PRODUCTION AND EMPLOYMENT OF CHAMOTTE-CARBON STEELCASTING PLUGS

V.S. OZHIGANOV, A.M. PROKOP'YEVA AND Z.P. IVANOVA
(Upper Isset' Metallurgical Plant)

At Upper Isset' Plant high-silicon transformer steel is produced in open-hearth furnaces. Tapping temperature is about 1660 °C. The steel is cast at a high speed into small ingots; the number of laps during castings reaches 60 to 80. Such manufacturing conditions result in substantial wear and tear of the plugs and a waste of metal.

In order to determine the reasons for the high rate of wear and tear of the plugs made of ChO and "Chl" Chasov-Yar clay by plastic and semi-dry methods, the thermal stability of these goods was investigated according to the All-Union Institute of Refractories test. The method consists in introducing the specimen into a kiln preheated to 800° C, holding it for 15 minutes and air-cooling it. Results: the plugs with a screw joint made by plastic or semi-dry method had most spalled (see Fig. 1 to 4); plugs with bolt fastening made at the refractory shop of the Upper Isset' Plant by plastic method revealed cracks, firecracks and spalling. The plugs had to be discarded. The standard plugs with a screw thread made at the refractory shop of Nizhniy Tagil', Bogdanovichi and Chasov-Yar Plants spalled in the spherical part frequently causing an unrestrained flow of metal. The plugs with bolt fastening made at the refractory shop of the Upper Isset' Plant were somewhat better; however, the plugs

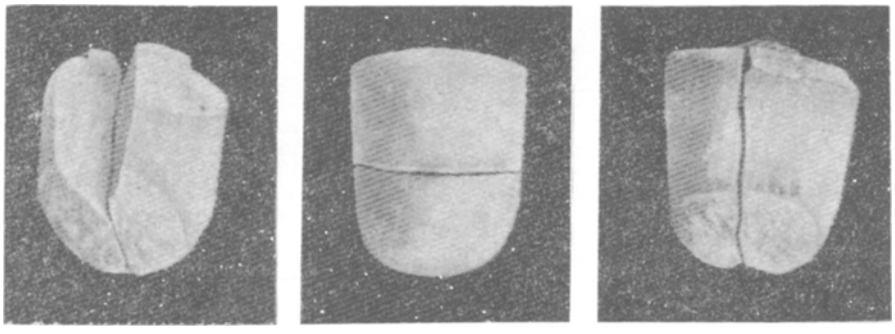

Fig. 1. Plugs with screw joints made by the plastic method at the Bogdanovichi Refractory Plant.

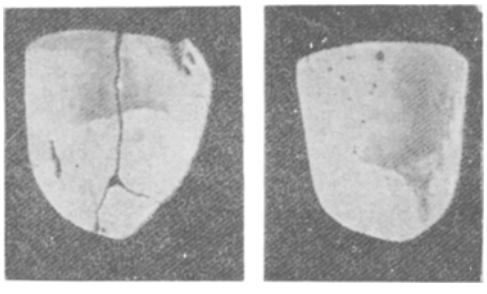

Fig. 2. Plugs with screw joints made by the plastic method at the Chasov-Yar Combine for Refractory Products.

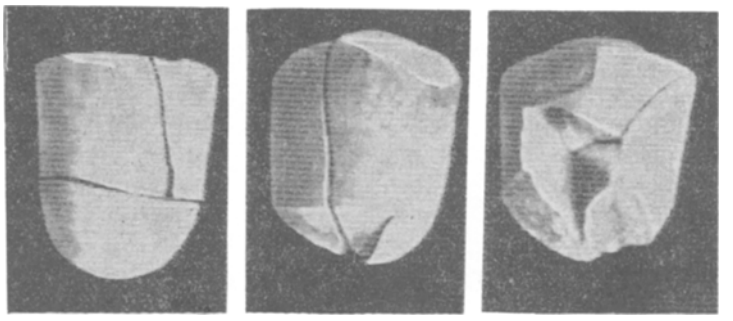

Fig. 3. Plugs with screw joints made by the plastic method at the refractory shop of the Nizhniy Tagil' Metallurgical Plant.

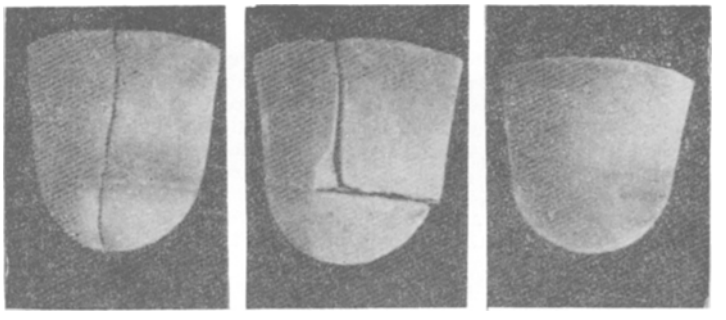

Fig. 4. Plugs with screw joints made by the semi-dry method at the refractory shop of the Nizhniy Tagil' Metallurgical Plant.

also wore rapidly and in most cases did not even last throughout a teeming operation (see Fig. 5).

Jointly with the Ural Division of the All-Union Institute of Refractories, the Upper Isset' Plant produced several test batches of plugs with commercial alumina and high-alumina slag from ferrous metal processes. The refractoriness of these plugs was 1770 °C and higher, initial softening at 1420 °C occurred under a load of 2 kg/cm^2, shrinkage at 1600 °C — 40% but thermal stability was inadequate (see Fig. 6). The test batch had to be rejected.

Furthermore the refractory shop at the Upper Isset' Plant prepared plugs of enriched Kyshtym kaolin and Buskul clay. The refractoriness of the specimens was 1730 °C and their thermal stability somewhat superior to that of high-alumina plugs. The use of these plugs somewhat reduced the loss of metal and create normal teeming conditions, a group of experts [1] at Upper Isset' Plant developed a production process for carbon-chamotte steelcasting plugs endowed with high thermal stability and wear resistance under the conditions prevailing at the plant.

[1] Yu.R. Mesnyev, A.A. Berezhnaya, Ya.I. Rubshteyn and G.N. Batuyeva participated in the work.

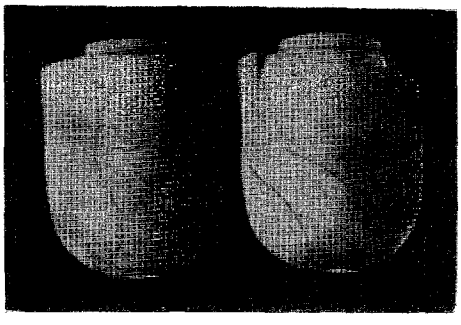

Fig. 5. Plugs with bolt fastening made of "Ch1" clay at the Upper Isset' Plant.

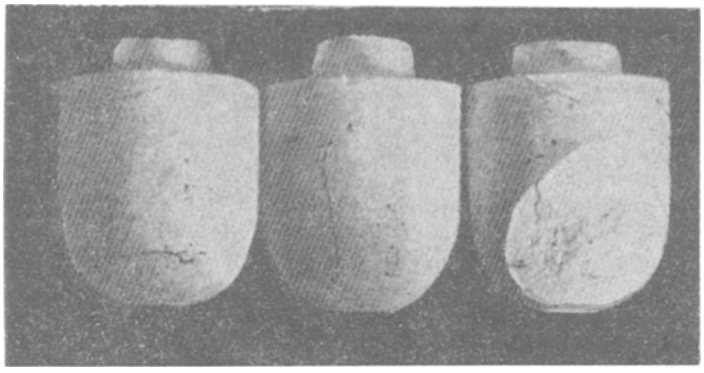

Fig. 6. Plugs with bolt fastening made by the plastic method, with commercial alumina added, at the refractory shop of the Upper Isset' Plant. After 5 heats.

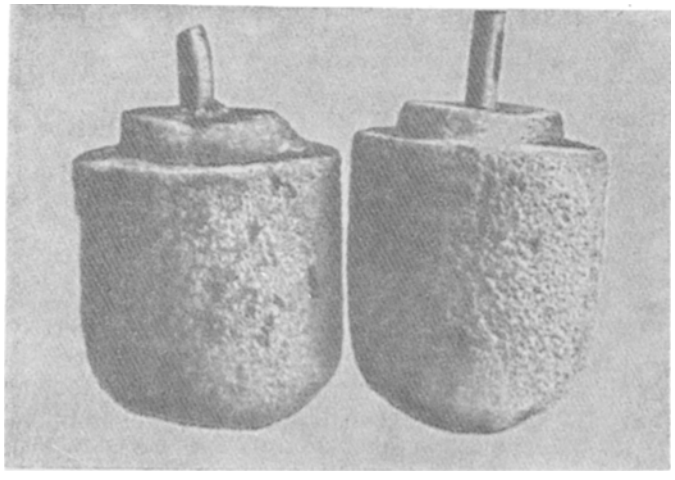

Fig. 7. Carbon chamotte plugs after service.

Most favorable results were obtained in using crushed electrodes by way of carbon additions. Fresh crushed electrodes were introduced in quantities of 10 to 15% to the charge. Granular distribution which was similar to that of chamotte allowed the production of a homogeneous charge, uniform distribution of carbon in the goods and eliminated lamellar structure.

The following charge was used in the production of carbon-chamotte plugs: 40 ±3% "Ch1" Chasov-Yar or Buskul clay, 45 to 50% chamotte with 8 to 18% water and 10 to 15% ground electrodes. After combined mixing in runner-edge mills, the mass contained up to 3% 1.5 to 2.0 mm grains and up to 65% grains under 0.5 mm. The mixture was treated by plastic method with a moisture content of 18 to 23% and was passed four times through a band press. The plugs were sintered at 1230 to 1250 °C in muffle furnaces. Porosity reached 23%, other indices met the requirements of State Standards 5500-50.

In 1961 carbon chamotte plugs produced according to the above method were used in the casting of transformer and dynamo steel at the Upper Isset'Plant. By comparison with standard chamotte plugs the new batch was endowed with high thermal stability and deformation was not observed after casting (Fig. 7).

According to the report of the State Institute of Refractories the number of unsatisfactory castings accompanied by the loss of metal in the 100 ton ladles of the Upper Isset' Plant and due to the use of chamotte plugs amounted to 1.49% in 1960 and dropped to 0.2% in 1961 after the introduction of the new plugs.

Practice has shown that carbon-chamotte plugs are suitable for the casting of electrical steels. The experimental use of carbon chamotte plugs in the continuous casting and vacuuming of steel is recommended.