transmitted light without analyzer.

Fig. 3. Anisotropy (white sections) of edge parts of the grains of calcium oxide (×160). Transmitted light without analyzer.

Fig. 4. Development of new mineral (white prismatic forms) at the edges of the crystals of calcium oxide. Transmitted light with analyzer (×160).

vertically arranged single or multiple plasmatrons. Material fused in the same furnace should preferably be used for lining the furnace.

A laboratory plasma furnace was used to melt metallurgical lime with particle sizes of up to 25 mm containing 91.7% CaO, 0.21% SiO₂, 0.20% FeO, 1.44% Al₂O₃, 0.92% MgO, 0.007% P₂O₅; loss on ignition 5.3%. The melting was done "on the block" with voltages of 85-95 and a current of 300-450 A. Melting was done without difficulties, the load was stable, and when the lumps of lime fell under the plasma jet, did not break away since the "cord" enveloped the lumps and moved under them perpendicularly to the bottom electrode. The fusion time for 5.5 kg of lime was 21 min. The batch was placed on the peripheral sections of the fusion zone and its level was maintained at the lower section of the head of the plasmatron in order that the heat losses by radiation to the surroundings should be minimum. After the fusion of the block the melt was kept for an extra 5 min under load to reduce the cavity shrinkage, and then the block was cooled with the furnace.

In the central part of the block a shrinkage cavity developed with a depth of up to one third of its height and with a width of 1/8-1/10 of its diameter. Directly near the cavity there was a dark-gray zone with brownish shading (50-60%), changing into a gray zone with a light greenish color (40-50%), terminating in partly fused pieces of lime. In both zones the material was dense and thoroughly crystallized; individual pores measuring from microscopic sizes to 0.5-0.7 mm occurred in the dark zone near the lower part of the shrinkage cavity.

Under the binocular microscope and ordinary microscope, sections were noted with crystals of different size, form, and color. Very fine grains had a polygonal outline (Fig. 1a), and the coarser grains were mainly cubic, consisting of combinations of cubes and octahedra (Fig. 1b). All the crystals exhibited perfect twinning on the cube. In the intermediate spaces between the grains of CaO and in the form of inclusions, plate-like, dark-brown, almost black material was noticed, giving the specimen a brownish color in places.

The sections of the red (dark, sometimes almost black) color have a dendritic form of crystallization of CaO (Fig. 1c). They are alternated by weakly colored, sometimes colorless, sections of a coarser grained structure; subsequently it was possible to observe glassy, structureless sections with irregular cracks, changing into sections with typical cubic twinning (Fig. 2). The crystals of CaO had the cubic symmetry (isotropic with N = 1,834). In the x-ray investigations the Debye pattern showed all the basic lines typical of calcium oxide.