PRODUCTION OF UNFIRED STEEL POURING FUNNELS WITH USE OF ACID WASTE

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In development of a method of production of unfired funnels for bottom pouring of steel it is necessary to solve two important problems involving selection of the type of binder and the heat treatment of the parts. In addition to reliable service properties unfired refractories must possess sufficient strength and water resistance.

Unfired specimens may be strengthened by addition to the mixtures of binders hardening either cold or in heating to low temperatures (600°C max.). Recently phosphate binders have found the greatest use in production of unfired refractories and compounds [1, 2]. However, as experience shows, the high cost of such binders restricts their use, especially in the production of large-production parts. From this point of view spent acid electrolyte after electropolishing of tubes containing 51.9% H₃PO₄, 21.1% H₂SO₄, 1.5% Fe²⁺ + Fe³⁺, 0.6% Cr³⁺, Ni²⁺ and remainder water deserves attention. These acid wastes were used in this work as the phosphate binder.

In conducting the laboratory investigations type Ch2 clay, chamotte with a water absorption of 9-10% produced from type Ch3 clay in the shaft kiln of Chasov Yar Refractory Combine, acid wastes with a density of 1.6 g/cm³, and an aqueous solution of commercial lignosulfonates with a density of 1.08-1.12 g/cm³ were used.

It is known that in production of chamotte refractories a portion of the clay binder is added to the mixture together with a commercial lignosulfonate solution in the form of a heated slip. This provides obtaining of a dense and sufficiently strong unfired part. As the results of the laboratory investigations showed, it is desirable to add the spent electrolyte to the mixture by first preparing a clay slip with a density of 1.20-1.25 g/cm³ using aqueous commercial lignosulfonate solution and then mixing it with spent electrolyte in a 1:1 volume ratio. The binder obtained is called a composite one [3].

The investigations were made on specimens with a diameter and height of 25 mm. The composition of the charge was 40% clay and 60% chamotte. The composite binder was used as the binder. The specimens were formed under a pressure of 40 N/mm², dried at 100-120°C to a constant weight, and heat treated in an electric resistance kiln according to the specified cycle. The compressive strength, water resistance,* open porosity, and apparent density were determined on the specimens. The properties of the specimens were determined the next day after heat treatment and cooling to the temperature of the

*Property has not been standardized for refractories. Development of a special method and approval of it by the established procedure are necessary.

In development of a method of production of unfired funnels the influence on the properties of the specimens of the composite binder content, pressing pressure, and heat treatment was studied. The specimens were heat treated at 320-340°C with a 3 h hold. An increase in composite binder content from 6 to 12% causes an increase in apparent density of both the unheat treated and heat treated specimens. However, the compressive strength of the heat treated specimens increases only with an increase in binder content to 10% (Fig. 1). The strength of the unheat treated specimen has a similar relationship to composite binder content but the maximum in compressive strength corresponds to 7-9% binder. Therefore the optimum composite binder content is 8-10% (above 100%).

In production of refractories compaction of the material occurs in two stages of the production operation, in pressing of the unfired part and in firing of parts. Unfired refractories are compacted only in the deformation period. As the result of this the role of this process in the production of unfired parts increases even more and to a large degree determines production quality.

In studying the influence of pressing pressure on the compressive strength and water resistance of heat treated specimens areas with weak and strong relationships of these properties to apparent density of the unheat treated part were