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POLYMER REAGENT IN CONSTRUCTION PRACTICE

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Abstract

This article is devoted to the use in concrete of the polymer reagent POLY-ANS, developed on the basis of waste from the production of polyacrylonitrile fibers. The results of the action of the reagent on the capillary absorption of concrete, which contributes to the high resistance of cement concretes in salt media, are presented.

1. Introduction.

The most important topical problems in the republic requiring prompt resolution include the problem of protecting buried concrete structures of buildings and structures from sulfate aggression.

Corrosion processes occurring in concrete in a sulfate environment lead to the formation of gypsum and hydrosulfoaluminates in the structure of concrete with an increase in the volume of solid phases, which causes the appearance of internal stresses that, exceed the strength of concrete and destroy concrete [1].

An increase in the resistance of concrete to corrosion processes and inhibition of destructive processes in cement stone and concrete is achieved by a number of technological measures. The most significant measures are: limited content of C2S in order to reduce the content of Ca (OH) in the cement stone; introduction of amorphous silica additives into cement for chemical binding of calcium hydroxide; increase in density with the help of surfactants, water repellents, etc. [2].

2. Method

To modify the structure of cement stone, the most relevant in terms of protection against corrosion of crystallization and exposure to dry hot climates at the moment are additives of water-soluble polymers - polymer gels (gelpolymers).

In Uzbekistan, reagents have been developed - polymeric stabilizers based on waste from the production of nitron and acrylonitrile fibers - K-9, POLY-ANS.

In particular (hydrolyzed stabilizing polyacrylonitrile) obtained by hydrolysis in an alkaline medium using cross-linking agents (polymerizers) and modifiers [3]. As a polyacrylonitrile raw material for the preparation of the agent, polyacrylonitrile fiber waste is used.

POLY-ANS reagent is intended for use as a stabilizer of drilling fluids in oil and gas well drilling, as well as in agriculture as a soil structure former and other sectors of the national economy. The reagent is an effective stabilizer of drilling fluids, salt-resistant (up to full saturation with NaCl). Brand - POLY-ANS Tsh 64-22165670-001:2012. Appearance Yellow viscous liquid. Mass fraction of dry residue, % not less than 10. The relative viscosity of a 1% aqueous solution according to a viscometer at a temperature of 20+ 0.50C is within 30-60. The indicator of hydrogen ions Ph is within 10-12. Density in g / cm3 - not less than 1.050. Warranty period of storage - 3 months. At normal temperature, the reagent does not emit harmful substances. The reagent is fire and explosion-proof.

3. Technology. Experiment results.

The polymeric reagent was used in the development of corrosion-resistant concrete intended for operation under conditions of sulfate aggression.

The development of corrosion-resistant concrete was carried out on the basis of local materials: alite Portland cement of the Kuvasay cement plant; aggregates (large and small) of the Akbarabad and Beshalysh quarries; fillers - acid ash from thermal power plant of dry selection of Fergana thermal power plant; chemical additive - polymeric reagent POLY-ANS; aggressive media - saline groundwater.

For research, the compositions of the concrete mix were used for three classes of concrete B15, B25, B30 and their compositions were determined ((Ts: P: Shch) - (1:2.31:4.57) ; (1:1.72:3.42); (1:1.26:2.50) respectively.

The assessment of sulfate resistance of cements was carried out according to the coefficient of resistance, determined by the method of V.V. Kinda. At the same time, such cement is considered sulfate-resistant, in which the coefficient of resistance after 6 months is at least 0.8.

The strength of samples with POLY-ANS additives is: from 3 to 180 days of hardening in a solution of 1% $MgSO_4$ - 43-106 MPa; in a solution of 5% Na_2SO_4 changes from 41 MPa to 110 MPa, i.e. strength in solutions of 1% MgSO4 increases by 92%, in 5% Na2SO4 by 130%[10-34].

The strength of cement samples with the addition of finely ground ash from thermal power plants at 3-180 days of age has the following results: in a solution of 1% MgSO4 - 33-96MPa; in a solution of 5% Na2SO4 3 5-102 MPa, i.e. the increase in strength to 180 days in 1% MgSO4 is 88%, in a solution of 5% Na2SO4-122%.

Table 1. - Strength of multicomponent binder with polymer additive

№	Introduced additive	Aggressive Wednesday	Compressive strength of specimens, MPa, day						
			3	7	14	28	90	180	360
1	POLY– ANS	1% $MgSO_4$	43	48	54	63	79	98	106
2	Ash TPP	1% $MgSO_4$	33	36	40	54	78	96	102
3	-	1% $MgSO_4$	33	41	50	53	50	51	48
4	POLY– ANS	5% Na_2SO_4	41	50	54	62	85	106	110
5	Ash TPP	5% Na_2SO_4	35	40	48	66	84	102	109
6	-	5% Na_2SO_4	26	28	35	41	45	46	47

Without additives, Portland cement has a water resistance coefficient of 1.00 for 28 days of hardening; in 1% $MgSO_4$ -1.43, in 5% Na_2SO_4 -0.95. With the introduction of POLY-ANS additives and finely ground ash from thermal power plants, the resistance coefficients of samples both in water and in salt solutions increase and have maximum values in water, solutions of 1% $MgSO_4$ and 5% Na_2SO_4 (Table 5.2).

Table 2.- Coefficients of resistance of cements with additives

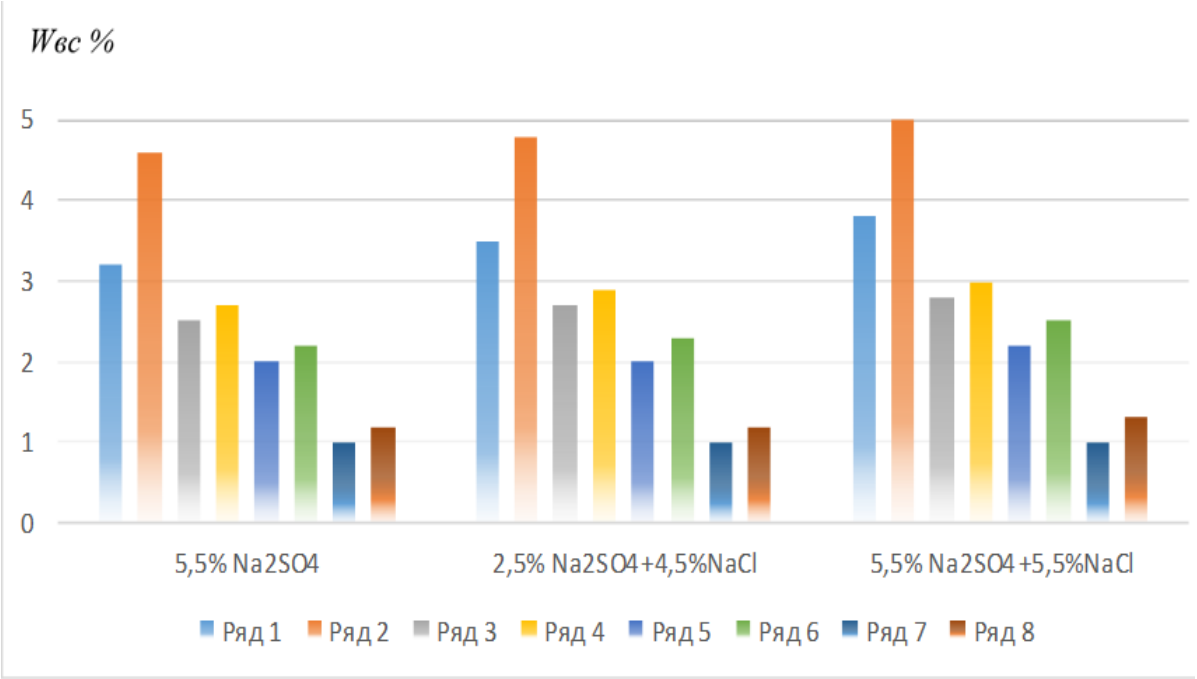
№	Introduced additive	Stability coefficient, Kc, day								
		H_2O			1% $MgSO_4$			5% Na_2SO_4		
		90	180	360	90	180	360	90	180	360
	Portland cement (alite Kuvasay)									
1	POLY–ANS	1,73	2,13	2,20	1,52	1,53	1,58	1,63	1,66	1,67
2	Ash TPP	1,00	1,14	1,07	1,35	1,33	1,33	1,45	1,42	1,42
3	-	1,05	1,00	1,02	1,17	1,14	1,04	1,05	1,05	1,02

The increase in sulfate resistance of cements due to the addition of POLY-ANS additives and finely ground ash from thermal power plants is explained by the binding of calcium hydroxide released during hydration.

The influence of the type and dosage of additives POLY-ANS (0.01,0.02,0.04%) on capillary absorption in working saline highly concentrated solutions was studied: 5.5% Na2SO4; 2.5% Na2SO4 + 5.5% NaCl ; 5.5% Na2SO4 + 5.5% NaCl.

The capillary absorption of concrete was studied by evaluating the ability of concrete to absorb saline in direct contact with the surface of a liquid aggressive medium after cyclic temperature exposure. The amount of aggressive solution absorbed by the concrete sample for a certain period of time (Wvs , %) is taken as the indicator of capillary absorption.

It has been established that the capillary absorption of concrete naturally increases as the composition of the salt solution becomes more complex.



1,2 - reference concrete; 3,4,5,6,7,8 - concrete with additives, respectively POLY-ANS1; POLY-ANS2; POLY-ANS 3; - normal hardening; - after preliminary cycle. temperature effect

Fig.1. Diagram of the effect of POLY-ANS additives on capillary absorption

4. Discussion of results

Additives POLY-ANS reduce Wvs to the extent that they affect the reduction of the water demand of

the concrete mixture, the parameters of the pore structure and the water resistance of concrete. The decrease in Wvs of concrete is due to the fact that under the influence of POLY-ANS additives, the density and water resistance of concrete increase and hydrophobization of the walls of pores and capillaries is ensured, that is, the wettability of concrete decreases.

An analytical method for calculating the measure of hydrophobicity of concrete by the value of capillary suction is proposed, which makes it possible to make a comparative assessment of the effect of POLY-ANS additives and other recipe-technological factors on the change in the relative measure of hydrophobicity.

Using this method, the influence of POLY-ANS additives and filler (TPP ash) on the relative measure of concrete hydrophobicity was revealed

The relationship between capillary permeability and salt resistance of concrete was determined by an indirect method: by changing the tensile strength of concrete samples in bending, the magnitude of relative deformations of concrete expansion and accumulation of SO_2-$_4$ and Cl- ions, as well as the coefficient of salt resistance (K_c).

The degree of change in bending strength, relative expansion deformations and the depth of corrosion destruction of samples when tested in salt solutions depends inversely on the measure of concrete hydrophobicity.

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The degree of change in bending strength, relative expansion deformations and the depth of corrosion destruction of samples when tested in salt solutions depends inversely on the measure of concrete hydrophobicity [15-34].

Table 3. - Values of the relative measure of hydrophobicity of concrete with additives POLY-ANS when testing samples for capillary absorption of salt solutions

Additive type	Average pore radius, and for concrete with cement consumption, kg/m^3			The values of the relative measure of hydrophobicity of concrete with cement consumption, kg/m^3 when tested in saline solutions (numerator - sulfate, denominator - sulfate-chloride		
	290	360	430	290	360	430
Without additive	96,5	92,4	90,8	-	-	-
POLY– ANS1	83,4	80,2	78,6	0,46 / 0,61	0,50 / 0,62	0,61 / 0,65
POLY– ANS2	78,3	76,1	74,2	0,60 / 0,70	0,67 / 0,73	0,76 / 0,78
POLY– ANS3	69,1	66,2	64,0	0,82 / 0,89	0,87 / 0,90	0,91 / 0,93

It is customary to calculate the coefficient of resistance of concrete from the ratio of the tensile strength of concrete in bending after testing samples for capillary suction to the strength of concrete in tensile bending after keeping the samples under normal conditions at 28 days of age. It is recommended that concrete with a polymer additive be considered corrosion-resistant if Kc after one year of testing is at least 0.85.

Table 4 shows the K_c data for concrete on ordinary Portland cement with a polymeric additive and microfiller (TPP ash) after one year of testing for capillary absorption of aqueous sodium sulfate and sulfate-chloride solution.

Tab. 4. - Data of the coefficient of salt resistance Kc of concrete

Concrete class	Additive type	Salt resistance coefficient in solutions	
		5,5 %Na_2SO_4	5,5 %Na_2SO_4 + 5,5% NaCl
B 15	POLY– ANS1	0,64	0,58
	POLY– ANS2	0,83	0,79
	POLY– ANS3	0,85	0,77
B 25	POLY– ANS1	0,63	0,59
	POLY– ANS2	0,79	0,69
	POLY– ANS3	0,85	0,84
B 30	POLY– ANS1	0,65	0,58
	POLY– ANS2	0,83	0,78
	POLY– ANS3	0,88	0,85

5. Resume. Thus, the introduction of the polymeric reagent POLY-ANS ensures the salt resistance of concrete. The coefficient of salt resistance after one year of testing is generally within the established requirement - 0.85.

For an accelerated assessment of the degree of influence of the reagent (and other additives) on the permeability of concrete, it is effective to use the criterion of the relative measure of hydrophobicity. When developing technological methods for reducing capillary permeability with the use of additives, the determination of the relative measure of the hydrophobicity of concrete is carried out in a certain sequence, in particular, samples are tested for capillary suction during the evaporation of a saline solution; the average radius of capillaries of concrete is determined by mercury porosimetry, and more.

The conducted studies have established the positive effect of the polymeric reagent POLY-ANS on the capillary absorption, capillary permeability of concrete, predetermining the high resistance of cement concretes in various aggressive environments. [10-34].

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