Improving the Slip-Casting Technology for Ceramic Articles

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Ways of optimizing the technology for ceramic articles based on the method of slip casting under the effect of capillary forces in porous molds under pressure are considered. The technology for preparing fired molds with channels for slip casting under pressure is presented.

Improvement of the production process in slip casting of ceramic articles is a subject of research for many domestic and foreign specialists. For example, ways of optimizing slip casting based on combining the casting process and drying in molds are discussed in [1 - 3]. Japanese specialists have suggested a device for maintaining a constant level of slip with inflatable elastic shells (Application 57-45646, Japan). The author of this paper has suggested a device for slip casting of hollow ceramic articles (USSR Inventor's Certificate 1570900) that provides for a constant level of slip in the mold and removal of the molten metal by squeezing it out of the expanding shell.

A new method of slip casting of hollow articles with simultaneous casting of the body and handle as a continuation of the body can be of interest for specialists. This method simplifies the technology and decreases the number of molds used without worsening the quality of the castings (USSR Inventor's Certificate for Application 4702849/33, 1989).

Slip casting of hollow articles with simultaneous casting of the body and handle is presented schematically in Fig. 1. The mold consists of functional part 1 that shapes the body of cup 2, and pouring gate 3 with a cavity having the shape of the handle of the cup 4. The functional part of the mold and the pouring part are equipped with locks 5 for assembling the mold. Dashed line 6 indicates the final configuration of the handle after the mold is removed.

Casting is conducted in the following way. Ceramic slip is poured into the assembled mold (for one article) and after filling it, the excess slip is poured out of the mold. Then, after drying and curing in the mold, pouring part 3 of the mold is removed from functional part 1, the protruding part of the preform (gate) is cut off with a knife, and the casting is withdrawn from the functional part of the mold. Then slip is deposited onto the end of the handle preform, it is bent (as shown by dashed line 6 in Fig. 1) and glued to the cup. The cut and glued sites and the internal surface of the cup are washed and it is transported for further drying, glazing, and firing.

When two articles are cast simultaneously (Fig. 2), the mold consists of two symmetric parts 1 and 2 forming func-
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Fig. 3. Diagram of slip casting of hollow articles with simultaneous casting of two bodies with handles with a porous insert.

Fig. 4. Diagram illustrating the production of channeled ceramic molds.

The use of another method for casting ceramic articles under pressure (USSR Inventor’s Certificate for Application 4906937, 1993), also utilizing the results in [4], makes it possible to substantially increase the density and homogeneity of the ceramic articles.

Another method for casting under pressure can be suggested, for example, for plates, which envisages final compaction by additional pressing of the casting after slip is poured in the mold under pressure. The additional pressing is conducted by drawing the half-molds 1 – 2 mm closer and compressing the elastic cuff sealing of the mold over the perimeter by the same value.

The author participated in creation of a technology for fired molds with channels made from unshrinkable cordierite ceramics for slip casting under pressure (USSR Inventor’s Certificate for Application 47222727/30, 1990).

The molds are produced in the following way (Fig. 4). Cordierite slip with a moisture content of 31% is fed into a porous matrix mold (for example, a gypsum one), held until the casting forms a layer of 2 – 4 mm, and the excess slip is poured out. Then the matrix mold is disassembled and spirally wound cotton cord (channel former) is slightly pressed into the surface of the casting. Then the matrix mold is again assembled, completely filled with slip, held for the required time until the cast mold is cured, and disassembled. The casting is withdrawn, washed, and dried to an equilibrium moisture content (one day at room temperature and then in a drier at 60 – 120°C).

In firing of the ceramic mold, the cotton cord is burnt off, leaving a spiral channel in it. When the mold is one-sided, it is expedient to shape the cast layer on one side of the matrix mold and then assemble it and fill it with an already established channel former.

The developed technology for producing molds makes the process of channel-shaping less laborious. Two-sided ceramic molds can play the role of both matrix and punch for...