Modern Problems of Obtaining Low Water Demand Fasteners

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ABSTRACT

The article describes methods for obtaining effective dry mixes based on binders of low water binders (LWB) for the production of cellular concrete. Ways of solving problems are given by mathematical planning of the experiment. Systematic dependences were established on the composition of the components and the intensity of the grinding process of the dry mix for cellular concrete.

Keywords: Concrete, Admixture, Super Plasticizer, Increase In Mobility, Increase In Strength, Decrease In The Duration Of Vibrations, Frost Resistance, Water Permeability, Viability.

Analyzing the trends in the capital construction industry in the world economy, in particular, saving resources and energy in the production of binders and cement, the use of innovative technologies and the solution of environmental problems are among the requirements of today and the future.

At present, the use of modern local materials and technologies in construction and housing and communal complexes plays an important role. This is especially true today with the creation of materials and technologies to replace buildings. It is known that concrete and reinforced concrete are traditionally widely used in both modern construction and reconstruction. Among the various building materials in use, they are a leader in the construction industry. However, concrete is the most complex artificial composite material with the most unique technical properties.

Therefore, the most important direction in the building materials industry is the production of mineral binders and various materials based on them.

One of the main tasks now is to develop new compositions of binders using various local raw materials and industrial wastes. Resolution No. PQ-4335 of the President of the Republic of Uzbekistan "On additional measures for the accelerated development of the construction materials industry" sets target parameters for the production of construction materials in 2019-2025, which includes the amount of cement produced, including high quality and on the basis of energy-saving technologies it is planned to deliver up to 2.26 million tons in 2025. According to the analysis, by 2020, per capita cement consumption in the Republic of Uzbekistan will be at least 328 kg of cement per year [1].

Currently, there are 12 cement plants in the country with an annual production capacity of more than 9.0 million tons [1], but the amount of cement produced does not meet market requirements. The increase in cement production capacity will be achieved through the modernization of existing plants and the construction of new technological lines.

Today, the world produces more than 4.1 billion tons of cement and 8-9 billion m3 of concrete per year [2]. It should be noted that the average cost of 1 kg of cement in the world is 40-60 cents, while synthetic polymeric materials are 10-30 times more expensive [3].

World cement production increased by 2,450 million tons or 2.48 times compared to 2000. The increase in production was mainly due to the countries of the Asian region, primarily China [2].

Demand for binders is growing due to the increase in construction in the Republic of Uzbekistan. In 2018, cement production in the country increased by 11.5% compared to 2016 and amounted to 9.20 million tons, while compared to the level of 2000, cement production increased by 5.9 million tons or 2.8 times [4]. It should also be noted that in 2018, cement consumption increased by 29.5% compared to the same period in 2017, ie. Increased from 9711 tons to 12577 tons and exceeded 3511 tons. Thus, these excess costs were covered by imports from other countries [4].

Cement has significant environmental disadvantages, the production of which requires a lot of energy: the use of equivalent fuel for clinker baking up to 215 kg / t (wet method), electricity for various processing and grinding in the production of "pure" cement PTs500D0 - 119 kW s / t; environmental disadvantage - the consumption of a very large amount of limestone and clay (1 ton of cement requires 1.5 to 2.4 tons of mirror raw materials); Large emissions of CO_2 and dust (more than 900 kg of CO_2 and 300-900 kg of dust in the production of 1 ton of Portland cement) are released [5].

Therefore, the less clinker in cement and the less cement in concrete, the higher the performance of cement in construction.

The most important priority of research in this field is the development of nanotechnology and innovative methods in the production of cement and binders. Low water-demanding binder (LWDB) is an effective binder based on Portland cement clinker, which has minimal water demand among the available mineral binders. The normal density of LWDB is 16-20%, and that of ordinary Portland cement is 24-30% [6].

LWDB - in the 80s of the last century Batrakov VG, Bajenov Yu.M. and proposed by other scientists and later developed by their students, they use Portland cement clinker or ordinary Portland cement with mineral powder fillers (quartz sand, slag, limestone, industrial waste or other natural raw materials) and dry organic modifier - various natural plasticizers are composite hydraulic binders obtained by grinding [6-7].

One of the ways to improve the quality of reinforced concrete products and structures, accelerate the production of concrete works and save cement is the use of chemical additives. The use of high-efficiency superplasticizers here significantly reduces the material, energy and labor costs of production, saves 25% of cement, obtains high-strength concrete in ordinary cements by reducing the water-cement ratio, improves the quality and strength of structures.

The mechanism of action of superplasticizers is associated with the adsorption of their polymer molecules on the surface of cement particles, immobilization of water bound in cement molecules, reduction of internal friction coefficient of cement-water system, flattening of microrelief of hydrated cement particles and in some cases superficial causes it to be pushed.

LWDB -based cement stone is characterized by high density and strength due to the maximum convergence of solid phase particles and the increase in adhesion strength of newly formed minerals [8].

The increase in strength of concrete prepared on the basis of traditional technology and LWDB-based concrete using JK-02 superplasticizer differs significantly from each other. After a certain period of time from the time of preparation of the LWDB-based concrete mix, its mobility is sharply lost, which leads to an intensive increase in the hardening of the concrete (after 6 ... 8 hours). Under normal conditions, the strength of LWDB - based concrete after 15 hours is 15 ... 25 MPa, after 1 day it is 20 ... 60 MPa, or the heat-wet processing time can be significantly reduced [8].

Admittedly, a number of researchers [9-10] have considered LWDB to be "immortal" or "eternal" cement. B.E. According to Yudovich [9], LWDB stored in silage jars and bags for 12 years has not lost any activity at all.

The authors [11] explain this by the fact that cement particles are "conserved" by the dense molecular shell of the superplasticizer, which prevents moisture from entering the cement particles from the environment. During the grinding process in the production of LWDB, the molecules of the superplasticizer not only "mechanically" bind to the cement particles, but also form a "shell" on their surface layer of 1 ... 2 microns. As a result, the active zones of the cement particles become hydrophobic.

Mineral admixtures incorporated into mechanically activated cements should be characterized by high amounts of silicon and its compounds as well as low humidity. It should be added that a third component is often added to reduce the cost of LWDB - a mineral soft filler with inert or putstsolan activity of natural and man-made origin.

The use of man-made raw materials in the production of Portland cement should not only outperform the use of natural raw materials in the production technology of Portland cement clinker and even completely replace them, and in the second stage should be their second main component in the production of mixed cement.

The use of these wastes as part of the creme in LWDB ensures the high density and quality of the cement stone, and accordingly the concrete lowers their cost.

Researchers [12] have managed to save 50 percent of the clinker content in Ecuador through the judicious use of pyroclastic rocks without reducing the bond strength of the building materials industry due to the expansion and use of raw materials, which has significantly reduced the environmental burden.

The authors [13] developed a fine-grained composite binder with a strength of up to 73 MPa using Portland cement-based terricon ash and a plasticizer additive. The addition of terricon ash to the binders has resulted in savings of up to 20% on Portland cement clinker.

Using a complex additive, thermal power plants have made it possible to obtain fast-setting concrete at the expense of replacing up to 30 per cent of the cement with sour volatile ash. When using a complex admixture, 40% cement was replaced with ash without reducing the strength of the concrete relative to the strength of the admixture.

Additional crushing of the ash, increasing its reaction surface and thus increasing its activity, does not lead to an increase in the water demand of concrete mixes. This is because the separated (melted) ash grains retain a large amount of capillary water in the time interval between them. With the breakdown of the aggregates during the final grinding process, the water demand of the mixture does not change, despite the increase in the specific surface area. This phenomenon is very natural, because the amount of water trapped adsorbed on the melted surface of ash grains is several times less than the amount of capillary water. According to the normative instructions, when replacing 50% (by weight) of cement with a filler additive, the performance of the concrete mix, measured by the decrease of the cone, should not exceed 1 cm. The higher the quality of the cement and its fineness, the more micro aggregates can be added and it hardens faster.

According to the researchers [14], using claydite powder as a mineral additive, PTs M500-D0 with Melflux PP 100 F hyperplasticizer can be obtained by crushing LWDB from ordinary Portland cement. It can be noted that the normal thickness of binders containing 40 and 60% expanded clay powder and 0.1% Melflux PP 100 F hyperplasticizer varies from 19.2 ... 20.9%, curing time from 3-20 minutes to 5-50 hours . With such a binder, it has the property of rapid solidification and has an activity of 56.1 and 50.2 MPa, respectively, after 28 days of solidification.

The increase in the performance of LWDB -based concretes can be explained by the improvement of their structural properties. LWDB -based cement stone and concrete have been found to have relatively low porosity and no large pores.

The simple addition of volcanic slag to the binder content is lower than the strength of the control sample during the initial solidification of any cement-volcanic slag ratio (up to 50%) and the binding control sample strength of up to 20% is achieved from 90 days. In concrete mixes with the same mobility, the strength of samples prepared using plasticizer by reducing the amount of water was achieved by 10-34% higher than the strength of samples without additives.

Research conducted in the laboratory showed that the experimental production of effective concrete made using LWDB and fine-grained multi-component cements obtained on the basis of joint crushing of different levels of Portland cement and mineral additives with the participation of superplasticizer JK-02 revealed reasonable areas of use: M400 Portland cement and the use of fine-dispersed LWDB based on granulated blast-furnace slag-based binder for the production of high-strength concrete (500-800 grade) or low-strength concrete with construction savings of up to 80% - saving up to 50% of Portland cement per 1 m3 of concrete of 200-300 grade concrete allows The use of LWDB and fine-grained multi-component cements provides 40-70% savings in cement, taking into account cement consumption in the production of building materials. At the same time, concretes made from LWDB obtained from slag are characterized by increased sulphate resistance, frost resistance and a number of other positive properties, which allows to significantly save cement.

The use of electric steel smelting slag in the production of LWDB leads to a decrease in the water demand of the binder by an average of 30%. An increase in the amount of electric steel melting slag in the LWDB will inevitably lead to a sharp reduction in the curing time of the cement paste and a decrease in the initial strength. Compared to LWDB-50 and SEM I, the strength of the concrete obtained when the binders were consumed at the same time was equal.

By the nature of the effect of cement on the hardening process, mineral additives are classified as active and inert. Active additives are artificial silicate materials that have hydraulic properties in volcanic or sedimentary rocks, including Ca (ON) $_2$ environment. The properties of sedimentary admixtures (trepel, diatomites, burnt clay rocks - gliej, opokas) as well as volcanic (volcanic ash, pumice, tuff, trasses) are given in the literature [15-16].

Researchers using limestone powder, volcanic ash, thermal power plant ash and quartz powder to obtain LWDB from various active mineral additives of different origins allow to obtain high-quality concretes of strength class V60 to V100. Reduces by 25-30%. In addition, it was concluded that the high rate of increase in the strength of concrete based on LWDBs can be achieved within 18-24 hours by avoiding the transfer of wet heat to the products and the removal of the product from the mold.

It is believed that the granulometric composition of fine-grained aggregates is smaller than that of Portland cement, and that the "soft aggregate effect" occurs as a result of the activity of chemical additives with them. In addition, V. Vlasov [17] believes that cement stone has an acceptable level of saturation with a fine aggregate in the formation of the structure, and an increase in the amount of additives from this level leads to a break in the bonds between clinker granules and a decrease in material strength.

Studies have shown that the porosity of a cement stone structure prepared by adding perlite, which appears to be 0-40% finer than the cement mass, to the binder at 3, 20, and 60 days led to a decrease in porosity as perlite reacted with hydration products. In addition, fine mineral additives have been shown to play the role of crystallization centers that enhance the hydration of clinker minerals.

According to the results, it was found that crushing cement with JK-02 superplasticizer at a rate of 0.6% by weight of cement significantly accelerates the process. This suggests that, in addition to the plasticizing effect, this is explained by the effect of pushing the additive into the cracks of the crushed material as a plywood during grinding. In addition, it can be seen that the crushing kinetics in obtaining LWDB by crushing Barkhan sand is the same as that of the man-made raw material previously studied. The use of complex binders and the high density placement of filler grains have been found to significantly increase the strength properties. The optimal choice of aggregate made it possible to obtain fibrous concrete with a compressive strength of 160.2 MPa and a flexural strength of 31.2 MPa using man-made sands in mechanically activated compositions. [4]

As a result of the work, effective multifunctional modifying additives based on LWDB were obtained for monolithic concrete mixes, which provides acceleration of hardening by 120 ... 150%, the strength of hardened concrete under normal conditions was more than 30 and 50 MPa on days 1 and 3, respectively. At 10 ± 2 0C, the increase in strength with the addition of the additive was 200 ... 250% (more than 20 and 40 MPa in 1 and 3 days) and more than 300% (more than 2 and 15 MPa) at 2 ± 2 0C. In 28 days, the use of the developed admixture will ensure the production of V60 grade concrete. Concrete mixes using LWDB additives up to 15% by mass of cement are distinguished by a high class in terms of mobility P5 and belong to the class of self-leveling concrete mixes. However, the mechanism of action of the admixture is the rapid formation of a crystalline hydrate structure with low water demand and an increase in the hydration level of the main highly active cement.

Portland cement clinker of Bekabadtsement JSC, volatile ash of New Angren TPP as mineral additives, granulated ETF slag of Jambul phosphorus plant, phosphogypsum dihydrate of Almalyk chemical plant, propylene as a crushing intensifier superplasticizer, Mapei Dynamon SP3 - acrylate hyperplasticizer and polycarboxylate-based - Sika VK 225 hyperplasticizer, effective results were obtained using calcium chloride, iron chloride, iron and sodium sulfates to control cement stone hardening.

Scientists and researchers of the department "Manufacture of building materials, products and structures" with positive scientific results are currently implementing production in cooperation with JSC "Kyzylkumtsement"

The results obtained show that when the specific surface area of LWDB increases from 3000-3200 cm2 / g to 5000-5500 cm2 / g, the strength almost doubles. Studies have shown that it is possible to obtain LWDB with activity up to 60 MPa. As a complex modifier of cement, a superplasticizer based on polycarboxylates and an intensifier of the crushing process were used during crushing.

The advantages of LWDB include the versatility of the compositions. However, an increase in the hydration level of LWDB, especially very fine-grained cements, can lead to a lack of clinker fund in the concrete, which affects the strength of the concrete products. The strength of very fine-grained cement samples reaches 420 kg / cm2 after three years, while that of ordinary cement is only 175 kg / cm2. Modern research has shown that it is sufficient to increase the specific surface area of the binders to 5000-6000 cm2 / g, as the strength of the concrete doubles in one day of age, but at the same time cracks may appear in the panels.

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