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PLASTICIZING ADDITIVES FOR CONCRETE

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Annotation. Concrete is one of the main building materials that is widely used in the construction of buildings and structures. Plasticizing additives play an important role in improving the physical and mechanical properties of concrete.

The existing and currently used plasticizing additives have significant disadvantages. The research and creation of new types of effective plasticizing additives is topical.

In this article, the types and purposes of plasticizing additives, their optimal amount, regulating abilities and plasticizing effects in the composition of concrete have been considered and studied. Also, along with the positive effect, their significant disadvantages and negative effects on some physical and mechanical properties of concrete were discussed.

Key words: Cement, concrete, plasticizing additives, surfactants, stabilizers, superplasticizers, hyperplasticizers, physical and mechanical properties of concrete, disadvantages of surfactants.

Аннотация. Бетон является одним из основных строительных материалов который широко используется в строительстве зданий и сооружений. В улучшении физико-механических свойств бетона, пластифицирующие добавки играют большую роль.

Существующие и используемые в настоящее время пластифицирующие добавки имеют существенные недостатки. Исследование и создание новых видов эффективных пластифицирующих добавок является актуальным.

В данной статье рассмотрены и изучены виды и назначения пластифицирующих добавок, их оптимальные количество, регулирующее способности и пластифицирующие эффекты в составе бетона. Также, наряду с положительным влиянием, изучены их существенные недостатки и отрицательные влияния на некоторые физико-механические свойства бетона.

Ключевые слова: Цемент, бетон, пластифицирующие добавки, поверхностно-активные вещества (ПАВ), стабилизаторы, суперпластификаторы, гиперпластификаторы, физико-механические свойства бетона, недостатки ПАВ.

Annotatsiya. Beton - qurilish va inshootlarni qurishda keng qo'llaniladigan asosiy qurilish materiallaridan biridir. Plastiklashtiruvchi qo'shimchalar betonning fizik -mexanik xususiyatlarini yaxshilashda muhim rol o'ynaydi. Mavjud va hozir

ishlatilayotgan plastifikatsiyalashtiruvchi qo'shimchalarning muhim kamchiliklari bor. Yangi turdagi samarali plastiklashtiruvchi qo'shimchalarni tadqiq etish va yaratish dolzarbdir.

Ushbu maqolada plastifikatsiyalashtiruvchi qo'shimchalarning turlari va maqsadlari, ularning optimal miqdori, tartibga solish qobiliyatlari va beton tarkibidagi plastifikatsiyalash effektlari ko'rib chiqildi va o'rganildi. Bundan tashqari, ijobiy ta'sir bilan birga, ularning muhim kamchiliklari va betonning ba'zi fizik -mexanik xususiyatlariga salbiy ta'siri muhokama qilindi.

Kalit so'zlar: Sement, beton, plastifikator qo'shimchalari, sirt faol moddalar, stabilizatorlar, superplastifikatorlar, superplastifikator, betonning fizik -mexanik xususiyatlari, sirt faol moddalarning kamchiliklari.

Introduction

Concrete is one of the most common building materials used in the modern world. Concrete is widely used because of its high versatility, various physical and mechanical properties which differ depending on additives and impurities, as well as durability and relatively low cost.

Concrete consists of a placeholder (fine and coarse), water, variable supplements (improving properties) and a binder, which is usually cement.

Plasticizing additives are in the first place among additives to concrete that have found most widespread use in the production of concrete and reinforced concrete. This is explained by the high efficiency type of additives, absence of negative impact on concrete and reinforcement, as well as accessibility and low price.

The main purpose of plasticizers is to increase the mobility or decrease the rigidity of the concrete mixture, and to liquefy it. The effect of liquefaction of the concrete mixture is used to facilitate the processes of forming structures, to increase the density and strength of concrete by reducing the water demand of the concrete mixture while maintaining the original mobility, or to reduce the consumption of cement. Organic surfactants used as plasticizers have successfully entered construction and are now widely used.

According to modern concepts, plasticizers are dispersants - stabilizers that form a structured film as a result of adsorption on the surface, and the separation of solid and liquid phases. Immobilization of water bound in cement floccules, a decrease in the internal friction coefficient of a cement-water suspension, a smoothing of the microrelief of hydrating cement grains and, in some cases, an increase in the electrostatic repulsion of particles due to a significant change in their electrokinetic potential are the main factors of the plasticizing effect of surfactants on cement-water systems, and a decrease in their water demand and the consumption of the binder.

All plasticizing additives in accordance with the classification refer to additives that regulate the properties of concrete and mortar mixtures, and according to the magnitude of the plasticizing effect, they are subdivided into:

- superplasticizing;

- plasticizing.

The first water-reducing additives were used in the domestic production of precast concrete and are known as technical lignosulfonates (LST). The use of these additives in concrete technology causes plasticization of cement systems, slows down the hydration of portlane cement, promotes air entrainment, and, as a consequence, increases the frost resistance of heavy concrete. LST can reduce the amount of mixing water only up to 10%, which is ineffective and does not allow the production of high-quality cement-based materials.

Plasticizing surfactants, for example sulfite-alcohol stillage, sulfite yeast mash, alkaline adipic plasticizer, significantly increase the fluidity of the cement paste by reducing the surface tension energy at the interface. As a result, the water demand of the concrete mix is significantly reduced. Additives of this group are most effective in concrete mixes with a relatively high cement consumption. A typical representative of this group of additives with a hydrophilic effect is sulfite-alcohol stillage, the mechanism of action of which is to reduce the surface tension energy at the solid-liquid interface due to the adsorption of additive molecules on the surface of cement grains and hydrated neoplasms. The adsorbing molecules of the additive separate the cement particles, prevent them from flocculation and ensure their mobility, while simultaneously reducing the water demand. This allows cement consumption to be reduced by up to 10%.

In scientific research, the effect of surfactants has been studied depending on the mineralogical composition of cement. It has been shown that the higher the content of C_3S in cement, the more surfactant is required to achieve a given mobility of a mortar or concrete mixture. The rate of cement hydration in the presence of surfactants depends on the chemical composition of the additive and its concentration. In a number of works, it was found that surfactants, as a rule, reduce the rate of crystal growth, reduce the cross-section of supports in cement stone, and provide the formation of closed or semi-closed pores. This, in turn, sharply reduces the absorption of water and aqueous solutions of aggressive substances by concrete, increasing the frost resistance and corrosion resistance of concrete. Among the additives that improve the frost resistance of concrete, neutralized air-entraining resin lignosulfonates and organosilicon compounds are relatively well studied. The use of surfactants, as shown in the work, in concretes with a minimum consumption of cement increases its crack resistance. A significant disadvantage of most surfactants is their propensity to slow down the hardening of concrete. As a rule, the strength and deformation properties of concretes modified with surfactants are lower than concretes without additives. It has been shown that lignosulfonates, hydroxycarboxylic acids and their salts increase the shrinkage and creep of concrete. Concretes modified with surfactants, as a rule, require extended heat treatment modes and are characterized by a slow increase in strength at an early age, mainly due to the screening effect of adsorption shells on cement grains.

Additives - superplasticizers have a significant water-reducing effect. These modifiers make it possible to reduce the water-cement ratio to 25%, depending on

the mineralogical composition of the cement, the amount of added additives and their base.

Superplasticizers have become widespread due to the extreme plasticizing effect of the concrete mixture. It is customary to refer to specially synthesized oligomers based on cyclic and heterocyclic compounds as superplasticizers. The most widespread of them are sulfonated melamine-formaldehyde, aniline- and naphthalene-formaldehyde resins, as well as modified lignosulfonates. Superplasticizers differ from conventional plasticizers in the high thinning effect of the concrete mixture without reducing the strength of the concrete.

The use of sulfonated melamine-formaldehyde resin in amounts of 1-5% of the mass of cement, along with an increase in concrete strength by 28%, makes it possible to increase its hydrophobicity and, accordingly, its durability. Research has also shown that the use of a superplasticizer on this basis promotes an increase in the adhesion of cement mortars and concretes to various materials, including old concrete, an increase in frost resistance and sulfate resistance of cement compositions.

The efficiency of application of superplasticizers C-3, 10-03 is shown; 20-03, 30-03 in high-strength concrete made from mixtures of increased mobility. The high dilution of the concrete mixture, the absence of retardation of the hardening of concrete made with cements of various compositions, made it possible to use the C-3 additive for the manufacture of a number of critical structures. The experience of using this additive makes it possible to reduce the molding time 3-4 times and significantly reduce the noise level.

The specific properties of superplasticizers are used: their effect on the rheological properties of the mobile concrete mixture, the preservation of its cohesion and non-delamination. In foreign practice, these additives are widely used for the manufacture of monolithic structures from cast concrete mixtures with a cone draft of 20 cm. The use of such mixtures is economically feasible, since labor costs for processing concrete are reduced, and labor productivity is increased by 50-90%. The cast concrete mix, obtained by introducing a superplasticizer, allows one to combine good workability with high compressive, tensile and flexural strength of concrete. Cast concrete mixes have increased water retention capacity and reduced water separation. All over the world, mobile concrete mixes with additives of superplasticizers are also used in precast concrete structures. The use of mobile mixes reduces labor costs for the preparation, transportation of concrete mix and the formation of structures, significantly improves working conditions for workers, and improves the quality of products and their appearance. A distinctive feature of superplasticizers, in comparison with conventional surfactants, is their property not to slow down the hardening and hydration of the binder, the absence of air entrainment, as a result of which concretes with such additives have increased strength indicators. The introduction of superplasticizers into homoplastic concrete mixtures reduces their water demand by 25-30% compared to compositions without additives, while the density and durability of concrete increase significantly, and its

strength increases by 50-70%. This makes it possible to obtain high-strength concrete with a strength of up to 100 MPa.

The use of superplasticizers in the production of precast concrete is carried out with the following main objectives: reducing the consumption of cement; increasing the mobility of the concrete mixture while maintaining the physical and mechanical properties of concrete and a sharp decrease in the labor intensity of forming structures; obtaining high-strength concrete; and, finally, obtaining concretes with improved physical and mechanical properties and durability.

The mechanism of the plasticizing action of superplasticizers consists in the chemical interaction of sulfonate groups of polymer molecules with calcium ions on the surface of cement particles to form calcium salts of the polymer, which prevent particles from sticking together and improve their sliding relative to each other. In some works, it is noted that significant water reduction of cement systems in the presence of NF, MF, LSTM is achieved mainly due to adsorption on cement grains and hydrate phases, and giving them an electrostatic charge of the same name, which causes repulsion and dispersion of cement floccules. At the same time, it is known that the use of these additives leads to a slowdown in the hydration of cement in the early stages of hardening, can lead to delamination of cement suspensions, which is an obstacle to obtaining modern cast, self-compacting and high-quality cement concretes.

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