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OPTIMIZATION OF CORROSION-RESISTANT CONCRETE WITH CHEMICAL ADDITIVES

Abobakirova Zebuniso Asrorovna
Fergana Polytechnic Institute, Ph.D. Associate Professor
z.abobakirova@ferpi.uz), (ORCID 0000-0002-9552-897X).

Umarov Shodiljon Abdugofurovich
Fergana Polytechnic Institute, PhD, head of the department
sh.umarov@ferpi.uz, (ORCID 0000-0003-2265-3232)

Mirzababaeva Sakhiba Mirzaakbarovna
Fergana Polytechnic Institute, senior teacher
s.mirzaboboeva@ferpi.uz (ORCID 0000-0002-6183-4688)

Mirzayeva is the daughter of Zarnigor Alisher
Fergana Polytechnic Institute, Assistant
z.mirzayeva@ferpi.uz), (ORCID 0000-0002-9552-897X)

Abstract

Currently, due to the rapid development of the construction industry, the demand for concrete and reinforced concrete structures made using portland cement is increasing. In this regard, one of the priority tasks of the building materials production industry is aimed at modernizing production technologies, improving the quality of manufactured products, and increasing their durability, using chemical additives in the production of concrete and reinforced concrete structures, without reducing their strength.

Keywords: concrete, corrosion, moisture, polymer additive, POLY-ANS, mineral substances, superplasticizer.

Introduction

In addition to the optimization of the composition of concrete mixtures used for the production of concrete and reinforced concrete structures on a global scale, the use of industrial waste, chemical and mineral additives in their preparation, and the purposeful management of structure formation in hardening cement stone. -research works are being carried out. In this regard, in order to increase the resistance of concrete and reinforced concrete structures to the harmful effects of the environment, especially groundwater, the use of chemical and mineral additives, the provision of convenient placement of the concrete mixture, the acceleration of the initial strength of concrete and the achievement of high strength by intensifying the hydration of cement providing and at the same time increasing the strength of structural concrete, improving its cold tolerance, density and other properties is becoming important.

In our republic, special attention is paid to the introduction of resource and energy-saving technologies that allow the development of the construction materials industry, the economy of natural raw materials and the use of industrial waste in production, and the creation of corrosion-resistant types of concrete.

Important aspects of any optimization in the production of cement concrete are the improvement of physical, mechanical and other properties; reduce the use of scarce components; reducing the cost of the final product. Improving the quality of mixtures is carried out by increasing the amount of binders, adding chemical additives, etc. Each additive added to the mixture has its own mechanism of action and can have positive and negative effects when interacting with the binder. Various parameters can be used as a basis for optimizing the composition of additives in concrete. Since the subject of the study is monolithic and prefabricated reinforced concrete, the most important characteristics were obtained: the water demand of the concrete mixture and the strength of concrete. The compositions of the concrete mixture for the study were used for three classes of concrete B15, B25, B30, which are listed in Table 1 [1-10].

The methods of mathematical planning of the experiment were used in the selection of compositions of multi-component systems and in the development of technology for their preparation. With the help of experimental theory, experimental plans were developed, components that make up the material, heat treatment regimes were selected and their variability levels were assigned. The factors were selected taking into account the criterion of optimization. Preliminary experiments were used to establish the limits of variation, allowing the experiments to be as close as possible to the optimal region. As a result of the implementation of the experimental planning matrices, regression equations were obtained and graphical dependences of the change of material properties on the type and composition of the components were made.

The scientific significance of the results of the research is that the structure and structure of corrosion-resistant concrete with the help of various chemical additives for underground structures was determined, while its physical and mechanical properties, their changes, and the scientific basis for the definition of quality indicators are explained. .

In real conditions, concrete structures are usually affected by a combination of two or more operating aggressive factors. The combined effect of aggressive conditions and mechanical stress leads to an increase in destruction and, in particular, an acceleration of decay processes. Concrete deterioration is the deterioration of its structural integrity and loss of strength.

Concrete decay can occur as a result of the decomposition of hydrated clinker minerals in cement stone, as well as the formation of internal stress in concrete as a result of crystallization of decay products in the pores of cement stone.

The destruction of concrete as a result of the decomposition of hydrated neoplasms is associated with the removal of their dissolved components from the pore fluid, which causes an imbalance between the cement stone and its liquid phase.

The decay process caused by the crystallization of decay products in the pores of cement stone is related to the kinetics of the appearance of these products and the structural features created by them [11-19].

Due to the saturation of concrete with sulfate solution, high sulfate formation of calcium hydrosulfoaluminate (GSAK) is formed in its residues: 3SaO·Al2O3·3SaSO4·31N2O and low sulfate 3SaO·Al2O3·3SaSO4·12N2O. The first form is the most dangerous, and ettringite is its natural analogue.
In the first hours after cement mixing, when the structural foundations of the cement stone have not yet formed, GSAK does not have a tensile effect.
the results of sample experiments on the improvement of the composition of perfect concrete with polymer additives and their effect on the deformation, operational, technological, reinforced properties of concrete are presented. Portland cement concrete mixtures with consumption of 290-430 kg/m3 according to concrete classes V15, V25, V30 were taken as research objects.
As an initial parameter: Y1 – 28-day (R_sik^28) MPa concrete strength; Y2 – (V) water absorption of concrete mixture was accepted.
A large number of recipe-technical elements can affect the optimal content of additives. Based on the results of previous research, as a variable element: X1 - consumption of cement (TS), kg/m3, X2 - mutual ratio of fine and large particle fillers P/shch; Factors such as X3 – % additional amount (D) based on the volume of cement were taken into account.
The concentration of POLY-ANS polymer additives in the experimental matrix is determined according to the results of experiments in active experiments where preliminary studies were carried out.
Regression criteria were obtained as a result of calculating the coefficient of multiple contents according to the t-criterion and evaluating their significance, and the statistical analysis conducted according to Fisher's t-criterion showed that the second-order polynomial concrete properties were correctly described[14-23].
Technological analysis of mathematical models of concrete properties was carried out by graphoanalytical method and it was determined that cement consumption is the main factor affecting the strength of concrete and the water requirement of concrete mixture.
The second important factor affecting the strength of concrete and the water demand of the concrete mixture is the amount of POLY-ANS (X3) additive; The optimal dosages of POLY-ANS additives determined by differentiating the obtained equations are as follows: POLY-ANS 1-0.01%; POLY-ANS 2-0.02 %; POLY-ANS 4-0.04 %.
The optimal values of the ratio between small and large differentiation determined by differentiating the obtained equations for the considered supplements were as follows: POLY-ANS 1-0.52; POLY–ANS 2-0.50; POLY–ANS 4-0.48.
At moderate temperatures, POLY-ANS additives slightly slow down the initial composition of concrete, which should be taken into account in the production of reinforced concrete products.
In order to effectively use POLY-ANS in concrete plants, it is necessary to properly set the regimes of processing the concrete mixture in conditions of heat and humidity.
As a determining indicator, the strength of one-day concrete after R_sik^IXI or Y evaporation and the following variable factors: X1 - duration of initial storage, s; X2 – isothermal heating time, s; X3 is the isothermal heating temperature, 0C is taken.

Determined as a result of active experience and statistically developed laboratory parameters, concrete strength after TNT is exactly POLY-ANS-0.01%, POLY-ANS-0.01%, POLY-ANS-0.02% of mathematical models obtained for additives, their technological analysis shows that the optimal size of POLY-ANS additives has a positive effect on concrete strength under normal conditions, heat and moisture treatment conditions.

Addition of admixtures in the optimal amount helps to reduce water seepage and delamination in concrete by 1.8-3 and 1.6-2.7 times. POLY–ANS-0.01% admixture is known to have a better effect on dry concrete mixes, POLY–ANS-0.02% and POLY– ANS -0.04% on “oily” concrete mixes. This is determined by their different mechanisms of action.

A reduction in water demand based on cement volume indicates that admixed concrete mixes are less prone to delamination and water segregation.

Improving the technological properties of the concrete mixture with the addition of additives and reducing its need for water has a positive effect on the strength properties of concrete (Fig. 1, 2).

The cube strength of the optimally selected concrete is 9-10% with POLY-ANS 1 depending on the amount of cement; by 20-28% with POLY–ANS 2; POLY-ANS 3 increases by 28-36%, and bending elongation is 11-12; 26-39; leads to an increase of 40-54[9].

Experimental results show a positive effect of additives on reduction of defects of concrete, growth of dispersion of cement crystal hydrates and increase of bond strength. As a result of this, a natural increase of the prismatic strength coefficient occurs, its indicators are, respectively, for concrete with additives: 0.72-0.73; 0.74-0.79; It is 0.78-0.82. At the same time, a decrease in the Rsj/Rr ratio is observed.

In the initial period (3-7 days), the increase in the bending and compressive strength of the added concrete slows down compared to the reference samples. After that, the degree of hardening of concrete with additives in the period from 28 days to one year is 9-16% (Rsik) and 11-18% (Regil) for POLY-ANS 1; 20-42% (Rsik) and 26-48% (Regil) for POLY–ANS 2; For POLY-ANS 3, it increases to 29-49% (Rsik) and 40-62% (Regil).

These factors are determined by their low water demand, uniformity of content and lack of defects. In addition, the cement stone with additives has a small amount of capillary and general pores conditionally - large volume of small pores of a closed character.

The influence of additives on the water saturation of concrete, as a result, on the frost resistance and waterproofing properties was studied. The water absorption property of concrete with additives is 22-39% lower than standard concrete. Additives reduce water saturation of concrete by 1.2-1.7 times.

The frost resistance of concrete with POLY-ANS 1, POLY-ANS 2, POLY-ANS 3 additives is 1.7-2.7 times higher than standard concrete, i.e. 250, 300 and 400.

The water resistance of concrete with additives is 1-3 times higher than the control composition, which is explained by the low initial water content of concrete with additives and the significant improvement of the properties of the pore structure.

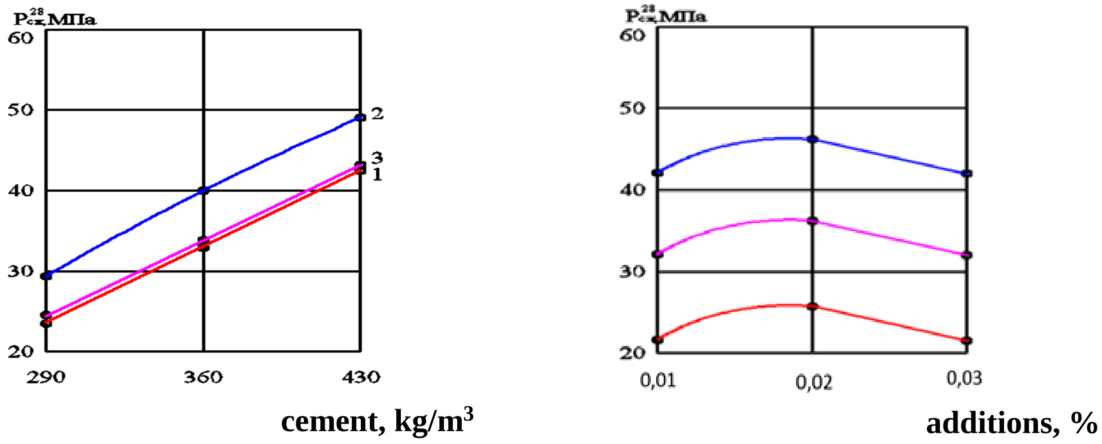

Figure 1. Strength of concrete with POLY-ANS 2 additives. A. influence of cement cost 1,2,3- 290,360,420 kg/m3, respectively; B. the effect of the dose of supplements

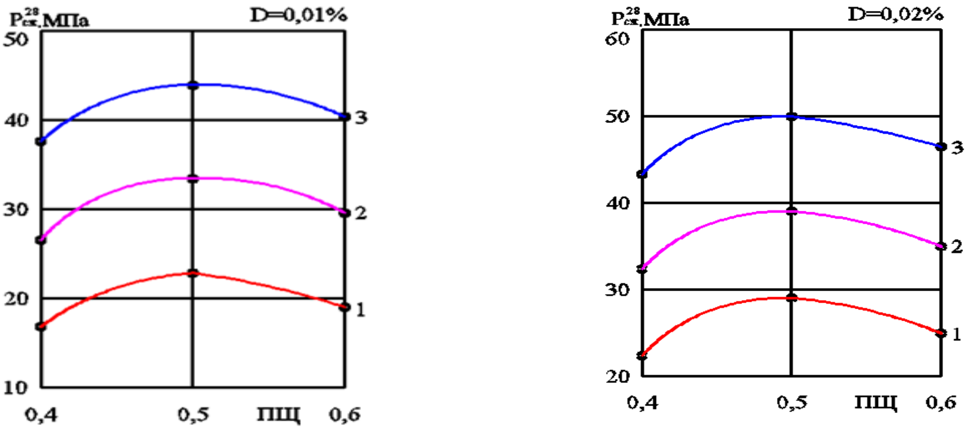

Figure 1.1. Strength of concrete with POLY-ANS 2 additives.

The frost resistance of concrete with POLY-ANS additives is 1.7-2.7 times higher than the standard; water demand is 22-39% lower; water saturation - 1.2-1.7 times less, water impermeability increases from 4 to 6-12 ATI or 1.5-4 times.

In the article, great attention is paid to indirect experimental studies of the influence of POLY-ANS additives on internal stress in concrete. For the same purpose, experimental studies of decay properties (shrinkage, tensile modulus, relative decay) were conducted.

Table 1

Water resistance level of concrete of class V 25 of mixtures

Attachment type	Maximum pressure before water leakage, ATI	Maximum pressure retention time before water leakage, s-min
	V 25 class	
1	2	3
Standard	4	3-52
POLY– ANS 1	6	4-40
POLY– ANS2	8	5-36
POLY– ANS3	12	6-45

POLY-ANS additives reduce the stiffness of concrete and improve its deformation properties while increasing the flexibility of the composition. Here, the tensile modulus of concrete with additives decreases by 18-24%, and Poisson's ratio increases from 0.208-0.232 to 0.212-0.249. [17-21].

Relative deformation limits of concrete mixed with POLY-ANS admixture are 13-18 and 22-28% higher on the longitudinal surface compared to concrete without additives. Deformations in the zone of compacted concrete with added additives are 3-10 and 15-22% higher than ordinary concrete, respectively.

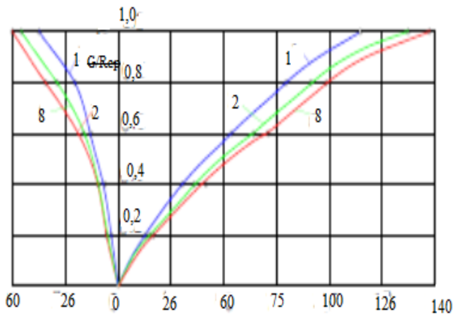

Figure 2. 1- concrete without additives; Concrete with 2-POLY-ANS 1 admixture; 3-POLY-ANS 2-joint concrete concrete compression transverse (left) and longitudinal relative deformation

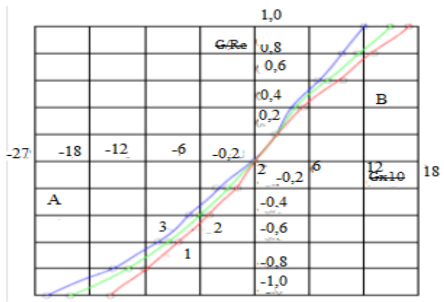

Figure 3. A-stretched zone; V-compressed zone; 1- concrete without additives; Concrete with 2-POLY-ANS 1 admixture; Concrete with 3-POLY-ANS 2 additives. Relative deformation of concrete elasticity

Reduction of erosibility of concrete with POLY-ANS polymer admixture, adhesive layer between crystal hydrates of cement stone, defferent property formed due to the expansion of adsorption layers, high degree of homogeneity of concrete structure and small pores between mixture and filler determined by increasing strength.

When using cement concrete in an aggressive environment, it is necessary to determine the effect of polymer admixture on the cracking resistance of concrete. When cement consumption is reduced by 5-20% without affecting the initial strength of concrete, the crack resistance indicators naturally increase by 1.3-1.52 times. [21-29].

Conclusion: Based on the results of the theoretical and practical research of the article "Designing and optimizing the properties of effective corrosion-resistant concrete with ionogenic additives for underground structures", the following conclusions were drawn:

1. The possibility of developing the perfect composition of effective, erosion-resistant cement concrete based on mixed thickener and ionogenic chemical additives for underground structures has been proven.

2. For the first time, in the composition of cement concrete with ionogenic properties (POLY-ANS) additive, polymer reagent stabilizing hydrolyzed (hydrolyzed stable polyacrylonitrile), coupling agents (polymerizers) and modifiers, additives obtained by hydrolysis in an alkaline environment were used.

3. Intensifiers mixed with IES ash and ionogenic chemical additives (POLY-ANS) with improved physical and technical characteristics and improved porous structure have been developed, which indicates their increased resistance to aggressive environments.

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