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STUDY OF THE PHYSICAL AND MECHANICAL PROPERTIES OF CONCRETE WITH COMPLEX CHEMICAL ADDITIVES

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Abstract

Currently, one of the available and effective methods of purposefully forming the structure of cement stone, which is characterized by high productivity and strength characteristics, is the modification of concrete with chemical additives. Various types of complex chemical additives are used in the production technology of strong and durable concrete in Uzbekistan and developed foreign countries. However, the chemical additives used by the producers of the Republic of Uzbekistan in the production technology of concrete and reinforced concrete products are very limited. The article explored the problems of creating strong and durable concrete and its chemical additives with energy-saving technology based on local raw materials.

Keywords: cement stone, complex chemical additives, the technology of concrete, energy-saving technology, antitumor effect, the heat of moisture treatment of concrete.

Introduction

The main tasks of modern materials science are the development of methods for the directed formation of a highly durable structure of composite materials, the production of concrete with desired performance properties with the maximum simplicity of production technology and the saving of raw materials. At the same time, the creation of energy-saving concrete technology based on local raw materials and secondary resources occupies a special place[1-4].

The main directions for improving the operational characteristics of concrete are to improve manufacturability and increase strength and durability.

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To solve this problem, much attention is paid to the development of new complex chemical additives, which allow for simultaneous, purposeful control of several properties of concretes based on hydraulic binders. Currently, in Uzbekistan and abroad, concretes of almost all compositions are developed and produced with chemical additives. Chemical additives used in concrete are produced both in our country and abroad. However, complex chemical additives created by scientists of the Republic of Uzbekistan are introduced into concrete technology in a very limited amount. It should be noted that complex chemical additives are multifunctional. The introduction of complex chemical additives into the composition of concrete mixtures significantly changes their properties, complex chemical additives increase mobility, and reduce the water demand of the concrete mixture, which leads to an increase in strength and at the same time positively affects the increase in frost resistance, durability and other operational properties of concrete.

The main objective of this dissertation work is the creation and study of energy-saving technology for concrete with chemical additives based on local raw materials.

This paper presents the results of a study of the effect of complex chemical additives on the properties of mortar and concrete carried out by scientists of the Republic of Uzbekistan and developed foreign countries, the rationale for the source materials used for research, the development of research methods, the optimization of concrete compositions with chemical additives and the study of micro and macrostructure formation of concrete with chemical additives.

Modification of concrete with chemical additives leads to a decrease in the water-cement ratio when the same workability is achieved, which positively affects the change in the physical and mechanical properties of concrete.

The purpose of the work is to generalize and systematize scientific research in the field of developing the technology of concrete with chemical additives, carried out by scientists of the Republic of Uzbekistan and developed foreign countries, developed the optimal composition of concrete, the study of micro and macrostructure formation of concrete with chemical additives [2-5].

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The Main Part

The need to use chemical additives in the technology of production of concrete and reinforced concrete products has set the task of studying scientists' experience in this area. The leading foreign and Russian authors dealing with these issues are Yu.M.Bazhenov, V.G.Batrakov, A.I.Vovk, Zakharov S.A., Nesvetaev V.G., Soloviev V.I., Izatov V.S., etc. Their works had a significant impact on the scientific research and development of scientists working in this area. The domestic authors dealing with the use of chemical additives can be called prof. N.A. Samigova, prof. U.A. Gazieva, Assoc. H.H. Kamilov and others [3-7].

Given the relevance of the topic under study, the following tasks are considered and solved in the dissertation:

– Analytical review of existing developed research and patent-licensing searches on the topic;
– Analysis of the raw materials used;
– Development of research methodology;
– Optimization of concrete compositions with chemical additives;
– Research of physical and mechanical properties of concretes with chemical additives;
– Study of macro and microstructure formation of concrete with chemical additives. The object of the study is fine-grained concrete with the chemical additive J-3. Experimental studies were carried out in the laboratories of TASI and the central laboratory for the construction of GosArkhitektStroy.

Little attention has been paid to the issues of studying the introduction of scientific and technological achievements in the field of the use of chemical additives in concrete production technology. Based on a comparative analysis of the existing results of scientific research, as well as foreign studies, based on a comparison of the main performance indicators, the most effective option for the use of chemical additives in concrete technology has been identified [8-15].

The scientific novelty lies in the fact that the formation of physical and mechanical properties and durability of fine-grained concrete with chemical additives have been experimentally established. J-3. The increase in the strength of the concrete composition is due to a decrease in the type of need for the concrete mixture.

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The practical significance of the dissertation work is to obtain fine-grained concrete with high strength, reduce the consumption of binder materials by 10%, and reduce the time of heat and moisture treatment of concrete, thereby reducing energy costs in the production of concrete and reinforced concrete products. It should be noted that the development of optimal compositions of fine-grained concrete with chemical additives is carried out mainly based on local raw materials.

The introduction of chemical additives J-3 into the composition of concrete mixtures significantly changes their properties. Complex chemical additives reduce the mobility of the concrete mixture, improve the properties workability, reduced water demand and others.

The introduction of complex additives reduces the water-cement ratio, and reducing water consumption leads to an increase in the strength characteristics of concrete, which opens up the possibility of obtaining high-strength concrete. This circumstance has a favourable effect on the durability of concrete.

To study the effect of complex chemical additives J-3 on the physical and mechanical properties of concrete, Portland cement from the factories "Kizilkumcement" and "Bekabaadcement" PC-400 D0 and PC-400 D20 were used. Concrete grade M-200, mobility of the mixture with a draft of the cone 4-5 cm.

Analysis of experimental studies of the rheological properties of the cement mortar and concrete mixture found that from the studied compositions of the mixture with the content of additives in quantities of 0.5; 1.0; 1.5 and 2% by weight of cement [15-26].

the best performance was obtained with the content of additives in the amount of 2%. Based on experiments to optimize the content of the complex additive for the study of the physical and mechanical properties of concrete, J-3 was adopted in an amount of 2% of cement.

For experimental studies, samples were made with dimensions of 4x4x16 cm and 10x10x10 cm.

Samples after manufacture were placed in a normal storage chamber. Samples were tested after 1, 3, 7, 14, and 28 days of normal storage. The second series of samples were subjected to tests to determine the density and water absorption by weight.

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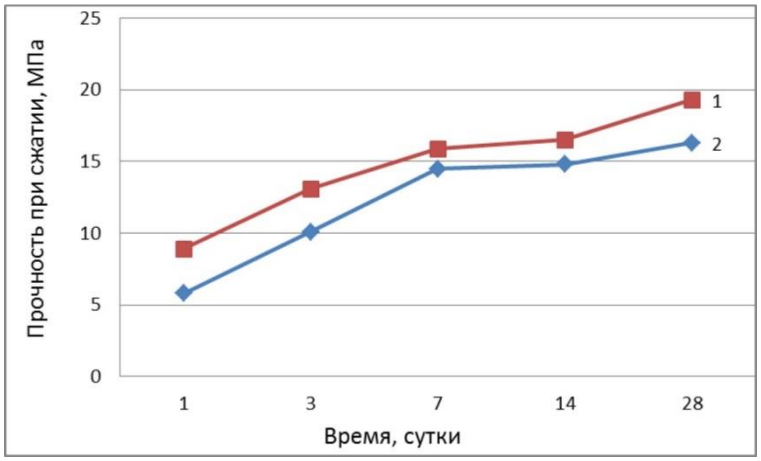

Fig. 1. Influence of the complex additive J-3 on the compressive strength of concrete: 1- the strength of concrete with an additive of 2% by weight; 2-no additive;

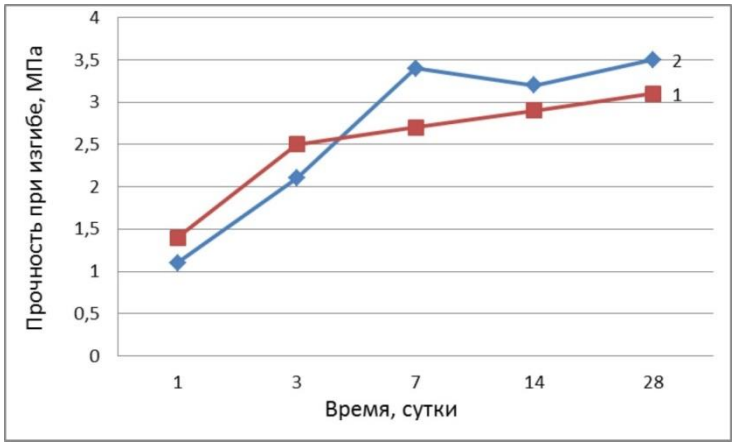

Fig. 2. Influence of the complex additive J-3 on the flexural strength of concrete: 1 - the strength of concrete without additive; 2-strength of concrete with the addition of 2% by weight;

The introduction of complex chemical additives affects the density and water absorption of concrete. The analyzes of the conducted studies found that the density of concrete increases by 4-5%, and water absorption by weight. The additive under study increases the strength of concrete during all periods of hardening. However, the greatest increase in strength in the first three days of hardening is provided by the introduction of J-3 by 15%. At the age of 7 days, the compressive strength with the addition of J-3 is achieved by 80%, compared with the design strength of concrete (Fig. 1, 2).

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Experimental studies to determine the effect of complex chemical additives KJ-1 and KJ-2 on the physical-mechanical, chemical and operational properties of concrete, as well as to identify the polyfunctional effect (plasticization, acceleration of hardening at an early age, antifreeze effect) of additives show a high effect.

Thus, according to the results of the studies, it was found that the complex additive KJ-2 in the amount of 2% by weight of cement has the best effect on the physical and mechanical properties of concrete.

Conclusion

1. Scientific research results show the complexity of the structure of the cementing agent. In the main gel-like mass of neoplasms, needle-shaped ettringite crystals are observed that fill free cavities. Neoplasms of ettringite are formed in free volumes. On electron micrographs of cement stone samples with a hyper plasticizer additive, pores are filled with both gypsum and calcium hydro sulfoaluminate. An increase in the concentration of calcium hydro sulfoaluminate and an increase in the specific surface of hydrated phases, both in the general structure of the cement stone and in defective areas of the spatial skeleton, leads to the strengthening of the microstructure of the material. It was established when studying the IR spectra of cement stones with APS superplasticizer, high crystallization of calcium hydro sulfoaluminate, sub microcrystals of hydro silicates of the tobermorite group and the presence of hydroxyl hydro silicates of the xonolite group. The compaction and strengthening of the structure of Portland cement compositions at the initial stages of hardening is a consequence of the fact that both gypsum and calcium sulfoaluminate when a superplasticizer is added, crystallizes with an increase in volume.

The results of physical and chemical studies can be used in the examination to assess the residual strength and durability of concrete in various operating conditions.

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