



OF NANOMATERIALS IN MODERN CONCRETE PRODUCTION PLACE

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Abstract: The use of nanoparticle cements to improve their physico-mechanical properties, brand and other properties in the production of concrete and reinforced concrete products is the basis for their wide use in construction and other industries. Materials obtained on the basis of nanocements are promising building materials.

Keywords: binding materials, modifiers, active mineral additives, reinforcing fibers, nanostructure, nanotechnology, hydrated alite, aggregated nanoparticles, nanosilicates, microsilica, dispersant-hyperplasticizer, polycarboxylate superplasticizer.

Researchers' penetration into the nanoscale puts concrete on par with high-tech materials whose structures are "engineered" in advance: These criteria include levels of strength and durability and low environmental impact. This ensures that concrete will remain the main construction material in the near future.

In the last decade, significant progress has been made in concrete technology. In these years, new effective binding materials, modifiers for them and concrete, active mineral additives and fillers, reinforcing fibers, new technological and construction composites production methods were created. Concretes are composite materials with the structure of hydrated cement phase with particle sizes of 1...100 nm. Decreasing the amount of constituent elements, the formation of unique threadlike continuous structures, the formation of three-dimensional contacts between nanoparticles of different phases led to a radical improvement in the field of their use [1, 2].

In the transition from macro to nanoscale, electrical conductivity, optical absorption, chemical reactivity and mechanical properties, surface energy values and surface morphology of composites undergo drastic changes.

Introduction of methods of control of properties and reactions in nanostructures allows to create new materials, technologies and devices.

The principles of using nanotechnologies in concrete were mainly aimed at studying the structuring of cement materials in cement and their decomposition mechanisms.

With the help of new equipment, it is possible to observe the structure of cement composites at the atomic level and determine their strength, hardness and other main properties in micro and nanospaces. For example, it allows studying the amorphous S-8-N gel under an atomic microscope and shows that the product has a highly ordered structure [6].

Examination of the smooth surface of hydrated alite with atomic microscopy shows the presence of nanoparticles with aggregated dispersed phase elements in S-B-N form. The S-B-N gel of the hydrated cement paste forms a mesh of nanoparticle plates with a size of 60x30 nm² and a thickness of 5 nm, according to the results of atomic microscopy.

With the help of nuclear magnetic resonance, it is possible to determine the various surface layers formed as a result of the hydration reaction. For example, a surface layer with a thickness of 20 nm acts as a semi-conducting membrane, and this leads to the absorption of water into the cement particles and the alkalization of calcium ions. But larger silicate ions are "trapped" in this membrane, if there are no Ca^{2+} ions under the surface layer, silicate tetrahedrons in the form of a polymerized gel are formed, and this causes the cement particle to shrink. Such disruption enables the absorption of silicate ions and the formation of the S-B-N gel, binds cement particles and responds to the strength of concrete.

The transition to the nanometric level makes it possible to perform paramechanic analysis of cementitious systems. From the point of view of paramechanics, the S-B-N globule contains 18% internal nanopores, which are filled with structural water and are considered "elementary solid phase". The fluidity of concrete is explained by the dependence of the density change of S-B-N nanoparticle regrouping. Thus, considering the relationship of cement stone with microsilica, it becomes clear why the addition of microsilica reduces the flowability of concrete, and this creates an opportunity to obtain high-order materials.

Knowledge of these mechanisms opens up the possibility of controlling the properties and structures of newly formed cement composites in a certain direction.

The introduction of nano-sized particles into the concrete mixture has a significant effect on its properties. For example, the use of nanosilicates with a specific surface area of not less than 180 m²/g is ten times greater than the specific surface area of microsilica, and composites obtained on the basis of new dispersant-hyperplastics provide a new strength structure of cement stone. This makes it possible to increase the compressive strength of composite powders up to 800 MPa and their bending strength up to 100 MPa.

The use of concrete nanosilicates not only improves the location of their constituents. Perhaps, increasing their strength allows to control the reaction of formation, to control the progress of reactions to ensure the strength of cement stone.

The use of BYU2 nanoparticles increases the activity of the released ash sufficiently, and this leads to an increase in the strength of concrete containing a large amount of this additive [7-9].

Electron microscope studies show that Fe_2O_3 and BYU2 particles fill the pores and reduce the amount of $\text{SA}(\text{OH})_2$ during hydration. This improves the properties of nanoparticle cement fluids.

Soil nanoparticles affect mechanical properties. Resistance to the penetration of chlorides reduces the permeability and penetration of concrete, and therefore they are used in self-compacting concrete mixtures. Thus, based on the obtained data, the positive effect of nanoparticles on the microstructure and properties of cement can be explained by the following factors:

- finely dispersed nanoparticles increase the viscosity of the liquid phase and increase the stability of the mixture. Improves the comfortable positioning of the system;
- nanoparticles fill the space between cement granules and this causes connection with free water;
- finely dispersed nanoparticles are formed as a crystallization center in cement hydrates, thus accelerating the hydration process;
- nanoparticles have a positive effect on the formation of small aluminum ferrite crystals and increase the homogeneity of S-B-N hydrosilicates;
- BYU2 nanoparticles improve the structure of the contact zone of the filler, reduce the formation of cracks, increase the strength, resistance to displacement and slightly increase the bending strength of the cement base materials.

Carbon nanoparticles, nanotubes and nanofibers are used by many companies on an industrial scale to increase the strength of long-term construction materials that are relatively strong.

When nanotubes with a geometry close to the thickness of the S-B-N layer are inserted into the cement matrix, significant changes in its properties are observed. In this case, the compressive and tensile strength increases. In recent years, polycarboxylate superplasticizers, which have higher efficiency, have been used more and more in the construction process in the preparation of concrete. With the help of such superplasticizers, it is possible to reduce the water-cement ratio up to 40% [8-10].

The decrease in water demand of the concrete mixture is explained by the rate of adsorption of electric charges and polymers to cement particles. Such plasticizers are used more in the preparation of self-compacting concrete mixtures and reactive powder concrete.

High-strength, highly elastic and shock-resistant coatings are somewhat resistant to chemical effects and

protect reinforced concrete structures from corrosion.

UV-modified TYU2 is used as a photocatalyst, and atomic oxygen is released from water vapor. Aj The released active oxygen plays an important role in breaking down organic pollutants, disinfecting buildings and killing bacteria.

In recent years, rapidly developing nanotechnologies are expected to produce the following nanoproducts related to concrete technology:

- catalysts to accelerate the hydration and synthesis of ordinary cements;
- creation of additives for mechanochemical activation of cements and grinding to super powder;
- creation of new generations of superplasticizers that reduce water consumption, nanoparticle, nanorod, nanotube binders;
- creation of environmental binders modified with nanoparticles;
- creation of nanobiomaterials;
- creating long-lasting cement-based composites, self-healing materials, and new nanocements with low thermal expansion.

Summary. 1. Nanotechnologies have changed our capabilities and views in the field of controlling the material world and will continue to change it in the future. Such changes will also find their place in the construction and building materials industry.

2. Modern progress based on nanotechnology will successfully solve many problems that are currently considered fantastic in the next decade.

3. Nanotechnologies are currently moving from basic science to industrial applications.

Currently, its use in practice, especially in the construction materials industry, is very limited. But the fact that nanotechnologies have a high potential is very promising in terms of improving the properties of simple materials and processes.

4. Portland cement is one of the materials most consumed by mankind, and its study has not yet been completed. The fact that the nano-level structure of cement-holding materials is very complex makes it possible to create a new generation of highly technological, efficient and ecological concrete.

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