MODIFICATION ADDITIVES FOR HIGH-STRENGTH CONCRETE

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Abstract. The article presents the results of research on the creation of a high-strength cement composite using a complex additive. The optimal concentrations of additives of the hyperplasticizer Odolit-K in combination with bentonite were determined.

Keywords: cement, Odolit-K, bentonite, hyperplasticizers, X-ray phase studies, surface, elasticity, concentration.

INTRODUCTION

In connection with the intensive development of high-rise construction, one of the main and priority directions in the field of building materials science is the production of high-strength cement composites using ordinary cements [1-3]. The main advantages of using these concretes are their improved mechanical and operational properties, the relative ease of the resulting structures, the reduction in the labor intensity of their production, the saving of reinforcement, and the comparative ease of creating architectural forms [4,5]. Despite these advantages, there are also a number of disadvantages associated with the relatively high consumption of the cement component, as well as the absence of a rigid stone skeleton. In addition, too high specific surface area of fine-grained concrete components due to high water demand leads to increased shrinkage deformations and deterioration of the structure. These disadvantages significantly limit the scope of application of fine-grained concrete.

MATERIALS AND METHODS

There are various methods that improve the quality of fine-grained concrete, where modifiers play the main role [3]. Concretes produced using chemical additives do not always and fully satisfy the high requirements of materials approved for use in the construction of modern critical buildings and structures.

Reducing the cost of manufactured products and obtaining building materials using highly effective surfactants of domestic production in combination with natural materials in concrete mixtures is an urgent task.

RESULTS AND DISCUSSION

The following materials were used in the presented work: hyperplasticizer Odolit-K, country of origin: C3S-62.13; C2S-16.15; C3A-7.42; C4AF-12.56. The chemical composition of cement is presented in Table 1;

Table 1.

Chemical composition of cement

Содержание оксидов						
SiO2	Al2O3	Fe2O3	CaO	K2O	SO3	MgO
21,96	5,45	4,13	66,71	1,75		

table 2

Chemical composition of bentonite

Содержание оксидов							
CO2	Al2O3	Fe2O3	CaO	K2O	Na2O	SiO2	MgO
12,1	17,4	20,0	2,1	2,4	1,3	41,7	3,1

Water for preparing samples was prepared as follows: the water was weighed, and the amount of bentonite was determined by calculating the concentration of the component and thoroughly mixed on a PE-6110 magnetic stirrer for 1 min. The resulting suspension was subjected to ultrasonic treatment on an IL100-6/2 ultrasonic unit for 15 seconds.

As a result of the introduction of powdered natural bentonite (Table 3), the compressive strength of the studied samples differs slightly from the control sample (composition 1). In this case, the maximum value of density and strength of the concrete samples under study is achieved in the range of bentonite concentrations of 2.28 - 3.38% in water. In this case, the percentage of bentonite per weight of cement is 0.4-0.6% by weight of cement.

Table 3

Physical and mechanical properties of cement stone

No.	Cement	Odolite-K, wt.% from cement	Concentration of bentonite powder, wt.% from cement	Surface tension mN/m	Normal density (NG), %	Density of cement stone, g/cm3	Strength, MPa
1	500			72,7	23,25	2,18	112,5
2	500		0,4	67,1	23,25	2,2	121,9
3	500		0,6	62	24,2	2,16	120,5
4	500		0,8	60,1	25,3	2,16	114,3
5	500		1,0	72	26,8	2,11	114,8
6	500	0,6		60,51	21,2	2,32	132,9
7	500	1,0		51,26	20,00	2,32	131,3
8	500	1,4		49,92	18,75	2,35	133,6
9	500	1,0	0,4	49,6	17,75	2,39	136,8
10	500	1,0	0,6	48,4	17,8	2,35	137,1
11	500	1,0	1,0	48,1	17,3	2,34	138,8
12	500	1,4	1,0	48,1	17,5	2,35	138,1

At the same time, the normal density of cement paste with the introduction of 0.6% bentonite increases by 4%, and the strength of the cement stone increases by 7%. When bentonite is used in combination with Odolit - K, the value of normal density differs from the control by 24%, a more intensive reduction of the liquid phase is noted in cement paste. This distinctive feature obviously manifests itself as a result of a decrease in the surface tension of the dispersion medium in the cement paste with the combined use of a hyperplasticizer and bentonite clay, as reported by the authors of this work [2]. With the combined use of Odolit-K with bentonite, the maximum decrease in the surface tension of water was 48.1 mN/m (34%), while the normal density of the cement paste prepared with this water was 17.3%. This means a reduction in the water-cement ratio by 34.4%. At the same time, the increase in the strength of cement stone was 26.3%. Analyzing changes in the surface tension of water in the presence of the complex additive Odolit-K - bentonite 34%, a change in the normal density of cement paste 34.4%, we can state the existence of a direct relationship between these values. The Odolit-K additive was studied by other authors, and the results of normal density obtained by the authors of this work coincide with the results from work [5].

CONCLUSION

Analysis of the data obtained during the study of high-strength cement composites based on the complex additive Odolit-K and bentonite showed that the resulting concrete

differs from the control concrete obtained without the use of additives in its high strength, elasticity and high ultimate elongation.

A formulation of high-strength fine-grained concrete with high ultimate deformability has been developed.

Based on the above, the formulation of the resulting high-strength cement composite can be used in the design and construction of thin-walled building structures in earthquake-resistant construction.

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