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INFLUENCE OF MODIFIED MINERAL FILLERS WITH HYDROPHOBIZING ADDITIVE ON STRUCTURAL-FORMING

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Annotation. The paper considers the issues of the influence of a hydrophoisizing additive adsorbed on mineral fillers selected by the coefficient of reduced hydration activity on the structure-forming and physicomechanical properties of the cement-sand mortar.
Keywords: water repellent, modification, mineral filler, plastic strength.

Introduction. The earlier studies made it possible to suggest that the improvement of the durability and thermal conductivity of non-autoclaved aerated concrete is possible using organosilicon water-repellents. [1-4] However, the identified shortcomings in the use of this water repellent agent suggest further research in solving these problems. According to the results of studies, it was found that the use of additives has a negative effect not only on the process of early structure formation, but also on the subsequent process of hardening of cements, however, by 28 days of hardening, the difference in the strength of the samples decreases slightly, but remains noticeable. Non-autoclaved aerated concrete production is coupled with early setting times and a quick set of strength for the turnover of formwork systems. In this regard, there is a scientific and practical interest in solving this problem.

To eliminate the negative effect of hydrophobizing additives at the initial stages of hardening, it is proposed to carry out their preliminary adsorption on a finely dispersed carrier [5-8]. The main problem of slowing down the setting time and low initial strength is that the molecules of the hydrophobizer are adsorbed on cement grains and impede their further hydration. It is assumed that preliminary adsorption of molecules on a population will allow one to control the setting time due to later desorption from the surface of the carrier of the hydrophobizator molecules.

In [9-12], it was established that the adsorption of organosilicon water-repellent molecules with mineral fillers proceeds according to the acid – base interaction mechanism. Moreover, the higher the number of active sites, the higher the adsorption capacity of the selected carrier.

The criterion proposed by the authors of [13-17], "an indicator of reduced hydration activity," allows us to more accurately assess the contribution of the surface activity of mineral fillers not only to the course of the processes of interactions and transformations taking place in a hydratable medium, but also to the adsorption capacity of these carriers of hydrophobizing molecules.

The proposed indicator is indicated by the $-P_{rga}$ symbol and is determined by the formula:

$$P_{pga}= P_{кв}+P_{кl}+0.33P_{ol}-0.1P_{ob}, \quad (1)$$

Where $P_{кв}$, $P_{кl}$, P_{ol}, P_{ob} – number of adsorption centers in regions $0<pKa<7$; $pKa>13,0$; $-4<pKa<0$; $7<pKa<13,0$ в 10^{-3} mEq / g accordingly.

This criterion characterizing the acid-base properties of the surface of mineral fillers allows you to scientifically substantiate the classification of mineral fillers according to the degree of their effect on cement systems and their adsorption capacity. In general, the

following classification of mineral fillers is proposed according to the P_{pga} criterion - an indicator of reduced hydration activity (Table 1).

Table 1: Classification of mineral fillers in terms of reduced hydration activity $P_{pga.}$

№	Type of mineral filler	Criteria Values$P_{pga.}$	Potential efficiency in cement systems, saving cement in %
1.	Low active	from 0< before. <10	Before 10%
2.	Medium active	from 10< before <25	10-20%
3.	Highly active	from 25< before <50	20-30%
4.	Super active	Over to >50	Before 50%

For mineral fillers accepted for the study, the calculation of this criterion, i.e., the indicator of reduced hydration activity, is presented in (Table 2).

A comparative analysis of mineral fillers according to the P_{rga} criterion makes it possible to predict their effective adsorption capacity, which makes it possible to scientifically substantiate the choice of adsorbent for water-repellent molecules.

Table 2: P_{pga} test in mineral fillers

№	Name of mineral filler	Initial data				Converted data		Criterion $P_{pga.}$
		-4…0	0…7	7…13,0	>13,0			
		P_{ol}	P_{kb}	P_{ob}	P_{kl}	$0,33P_{ob}$	$0.1\ P_{ol}$	
1.	Sand Quartz	8,04	9,11	8,75	1,88	2,65	0,87	12,77
2.	Sand dune	4,12	7,08	9,95	1,07	1,36	0,99	8,52
3.	Gliezh	13,22	16,47	10,08	2,87	4,36	1,01	22,39
4.	Basalt	23,41	22,15	11,16	1,96	7,72	1,12	30,71
5.	waste of electric smelting production	41,18	5,48	9,34	1,14	13,59	0,93	19,28
6.	Copper smelting waste	6,61	23,88	16,37	4,32	2,18	1,64	28,74
7.	Fly ash	43,14	27,61	11,77	5,32	14,23	1,18	46,68
8.	Zeolite containing rock	102,08	24,88	12,62	2,14	33,68	1,26	59,44

To verify the theory put forward, we selected the following fillers: fly ash, gliezh, quartz sand. The experiment was carried out after soaking mineral fillers in a hydrophobizing liquid (concentration of 25%) for 24 hours. Then they were dried at a temperature of 60-80 ºC to constant weight and crushed. A modified filler was added in a ratio of 0.1% by weight of the binder after mixing and was closed with water.

The results of the kinetics of the increase in the plastic strength of the modified cement binder are presented in Fig. 1

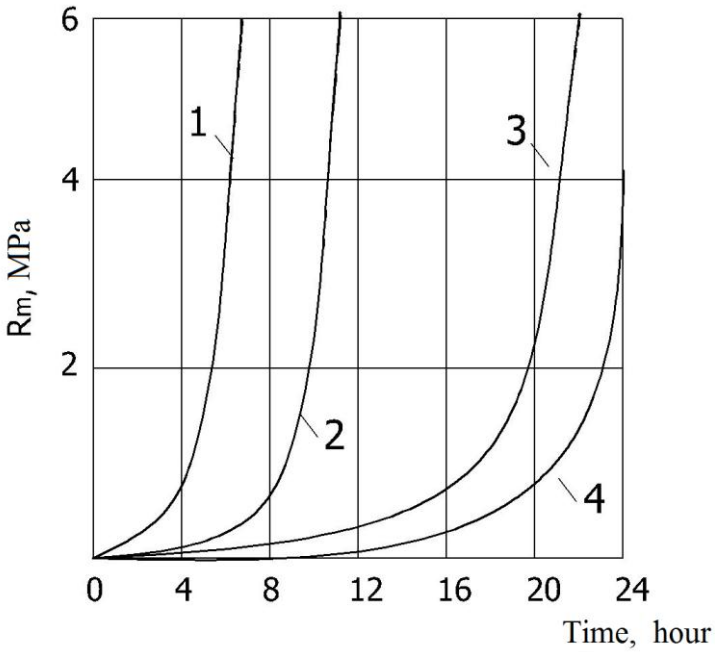

Fig. 1. 1- PC M400, 2- C + 0.1% water repellent on fly ash, 3- C + 0.1% on Gliezha, 4- C + 0.1% on quartz sand.

The results of a study of the effect of modified additives on the physicomechanical properties of cement-sand mortar are given in table. 3.

Table 3

The effect of modified filler on the physico-mechanical properties of cement-sand mortar

№	Content modified filler 0.1%	Bending strength $R_{b.s.}$ kg / sm^2		Compressive strength, $R_{c.s.}$ kg / sm^2	
		7 days	28 days	7 days	28 days
1.	---	45,3	55,8	348,5	486,5
2.	Fly ash	42,3	54,6	325,3	484,4
3.	Gliezh	38,5	50,4	300,4	460,7
4.	Quartz sand	36,5	50,4	232,5	450,4

Conclusions. According to the results of the studies, it was established that the local mineral fillers accepted for the study have an active influence on the adsorption processes of the water repellent molecules, which significantly affects the phase composition of the cement stone. Moreover, the degree of their influence on the cement binder is correlated with the proposed indicator of the reduced hydration activity of P_{pga} fillers, which confirms the advisability of using this criterion to assess the use of adsorption activity for water-repellent additives.

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