Advantages and advantages of binders of low water demand

Muzaffar Safarovich Makhammatov

Teacher of the department "Technology of Building materials, products and structures"

Samarkand State Institute of Architecture and Construction named after Mirzo Ulugbek

Abstract: *The advantage and advantage of binders of low water demand (VNV) is in their high dispersion, in very high strength (up to 100 MPa). This is achieved due to the content in large quantities of superplasticizer C-3.*

Keywords: *material composition, furnace slags, construction sand, pure clinker.*

According to the material composition, such binders are divided into pure clinker (VNV-100) and multicomponent with various mineral additives. For example, granulated blast furnace slags, fly ash, as well as fillers - inert additives in the form of construction sand, waste from mining and processing plants are used. This gives the binders good construction and technical properties.

One of the important conditions for obtaining a given quality of VHV is the necessary humidity of the initial components, the total value of which should not exceed 3 percent in the total mass of the composition.

Ball, tubular and vibrating mills are used for the production of binders of low water demand. However, studies have shown that ball mills equipped with a separator are preferable. They provide a given granulometric composition.

An organic modifier (SP C-3) introduced during grinding has a positive effect on the kinetics of crushed clinker. Thus, with the same initial grain dispersion (about 2500 sm^2/g), the duration of the clinker domol with the optimal amount of two-water gypsum and organic modifier until the specific surface area of the binder 4400 cm2 / g is reduced by 2 times compared to the duration of the clinker domol without a modifier. In this case, the modifier not only plays the role of a grinding intensifier, but also prevents aggregation of binder particles during finer grinding.

It is known that for factory-made cements, depending on the type and amount of mineral additives, the dispersion varies between 2500-3500 cm2 / g at a normal density of 24-28 percent, and sometimes higher. The normal density of the VNV with a specific surface area of 4500-5000 cm2 / g usually varies from 16 to 20 percent and even with the use of moisture-intensive mineral additives (for example, thermal power plant ash), introduced in an amount of up to 70 percent, does not exceed 24-26 percent.

The analysis shows that the activity of VNV significantly exceeds the activity of the original Portland cement brand 500. The possibility of replacing (up to 60 percent) of the clinker part with various mineral additives has been created.

They are characterized by a reduced degree of hydration of the elite in comparison with Portland cement, both at an early age and during prolonged hardening. This is due to the low water content of hydrate neoplasms. Thus, the degree of hydration of alite monomineral VNV at the age of 7 and 28 days of normal hardening is 28.5 and 34 percent, which is significantly lower than the same indicator of finely ground monomineral cement without a modifier (57.7 and 58.6 percent, respectively).

Despite the reduced values of the degree of hydration, the binder of low water demand has significant advantages over Portland cement, both in terms of hardening rates and absolute strength values. The strength of cement stone on the VNV (82.4 Mpa) at the age of 1 day of normal hardening is 2.6 times higher than the strength of control samples, and at a later date — 2.1-2.3 times. The absolute values of the strength of cement stone at the age of 28 and 180 days were 184 and 205 Mpa, respectively, and control samples—81.7 and 98.5 MPa.

A characteristic feature of cement systems based on such binders is a significant slowdown in the processes of structure formation in the first 4-8 hours after sealing, followed by an intensive crystallization and hardening process. The duration of the induction period of the cement dough based on the VNV is reduced with an increase in the content of the clinker component in its composition.

One of the advantages of VNV is the long-term preservation of activity and intensive strength gain of cement stone and concrete based on it in various, including early, hardening periods.

Storage (up to 180 days) of such a binder with a clinker component content of 30-100 (NV-30 — VNV-100) in paper bags and room conditions did not lead to a change in the parameters of dispersion, water demand and strength in standard solutions (both calculated and early, at the age of 1-3 days).

The strength of the solution on Portland cement grade 500 after 30 days of storage in similar conditions decreased by 17-20 percent, and after 6 months of storage was only 35-37 percent of the original. At the same time, the specific surface area of cement decreased from 3200 to 2600 cm2/g. This indicates the agglomeration of clinker particles.

Tests of concrete mixtures on VNV in production conditions have shown that the highest rates of loss of mobility are characteristic of the composition on pure clinker cement VNV-100. With the transition to binders containing mineral additives, there is an increase in the retention of concrete mixtures in the sequence: VNV-100, VNV-50, VNV-30.

The molding properties of concrete mixtures are characterized by increased viscosity at rest and significant thixotropic liquefaction under mechanical influences, which predetermine a high degree of their compaction and low energy consumption for the molding process.

The kinetics of hardening of concretes based on VNV differs significantly from the nature of the increase in strength of concrete from isoplastic mixtures with superplasticizer C-3, prepared according to traditional technology. It is characterized by an intensive strength gain after a few hours. At the age of 16 hours of normal hardening, concretes based on VNV have a cubic strength equal to 25 MPa. This creates a real possibility of obtaining concretes with the required decoupling, transfer (for prestressed structures) or release strength for 16-24 hours of normal hardening or with a significant reduction in the duration of heat and moisture treatment for precast concrete products.

The strength of concrete equal to 22.6 MPa, based on VNV-100, is achieved in 8 hours from the moment of sample production, which is almost twice less than the time required to obtain concrete of the same strength according to traditional technology. At the same time, during all periods of hardening, the coefficient of cement use in concrete based on binders of low water demand is significantly higher than that of concrete without additives and with superplasticizer C-3.

The use of VNV-100 is promising for high-strength concretes of classes B45 and higher, while 35-50 percent of the clinker part of cement can be saved. It is suitable for non-welded reinforced concrete technology. VNV-50 is promising in concretes of classes VZO-B45 and can be used in concretes of class B25. At the same time, the clinker part of cement is saved by 50 percent or more, the time and temperature of heat treatment are significantly reduced, and in many cases there is no need for these concretes.

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