INVESTIGATION OF THE MOBILITY OF A CONCRETE MIXTURE AS A FUNDAMENTAL FACTOR IN THE FORMATION OF MIXTURES FOR 3D-PRINTING

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An important task for realizing the possibilities of 3D-printing is the selection of mixtures of composite building materials that meet the required performance characteristics of the erected building and meet the requirements of the equipment. Fine-grained concrete mixtures are used that have the necessary strength, rigidity, frost resistance, increased adhesive and cohesive properties, and hardening speed are mostly used for this purpose.

At present, there are no recommendations on the selection of mixtures of concrete with the necessary set of properties. When designing the mixtures of composite materials, it is also necessary to take into account the features of the 3D-printer (mixture delivery time, mixture pressure, contact surface materials).

Concrete mixture transported through hoses must have relatively high mobility to allow its mechanized feeding to the extrusion site and not to separate, while it must retain its shape after extrusion. Hardened concrete must have high strength and deformability, especially with bending loads and high adhesion to concrete.

Therefore, the actual task is to develop a complex additive for a concrete mix, which gives the concrete mix high thixotropic properties with simultaneous increase in strength of the formed concrete stone and its adhesion to concrete.

The aim of this work is to study with the help of Agocel S-2000 additive based on polyacrylamide the control of the basic properties of solutions (water retention, mobility, strength).

The samples, cubes with dimensions 20 × 20 × 20 mm stored in air-moist conditions, were prepared to study the properties of cement-sand mortars modified with polyacrylamide, after which tests were carried out for strength in accordance with the State Standard 10180-2012 at 3, 7, 28 days of hardening. To carry out the tests, cement-sand mortars were prepared, the ratio is binding: the ratio of sand was 1: 2. The rheological characteristics of freshly prepared solutions were also studied: mobility, water-retaining capacity (the State Standard 31356-2013).

The following were used in the work: portland cement class Cem I 42,5N, according to the State Standard 31108-2016. The sand test was carried out in accordance with the State Standard 8736-2014. The grain composition and the size modulus of the sand, the bulk density, the true density, the content of silty and clay particles, mixing water were determined in accordance with the State Standard 23732-2011 "Water for concretes and mortars. Technical conditions ».

A modifying additive Agocel S-2000 with a viscosity of 1,500mPa s (5 g/l, 20°C, Brookfield RVT 20 rpm) based on polyacrylamide was chosen for a study.

The mechanism of action of polyacrylamide is connected to the interaction with mixing water. Presumably, the formation of a coagulation structure in the mixture, providing thixotropic properties of the mixture, is due to the formation of a spatial phase grid. At the same time, due to the fact that the formation of the structure occurs due to weak physical forces, the structure of the mixture is easily destroyed when the mixture is subjected to mechanical loads, thus the viscosity of the mixture does not increase during transportation. Thus, the introduction of polyacrylamide into the mixture for 3D-printing reduces the mobility of the solution, preventing spreading after the product formation process.

To determine the rational "additive-cement" ratio, additives were mixed with cement in the amount of 0.002; 0.004; 0.006% of the weight of the dry components. The dry components were first mixed, after which the mixture was covered with water. The water-cement ratio was 0.53.

The use of polyacrylamide showed a high thickening power when small amounts of additive were added to the cement-sand mixture. However, when introduced into the formulations, the

water-holding capacity of the mixture is decreased. In the future, this property can lead to stratification of the mixture into fractions, thereby negatively affecting the strength of the finished product. But at the same time, the introduction of an additive makes it possible to increase the strength characteristics of concrete. Thus, it is expedient to use this additive as a part of multicomponent polyfunctional action additive when forming mixture compositions for 3D-printing.