Application of Hyperplastificators for Production of Nanomodified Reactive Powder Concrete

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Abstract: *The purpose of this work is to establish the fundamental possibility of using complex modern plasticizers, which consist of molecular surfactants to catalyze the hydration of cement compositions, as well as to study the physical and mechanical properties of concrete. As a result of the research it was found that the introduction of plasticizing surfactants in the composition of the reaction powder concrete leads to a sharp increase in the compressive strength of concrete at the age of 28 days. The presence of the optimal surfactant content depending on its type is noted. Thus, the optimal amount of superplasticizer Master Silk is 0.0009%, and hyperplasticizer Srase "Adva 151" is 0.0005% by weight of water, which provides the formation of a concrete structure that provides maximum strength of the system.*

Keywords*: surfactant; cement; concrete; strength*

Introduction

The use of nanomaterials in a number of industries and medicine makes it possible to count on their successful use in the construction industry [1].

Taking this into account, nano-modification of concretes is currently intensively developing.

Nanoparticles can act as centers that accelerate hydration reactions, as well as fillers, increasing the density of concrete and decreasing its porosity.

Most of the known works on the use of nanoparticles to improve the characteristics of concrete relate to the use of SiO2 [2] and TiO2 [3]. Little research has been done on the use of nanoparticles of other chemical elements..

It was found that the introduction of microsilica without plasticizers practically does not lead to a positive effect [1], therefore its introduction into the composition of Portland cement compositions is usually carried out in combination with dispersing plasticizers [2,3], which prevent the aggregation of its particles. So it was found that when using the Xia superplasticizer containing SiO2 nanoparticles 3-150 nm in size, Megapol plasticizer and W / C = 0.25, there is a threefold increase in the compressive strength of concrete at one day of age and a twofold increase for concrete at the age of 28 days [1, 2].

Due to the fact that obtaining nanosilica currently presents significant difficulties from a technical point of view, this leads to significant costs and, as a consequence, its high cost. Microsilica is more readily available, but its industrial reserves are insufficient, and the effect on the properties of concrete is lower in comparison with nanoparticles..

In addition, the described method of producing concrete (reducing water consumption by using hyperplasticizers) [1, 2] causes fair concern and caution [4, 5].

This paper presents the results of the use of the latest generation of plasticizers as modifiers of the water structure, which makes it possible not to change the value of the water-cement ratio in concrete..

Survey Methodology

For the production of concrete was used Portland cement M400 of PJSC “Kryvyi Rih Cement” (Ukraine) was used for concrete production. As components of Nanomodifiers used colloid of surfactants in a matter of - molecular surfactant Master Silk and molecular surfactant Srase “Adva 151”. The components of the concrete mixture were dosed in the required quantities, according to the experimental plan, mixed in a laboratory mixer for 3 minutes. The resulting mixture was contained in a metal mold having a side size of 4x4x16 cm. Formed in this way concrete samples hardened for 28 days at ambient humidity of 70±10% and an ambient temperature of 293±2K. Indirect evaluation of the effect of nano-modifiers on the hardening kinetics of cement at a water-cement ratio (W/C) of 0.50 was performed based on the results of determining the hardening time by standard methods. The strength control of the samples was performed on a universal machine UMM-100.

Experiments and Analysis

The results of the studies shown in Figure 1 have shown that the use of modern plasticizers in much smaller quantities than those commonly used leads to a greater increase in the strength of concrete without reducing the water content.

The optimal content of Srase "Adva 151" is 0.0005%, and Master Silk - 0.0009%.

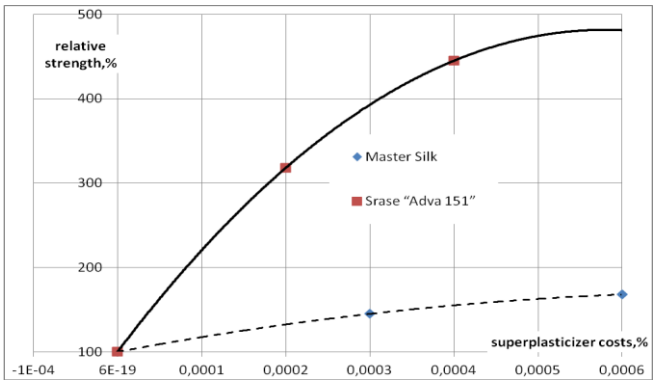

Figure 1. The effect of the content of the plasticizer on the strength of concrete

Conclusion

1. Modern plasticizers have been proven to increase the compressive strength of fine-grained concrete when introduced into the water on the basis of which concrete is made. This process occurs as a result of processes that obey the laws of catalysis.

2. It is proved that the compressive strength of fine-grained concrete depends on the content of modern plasticizers. Optimal the content of such plasticizers is from 0.0005% to 0.0009% depending on their type.

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