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PROCESS OF OBTAINING HIGH-QUALITY SAND-PLASTER MOULDS FOR THIN-WALLED ALUMINUM CASTINGS

The aim of the research is to develop a technology for the preparation and drying of moulds and cores based on sand-plaster mixtures, which allows to obtain exact details of a complex form of required quality.

There is a fairly large number of studies on the physicomechanical properties of plaster-based mixtures.

Casting into plaster moulds is very rarely used, and now there is a tendency to omission it in favour of using the Cronning and Dietert methods. Very precise castings for medical use are made in die-cast or pressure moulds. The solution of such problems is an urgent task of the casthouse production.

The whole process of plaster hardening can be divided into two periods: the first is the period of plaster hardening, or tangling of the released dihydrate crystals, the second period is sealing of bonds, i.e., cementing of crystals by salts evolving during evaporation of excess, free moisture.

The terms of hardening of plaster moulds and cores depend on a number of factors: the quality of the raw materials, the fineness of grinding, the heat treatment conditions, the ambient temperature, plaster and water during preparation of the composition of the mixture, the size of the water-plaster ratio, the duration and storage conditions.

Compressive strength on average lies in the range from 1,5 to 3,0 MPa. The durability of mixtures has made 12-15min, friability has made 0.1-0.15%, gas permeability has made 40-55pcs.

Recently a calculational-analytical method based on a planned experiment has been widely used to solve the problems of controlling the properties of moulding mixtures and their stabilization.

To simulate the properties of the plaster mixture, a planned experiment has been conducted. The basic physicomechanical indicators of the properties of moulding mixtures have been selected as initial parameters: compressive strength (y_1) after drying, gas permeability (y_2).

The independent variables that determine the quality of mixtures have been the amount of: plaster (x_1), water (x_2) and asbestos (x_3). The amount of sand in the experiment has been taken assuming that its quantity and the amount of plaster has made up 100% of dry mixture in total.

In order to eliminate the influence of systematic errors caused by external conditions, the experiments specified by the planning matrix have been carried out in a random sequence, that is randomized in time. The order of holding the experiments has been chosen according to the table of random numbers.

To improve the accuracy of determining regression coefficients at each point of the plan, three to five parallel measurements have been performed.

Conducting the experiment the need to determine the error of experience or dispersion of reproducibility has been taken into account. Reproducibility has been assessed according to the results of parallel experiments, and at the same time the experiments have been carried out at the main level. The statistical significance of the coefficients for each determined optimization parameter has been checked using the student's criterion.

Thus, the following equations have been obtained for the properties of mixtures (for instance (1, 2).

$$y_1 = 1,53 + 0,89x_1 - 0,61x_2 - 0,56x_1x_2 + 0,19x_1x_3 - 0,2x_2x_3, \text{ MPa} \quad (1)$$

$$y_2 = 55,56 + 6,27x_1 + 9,6x_2 + 3,77x_3 - 1,31x_1x_2 - 1,62x_1x_3 + 6,38x_2x_3, \text{unit} \quad (2)$$

The obtained equations can be used to estimate the influence of the input parameters on the properties of the mixture, as well as to optimize the composition of the mixture.

When analyzing the obtained data, it has been established that the influence of variable factors on the optimization parameters corresponds to theoretical ideas about the formation of the properties of the mixture during its preparation. Compressive strength increases when increasing the amount of plaster and decreases when increasing the amount of water. Gas permeability decreases when increasing the amount of plaster and water.

The composition of the mixture which meets the requirements for the quality of castings is determined by the range of values: for plaster it is from 48 to 78 masses % and from 37 to 49 masses % with the asbestos content of 2 masses %.