TESTING ROOF REFRACTORIES IN THE
ALL-UNION COMPETITION FOR 1964

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Zh. A. Vydrina, A. P. Klyuchev, and M. A. Abdulina
(Nizhne-Tagil'sk V. I. Lenin Steel Combine)
A. E. Nazarenko
(Gisogneupor)

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To find the most wear-resistant brick for the roofs of large open-hearth furnaces working with oxygen, the
central authority of the Scientific-Technical Society for the Iron and Steel Industry in 1964 held an All-Union com-
petition for roof products.*

The competition was entered by the Zaporozhe Refractories Plant, the Nikitov Dolomite Combine, which
entered periclase-spinel brick PShS, and the All-Union Refractories Institute (VIO), together with the Magnesit
Plant, which entered chrome-periclase brick made at the Magnesit factory and referred to subsequently as KhPS.

The tests on the bricks were done in 400-ton open-hearth furnaces at the Nizhne-Tagilsk Steel Combine,
heated with a mixture of coke and blast-furnace gas and working with the scrap-ore process on liquid iron (65-70%).

The iron is poured into the furnace at the combine through two gutters placed on the second and fourth charg-
ing windows. Carburation of the flame during melting and finishing is done with oil (about 5 kg/ton of acceptable
ingots).

Intensification of the process is carried out with oxygen in amounts of 30-40 nm³/ton of ingot, fed to the
flame through two water-cooled tuyeres located on both sides of the gas caisson.

During the campaign, the furnaces operate with one intermediate repair which is done with complete gas shut-
off, and under these conditions the roofs are not repaired.

The roofs are designed according to the thrust-suspension system. The height of the roofs over the level of
the charging windows is 3050-3100 mm. The ratio of the rise to the span of the roof is 0.17-0.18. The roofs are
built of 460-mm brick made by the Magnesit factory. Each ring has three brick units. The thickness of the metal
reinforcing plates is 0.8-1.2, and the suspensions 1.5-2.0 mm. Thirteen pairs of supporting angle-sections measur-
ing 150 × 150 mm are placed right up to the roof.

The suspension of the roof is made before the removal of the shuttering. Shrinkage of the roof after removal
of the shuttering is 20-30 mm, and the elevation at the end of heating is 30-40 mm. The heating cycle for the
furnace is regulated in relation to the melting periods. In particular, the temperature of the roof is maintained in
the limits 1450-1720°; during repairs to the hearth, it is dropped to 1000-1150°.

The structure of the upper 10-12 courses of the air checkers is made with the Cowper system; the remaining
parts of the checkers and the gas chambers are built according to the Siemens system with a cell aperture of 155
× 155 mm.

*In addition to the authors of the article, the following took part in the work: N. B. Kuznetsova, V. I. Bespamyatnykh,
L. I. Shelestova, A. S. Krytsikh, I. M. Gusarov, A. A. Shaposhnikova, V. S. Bespamyatnykh, R. S. Fremenko, G. V.
Golov, and V. I. Kryukov.
The upper 10-12 courses in the air and 5-8 courses in the gas checkers are normally made of forsterite brick. The lower courses are made of firebrick PM-60. The shortcomings of forsterite brick are compensated by the magnesite-chromite and fireclay brick containing 45-47% alumina.

The upper 10-12 courses of the air checkers are washed with water every decade to remove dust deposits. Every week the state of the furnace is examined.

The experimental roofs were built in the following way.

Furnace A: the right half of the roof from the axis to the neck of the flame window was built with competition brick PShS from the Nikitovsk combine; the left side was made from normal brick PShS produced by the Magnesit factory.

Furnace B: the right half was constructed from competition brick from Zaporozhe and the left half from competition brick KhPS.

Furnace C: the right half was made from brick KhPS, the left half with brick PShS from the Nikitovsk Combine.

The Zaporozhe and Nikitovsk periclase-spinel competition products were made using the existing technical specifications at these plants; the KhPS was made by the Magnesit factory using the technique developed by VIO.

Table 1 shows the size gradings of the original powders, and the batch and body compositions used for making the brick.

Finely ground mixtures at the Magnesit and Nikitovsk combines were prepared from magnesite powders and chromite ores in fractions finer than 1 mm, and at the Zaporozhe factory finer than 0.5 mm. All the products were made by using the technology for periclase-spinel brick with the introduction of 35-40% finely milled constituents, but the ratio of magnesite and chromite in the mixture was different; at the Zaporozhe plant the mixture was made up of 20-25% chromite and 80-75% magnesite, and at the Magnesit factory for making KhPS brick, the content of chromite in the mix was 60%, and in the preparation of ordinary brick PShS, 75%, and at the Nikitovsk combine it was 55%. The chrome-periclase brick KhPS was made with an addition of 5% chromite ore in the fraction 3-1 mm which was obtained from the chromite briquette fired at 1650°C.

The articles were pressed on 1000-ton hydraulic presses. They were fired in the Magnesit and Zaporozhe factories at 1700-1730°C in not less than two positions.

The physicochemical factors of the goods are shown in Table 2.

In comparison with other bricks, the KhPS brick and the Zaporozhe brick contained less Cr2O3 and more MgO. The temperature of initial deformation of these goods under load...