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IMPROVEMENT OF THE STRUCTURE AND PROPERTIES OF CONCRETE UNDER THE CONDITIONS OF DRY HOT CLIMATE HYDROPHOBIC - PLASTIC ADDITIVE.

Teshaboeva Nodira Djuraevna
Senior Lecturer, Fergana Polytechnic Institute, Fergana, Uzbekistan
Email – zokirjon.kimsanov@mail.ru

Abstract: *The results of studies of the effect of hydrophobic - plasticizing additives based on water-soluble acetone-formaldehyde resin and soap stock based on the properties of cement and concrete in a dry hot climate are presented.*

Key Words: *additive, water soluble, plasticizer, concrete properties.*

1. INTRODUCTION:

The regulation of the structure and properties of concrete is most effectively carried out using chemical additives of multifunctional action, which include hydrophobic-plasticizing substances. [1,2] then the ATC. It is known that hydrophobic plasticizing additives (GPA) provide a direct emulsion of a hydrophobizing agent in one hydrophilizer solution [1].

2. RESEARCH PROBLEM AND CONTEXT:

As the latter, the most widespread is SDB, which provides an acidic substance (PH = 4.5). Surface SDB is insignificant, therefore, to facilitate emulsification and improve the properties of GPA, it is recommended to additionally introduce alkali (Na2 OH), which complicates the composition and technology of its preparation [3]. In this regard, there is a need for search and application for obtaining GPA can serve acetone-formaldehyde (ACP) water-soluble resin, characterized by significantly greater surface activity than SDB, due to the increased amount of OH groups (16%). This is confirmed by the data obtained in [4], which showed that if SDB reduces the surface tension of an aqueous solution by 5.25 mn / m, then the ACV resin by 20.25 mn / m. This, combined with a neutral medium ACF resin (PH = 7.0) and makes it preferable to use it as a hydrophilizing component of GPA.

3. RESEARCH METHODOLOGY AND OBJECTIVES:

This article presents the results of studies on the effect of the new additive GPA-4 on the structure and properties of concrete in a dry hot climate (FFA) GPA-4 is a mixture of ACV resin and soap stock and differs from the traditional ones in that it can be introduced at higher dosages 0 75-1%. At such dosages GPD-4, thickened adsorption films form on the surface of cement and tumors, which serve as structural stress dampers in concrete and reduce its internal crack formation. Experimental studies were performed using ordinary Portland cement grade 400 of the Akhangaran cement plant and standard aggregators.

Table. 1 The influence of GPA - 4 on the characteristics of the pore structure of cement stone.

Total porosity cm3 / g 102	Dosage supplement GPA - 4	Pore Distributions Over Radii A					
		37-102		103-104		102-103	
		см3 /г	%	см3 /г	%	см3 /г	%
-	9,8	0,1	1,0	6,7	68,4	3,0	30,6
0,75	5,7	0,41	7,2	3,6	62,3	1,69	30,5

FFA conditions were reproduced in a climatic chamber. Two FFA modes were used in the experiments: Mode No. 1 (t = 39-430C;

V = 16-23% and V = 1.2-2.8 m / s) - when studying plastic shrinkage and water loss, it decreases by 16-24%, and the setting time of the cement paste in the conditions of FFA (mode No. 1) is extended by 90 min.

The stabilizing effect of GPA-4 during the induction period of structure formation and a decrease in the water demand of the binder in combination with the hydrophobizing effect positively affects the water loss and plastic shrinkage of the cement paste during hardening under the conditions of FFA. So, water loss of cement paste from 0.75% of GPA - 4 decreased almost 2 times, and plastic shrinkage by 77% in comparison with the standard.

The addition of GPA-4 due to the slowdown of the processes of binder hydration, stabilization of the induction period of structure formation increases the dispersion of crystalline hydrates and improves the characteristics of the pore structure of cement stone under the conditions of FFA (mode No. 2), which is confirmed by the data in Table No. 1.

The data in the table show that the total and capillary porosity of cement stone with a GPA - 4 in comparison with the standard is reduced by 1.7 and 1.8 times. The increase in the volume of micropores and the decrease in macropores are 4 and 1.8 times. Due to the improvement of the structure of cement stone has an extreme nature with max indicators at 0.75% of the GPA - 4. Moreover, the strength gain is 30%.

The influence of GPA - 4 on the water demand and strength of concrete is of the original nature with cement stone. Experimental studies of concrete with a GPA - 4 with a cement flow rate of 360 kg / m3 and B / C = 0.51 and the mobility of the concrete mix according to O.K = 2cm showed the following. The water demand of a concrete mix with 0.75 GPA - 4 is reduced by 18%.

GPA - 4 favorably affects the strength of concrete during hardening under conditions of FFA. The experiments showed (Table. No. 2): if the strength of the reference concrete (Rszh and Rizg) during natural hardening decreases by 22 -35 and 28 - 40%, then GPD-4-5-10 and 6-12%. In the case of hardening of samples under a moisture-proof coating (polyethylene film) under the conditions of FFA (mode No. 2) the strength of concrete with GPA-4 is slightly higher than that of normal hardening samples. This is due to more complete hydration of the cement, due to the exclusion of mass transfer with the environment (table. No. 1).

The use of concrete strength gain provides a 20% reduction in cement consumption. During the operation of concrete in the conditions of FFA, the most dangerous from the point of view of crack formation are undeveloped capillary shrinkage and cyclic temperature effects [5, 6]. Given this, studies have been carried out to determine the effect of GPA-4 on the crack resistance of concrete. The strength of concrete hardening in the conditions of FFA Table number 1.

Table 2

Cement consumption kg / m3	Dose GPA-4%	Hardening conditions	The tensile strength of concrete (MPa) at	
			Compression	Bending
360	0,75	normal SJK natural	34,8 46,6 27,7	3,8 5,8 2,8
360	0,75	FFA, waterproof Coating	 3,9	 5,4
360	0,75	FFA, waterproof coating	35,0 50,0	4,0 6,1

The crack resistance of concrete was determined by two methods. According to the first method, crack resistance was determined by the method according to [6]. According to the second method, crack resistance was evaluated as follows. Of the two series of samples, one was kept under normal conditions, the other was subjected to a cyclic temperature effect (4 h - heating in the temperature range 20-60 C and cooling for 4 h).

The number of cycles was repeated until the bending strength was stabilized. Then, the tensile strength during bending of the samples was determined after normal hardening and preliminary cyclic temperature exposure. The result of the ratio Rts / Rts was taken as the coefficient of crack resistance (Ktr). The results of tests of crack resistance of concrete are given in table 2

Table 3

Cement consumption	Dose GPA-4%	Hardening conditions	The coefficient of crack resistance according to the methods	
			1	2
36	---- 0,75	Normal	0,67 1.01	----- -----
36	---- 0,75	SJK	0,5	0,76 1,03

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Analysis of the data in Table 3 shows that GPA-4 increases the crack resistance of concrete in the conditions of FFA by 30-80%. In this way, GPD-4, by slowing down the hydration and hardening process, reducing water demand, the damping effect of water loss and plastic shrinkage, improves the pore structure of cement stone, increases the strength and crack resistance of concrete in a dry, hot climate. One of the urgent tasks used in the study of concrete, methods for determining capillary permeability adequately inadequately model the climatic factors of a dry hot climate (FFA), which makes the test results unreliable [1.2]. In practice, this creates difficulties in assessing the comparative effectiveness of using one or another concrete composition, chemical modifier, or a new technological technique to increase the salt resistance of concrete. This necessitates the development of an improved method for assessing the capillary permeability of concrete in the conditions of FFA.

It seems appropriate that the test method for capillary absorption of a salt solution during evaporation for capillary absorption of a salt solution during evaporation takes into account the appearance of additional defects in the concrete structure when the samples are kept under climatic conditions. In order to justify the method, the concrete test for capillary permeability of the saline solution was carried out comparative experiments, the results of which are presented in this article.

The studies were performed using samples of 4x4x4 cm beams made of concrete. Samples were made of concrete mix with a mobility of 2 cm of standard cone upsetting with a cement flow rate of 290, 390, 430 kg / m3 and W / c equal to 0.61, 0.51, 0.45 with the following ratios of 1: 2.31: 4.57 ; 1: 1.72: 3.42; 1: 1.26: 2.50.

The methodology is based on the assessment of the ability of concrete to absorb salt solution in direct contact with the surface of a liquid aggressive medium after cyclic temperature exposure to specimens - beams and stabilization of the defect of its structure.

The essence of the method is to determine the capillary absorption of saline. The values of capillary absorption are determined by the amount of aggressive solution absorbed by the concrete sample for a certain period of time in percent by weight [3]. According to the proposed methodology, the studied concrete samples should be made from concrete mix of laboratory or industrial composition that meets the requirements.

For each concrete composition, the required number of samples must be at least three. However, their initial mass should not differ from each other by more than 5%. The solidification conditions should be similar to the specified conditions for the solidification of concrete in concrete and reinforced concrete structures.

The test should be carried out after 28 days, after heat and moisture treatment of concrete samples or keeping them in the normal solidification chamber. The concentration of aggressive saline is taken depending on the specific operating conditions of concrete and reinforced concrete structures.

These experiments, we used a 5.5% solution of sodium sulfite corresponding to a salt solution concentration of 37,000 mg / L in SO2-4 ion. Control samples were dried at a temperature of 600 ° C to a constant weight before testing for capillary absorption. Another series of samples was subjected to preliminary cyclic temperature exposure to the climatic chamber according to the regime of 4 hours of heating in the temperature range of 20-600C and 4 hours of cooling to stabilize the defective structure. The defectiveness of the structure should be characterized by porosity. To simplify, the stabilization of the structural imperfection can be estimated by the capillary permeability index of concrete.

After drying the control samples of concrete to a constant weight and a certain number of cycles of temperature action on another series, the initial mass of the samples was determined before starting the capillary suction tests. Each sample was placed vertically in a vessel, on the bottom of which a Na2SO4 solution was poured. Samples, after being kept in saline, were removed and weighed every day until the weight gain of the samples was not more than 0.15%. As a result of the tests, the weight gain of the samples after capillary absorption of the saline solution in% was determined.

4. RESULTS AND ANALYSIS:

The results of the performed experiments are shown in Tables 4, 5, and 6. Analysis of the experimental data shows that the capillary absorption of the saline solution increases in direct proportion to the temperature and inversely to the relative humidity. The highest rates of capillary permeability of concrete are observed at a temperature of 400 ° C and a relative humidity of 30%.

With these test parameters, the effect of preliminary cyclic influence on the capillary permeability index of concrete was revealed.

Analysis of the data in tables 3 shows that at the beginning of the test, after 20 cycles of temperature exposure, the concrete structure was compacted due to additional hydration of the clinker foundation and capillary permeability decreased by 4-7%. With an increase in the number of cycles of temperature exposure, the defectiveness of the concrete structure due to thermal stresses is likely to increase, which also leads to an increase in capillary permeability by 12-39%, depending on the consumption of cement.

The tendency towards stabilization of capillary permeability is observed after 60 cycles of temperature exposure. Obviously, stabilization of the defective structure of concrete begins to this period. With an increase in the consumption of cement in concrete, apparently, temperature stresses also increase, as a result of which the defectiveness of the structure and, accordingly, the indicators of capillary permeability increase.

The dependence of the capillary absorption of concrete on the test temperature at a relative humidity of 50%:

Table 4

Type of cement	Cement consumption, kg / m3	M, temperature dependent test		
		20	30	40
Portland cement Akhangaran	290	2,39	2,78	3,14
	360	2,01	2,40	2,78
	430	1,4	1,90	2,26

Changes in capillary testing of concrete depending on the relative humidity at a temperature of 400C:

Table 5

Type of cement	Cement consumption, kg / m3	M, temperature dependent test		
		20	40	50
Portland cement Akhangaran	290	3,39	3,14	2,81
	360	2,98	2,78	2,52
	430	2,45	2,26	2,05

Capillary absorption of concrete in a 5.5% Na2SO4 solution of the preliminary cyclic temperature effect on the sample.

Table 6

Cement consumption	M,% after temperature exposure, cycles				
	0	20	40	60	80
290	3,39 100	3,25 96	3,79 112	4,13 122	4,16 123
360	2,98 100	2,83 95	3,52 118	3,87 130	3,90 131
430	2,45 100	2,28 93	3,06 125	3,39 138	3,31 139

5. CONCLUSIONS AND RECOMMENDATIONS:

Thus, if we take into account the climatic factors of FFA, the capillary permeability index of concrete increases significantly, which confirms the validity of the proposed technique. The work defines the optimal parameters of the method; temperature +400 relative air humidity 30%; the number of cycles of preliminary exposure, providing more reliable test results of the capillary permeability of concrete in the conditions SZhK.-60

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