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The Development of Compositions and Research of the Properties of Fine Concrete

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ABSTRACT: The article presents mathematical models, optimal compositions and properties of filling mixtures based on industrial wastes.

KEYWORD: filling mixtures, industrial waste, mathematical model, fly ash, copper smelting slags, developed space.

Purpose of work. Fine-grained concrete is obtained from a mixture of fine aggregate, cement and water in certain proportions. To increase the economic efficiency and reduce the consumption of the binder, chemical and mineral additives are introduced into the composition of the concrete mixture. The technical requirements for materials for fine-grained concrete are given in ГОСТ 26633–2015.

Research objectives. As a fine aggregate is used sand consisting of grains of 0.16-5 mm size and a density of more than 1.8 g / cm3. For the preparation of fine-grained concrete are used natural sands formed as a result of natural destruction of rocks, as well as artificial sands obtained from crushing and screening of hard rocks.

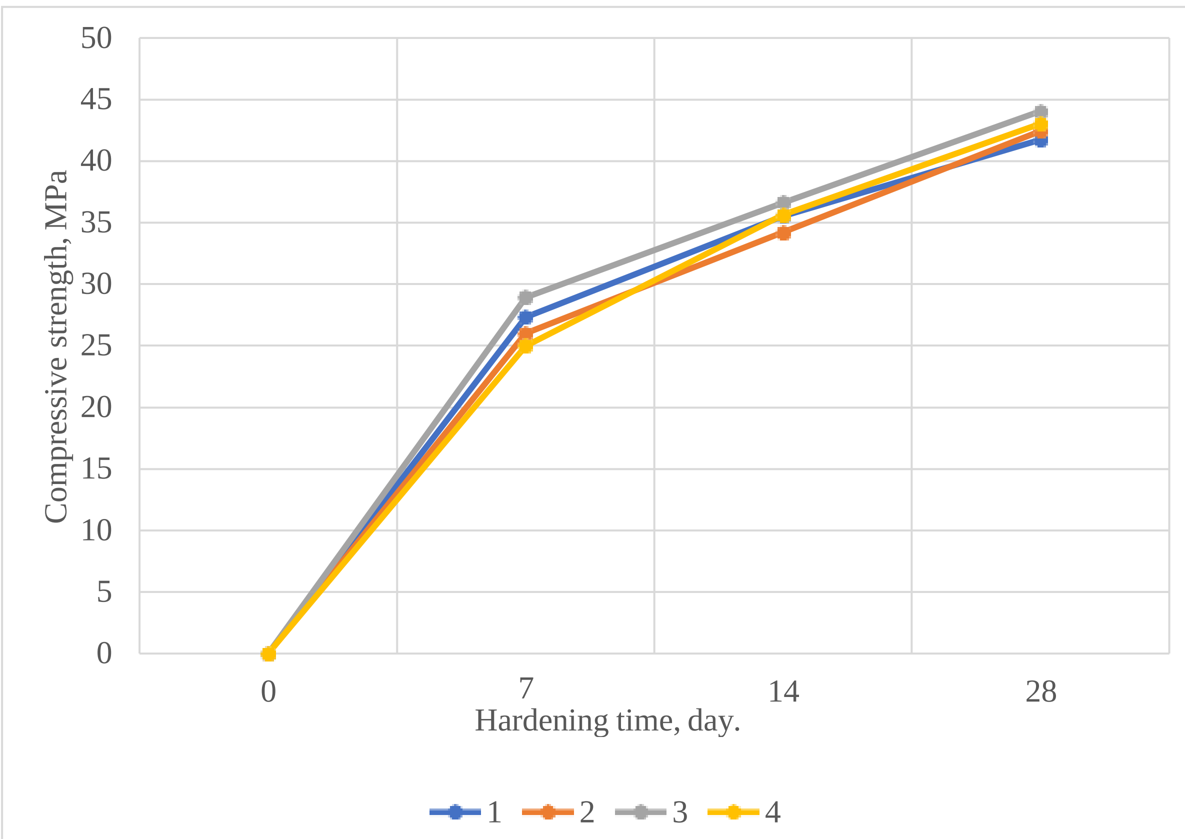
The quality of sand used for concrete production is determined by the mineral content, grain content and content of harmful impurities. The aggregate should consist of different grain sizes and the grain size composition of the aggregate should be set according to the approved instructions so that the smaller grains are located in the gaps between the coarse ones. The most common plasticizer additives (superplasticizers) in concrete technology improve the mobility of the concrete mix without increasing the water content and reducing the strength.

They also allow to reduce the water content without compromising the performance of concrete mixes and improve the basic properties of concrete or reduce the required consumption of binder with the given properties of concrete. Fine-grained concrete has increased flexibility, water resistance, and frost resistance. Since there is no coarse aggregate to determine the strength of fine-grained concrete, it makes sense to use samples of smaller sizes than usual: 3x3x3 cm, 5x5x5 cm, 7x7x7 cm cubes, and 4x4x16 cm beams (same). cement testing).

As a result, water and cement consumption increases by 20 - 40% compared to ordinary concrete, an equally mobile concrete mixture is obtained in homogeneous concrete and fine-grained concrete.

Chemical additives should be used to reduce cement consumption, effective compaction of sandy concrete mixes and coarse sands with optimal grain size composition. The use of plasticizers, superplasticizers and organomineral additives is beneficial in cement-sand mixtures with high cement content.

Problem solving methods. For this purpose, the selection of fine-grained concrete compositions with the addition of mineral and chemical additives is the main direction of research. The bending and compressive strength of concrete samples were determined on beams of 4x4x16 cm. The 1: 3 composition was selected as the control composition. Figure 1 shows a graph of the strength enhancement of ABA control composition and ash-slag added compositions. The consumption of components and the test results for bending and compressive strength of fine-grained concrete samples are given in Table 1.



Picture 1. The effect of ash-slag on the strength of fine-grained concrete: 1-control composition; 2 ash-slag additives - 5%; 3- ash-slag addition-10%; 4 additional ash-slag-15%

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Component consumption and compressive bending strength test results

Table 1

№	Consumption of components for mixing, kg				Chemical additive, kg		Aralashmaning zichligi, kg / m^3	Humidity, %	Spread, mm	Compressive strength, MPa		
	ЭТФ	Sand	NaOH	Ash-slag	Poly-plastic P	Polyplast R type 2				7 day	14 day	28 day
1	500	1500	290	-	-	-	2135	11	120	27,32	35,53	41,73
2	475	1500	290	25	-	-	2162	10	140	25,99	34,21	42,44
3	450	1500	290	50	-	-	2128	10	130	28,92	36,63	44,05
4	425	1500	280	75	-	-	2098	9,6	125	24,99	35,62	43,03

Component consumption and compressive bending strength test results

Table 2

№	Consumption of components for mixing, kg			Chemical supplement, kg		Density of the mixture, kg / m^3	Humidity, %	Spread, mm	Compressive strength, MPa		
	ETF + gray slag	Sand	NaOH	Poly-plastic P	Poly-plast R turi 2				7 day	14 day	28 day
1	500	1500	290	-	-	2135	11	120	27,32	35,53	41,73
5	500	1500	280	2,5	-	2078	9,5	135	33,38	35,62	42,12
6	500	1500	250	5,0	-	2096	8,6	125	35,12	37,14	44,54
7	500	1500	220	7,5	-	2088	7,8	120	30,90	34,12	40,52
8	500	1500	280	-	2,5	2082	10,2	120	25,08	33,10	41,16
9	500	1500	250	-	5,0	2110	9,1	115	29,97	36,86	43,14
10	500	1500	230	-	7,5	2096	8,3	115	32,18	37,64	44,82

Scientific results and their analysis. As a result of the obtained data, it can be assumed that the addition of ash-slag in the amount of 5-15% of the binder mass has a significant effect on the strength properties. Compositions 2 and 4 used ash slag with a specific surface area of 2500 cm^2/g. As the

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amount of ash-slag in the lime mixture increases, the amount of alkaline component added to the mixture also increases. This is due to the fact that ash-slag has a high adsorption capacity.

The introduction of volatile ash and slag as a mineral additive instead of a binder facilitates the pozzolanic process, in which amorphous silica (SiO2) binds to the lime formed during the hydration of the binder and is formed as a result of low temperature transition. will be. -basic hydrosilicates. The structure of the cement stone is compacted by fine particles that fill the gap between the particles in the mortar and the hydration products in the ash and slag stone, which in turn increases the strength of the fine-grained concrete.

The greatest increase in compressive and bending strength is achieved by replacing the ash slag with a 10% binder. We consider this dose of ash-slag to be optimal and use it in the subsequent selection of fine-grained concrete composition. Figure 2 shows a graph of the strength increase of the samples with the addition of the Polyplast R superplasticizer and the Type 2 complex additive Polyplast R. Consumption of components and test results are given in Table 2.

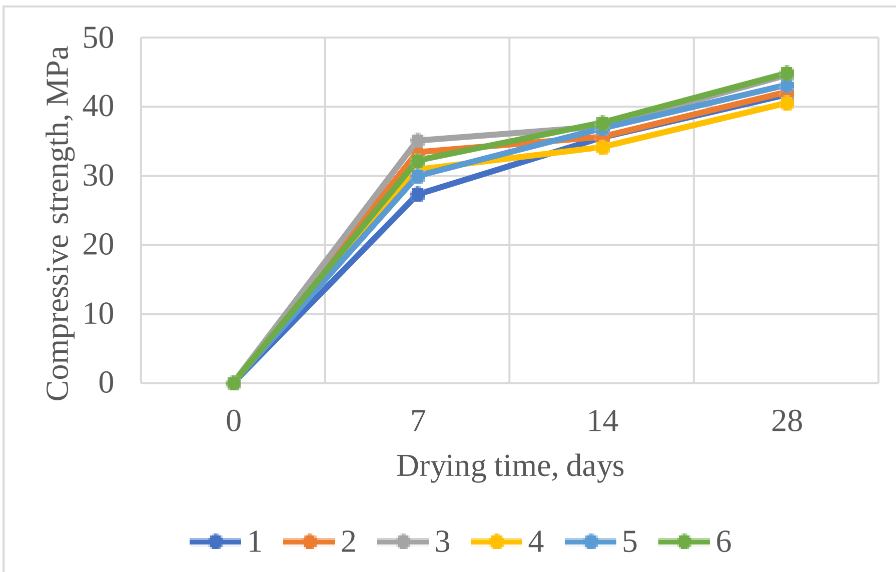

Figure 2. The effect of chemical additives on the strength of fine-grained concrete:

1 - control composition, 5 - additional Polyplast R 0.5%,

6 - additional Polyplast R 1%, 7 - additional Polyplast R 1.5%, 8 - additional; Polyplast R type 2 - 0.5%, 9 - additives Polyplast R type 2 - 1%,

10 - supplements Polyplast R type 2 - 1.5%

Conclusion. Based on the results obtained, it can be concluded that the introduction of chemical additives leads to a significant decrease in the water-cement ratio and an increase in strength in this regard. The best results for the plasticizer Polyplast R are characterized by the addition of additives in the amount of 1% by weight of the binder, for Superplasticizer Polyplast R 2 - by 1.5% by weight of the binder. From the data obtained, it can be concluded that the combined addition of mineral and chemical additives to fine-grained concrete increases the strength performance, reduces the water-cement ratio and porosity. The resulting mixture increased workability and plasticity. The optimal dose of supplements is 1-1.5%.

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The efficiency of fine-grained concrete is determined by the difference between the reduced costs per $1m^3$ of fine-grained concrete. To determine the economic efficiency of a new type of fine-grained concrete, it is necessary to compare the feasibility. The essence of the comparative analysis is that a comparison of reduced costs shows how cheap the recommended composition of fine-grained concrete is. When comparing the two options for the production of fine-grained concrete, it should be noted that both options used the same equipment.

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