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INVESTIGATION OF THE STRUCTURE OF CHEMICAL ADDITIVES AND THEIR EFFECT ON THE PROPERTIES OF CONCRETE AND CEMENT

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Annotation. This article discusses chemical additives in modern concrete technology and their effects on concrete strength. The role of chemical additives and their importance in obtaining clear technical and economic efficiency and the strength of concrete structures are shown.

Keywords: Concrete, structure, superplasticizer, cement, reinforced concrete polycarboxylate chemical additives, polymer, construction

INTRODUCTION

Concrete, which is used in our buildings and structures, which are being built today on the basis of modern technologies, is unthinkable without chemical additives. Chemical additives added to concrete serve to improve many properties of concrete. Today, most of the chemical additives added to improve the properties

of concrete are superplasticizers.

Over the past decade, superplasticizers based on polycarboxylates have become an example of the successful implementation of new technology in the production of concrete. Having started their way in the production of self-compacting concrete, they gradually penetrated into the field of precast concrete. Step by step, these additives have become actively used by manufacturers of ready-mixed concrete and, last but not least, by manufacturers of precast concrete products.

Due to the specificity of action, plasticizers allow concrete producers to obtain products with improved characteristics and optimize the production process, both from an economic and environmental point of view. Depending on the chemical structure of polymers and how they work, superplasticizers can be designed specifically for specific applications. In the production of precast concrete, polymers with long side chains produce a product with high early curing rates. The backbone of the polymer can be optimized by modifying the electrical charge density to achieve maximum performance (maximum long-term) workability of ready mixed concrete mixes. To fully reveal its properties in concrete, the superplasticizer must be compatible with other components of the concrete mixture. The chemical composition of the cements used in the production of the mixture, and in particular their sulfate content, can significantly affect the effectiveness of additives. The type of filler sand can also affect the effect of the superplasticizer. Due to the chemical structure, the polymer particles are easily incorporated into the clay layers if the clay is present as an impurity in the sand, and thus can lose effectiveness significantly. Knowledge of the properties and specific behavior of superplasticizers allows manufacturers to take full advantage of the technology.

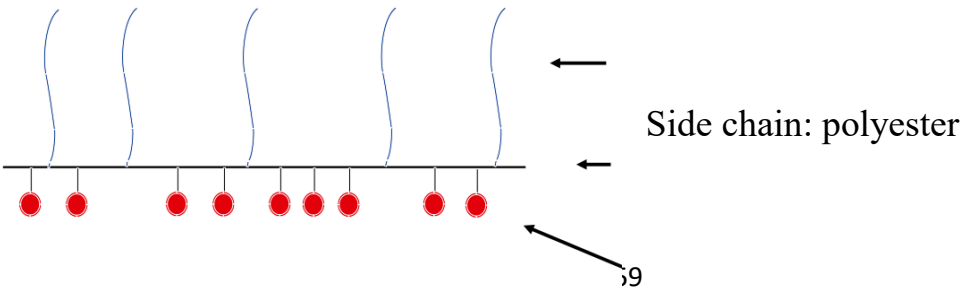
MATERIALS AND METHODS

Self-compacting concretes and ultra-high performance concretes can only be obtained using plasticizers. In the production of standard high-strength concretes,

additives replace the traditional products used, due to their wide variety and high efficiency.

Esters of polycarboxylates - from development to the present. The development of polycarboxylate esters is very closely related to self-compacting concrete. In the early 1980s, the first patent was filed in Japan for this group of substances and their use as superplasticizers for concrete. In the mid-1980s, the first projects using polycarboxylate esters and self-compacting concrete began to be implemented in Japan. The most famous of the objects are, first of all, the bridge across the bay in Tokyo (Tokio Bay Bridge) and the central high-rise buildings in Tokyo (Tokio Central Towers). It took about 10 more years before these products appeared in Europe in the mid-90s. Since that time, the process has moved very quickly: the development of new products has provided the market with access to polycarboxylate esters and their use as concrete additives. Thanks to the special properties of this class of substances, their exceptional efficiency and their diversity, over the next 10 years, polycarboxylate esters won more than half of the market volume in the field of plasticizers and superplasticizers in Western Europe.

At first, the main area of application of superplasticizers was the production of prefabricated elements. In this case, the strong thinning effect, the significant increase in the early strength of concretes when using these products and the use of self-compacting concretes played a decisive role. The strong thinning effect of superplasticizers is manifested in a significantly lower dosage, the strength of products compared to traditional superplasticizers based on sodium naphthalenesulfonate or melamine sulfonate increases several times.



Main polymer chain (polycarboxylate)

Carboxyl group

Figure 1: **The structure of polycarboxylate esters**

Further development of superplasticizers based on polycarboxylates produced polymers that met the needs of the ready-mixed concrete industry. In this field of application, the long-term retention of consistency and stable high strength of the products were of great importance, compared with fluctuations in these indicators during conventional production. The use of appropriate superplasticizers has made it possible for the first time to produce concretes with long-term workability of 90 minutes or more, with early strength rates that allow formwork to be removed as early as the day after the concrete is placed.

The additives that regulate the rheological properties of concrete and mortar mixtures are mostly surfactants. A distinctive feature of surfactants is their high physicochemical activity at the interface in dispersed systems.

In the main chain of the polymer, we find groups of molecules with a negative electric charge carboxylate groups. New are the side chains attached to the main chain of the polymer. By varying the length of the main and side chains, as well as the number of carboxylate groups and side chains, it is now theoretically possible to manufacture many different types of products. The variety of products can be even greater if other groups of molecules are incorporated into the main and side chain. Table 1 shows an overview of the relationships between polymer structure and the performance of plasticizers in concrete.

The production of self-compacting concrete is impossible without highly effective plasticizers. Especially in the production of precast concrete, self-compacting concrete already has a large market share in Western Europe, in particular in the Netherlands, Denmark and Sweden. The high content of fine

particles and the usually low W/C ratio necessitate the use of a high-performance plasticizer based on polycarboxylate esters. In addition, the action of superplasticizers has a positive effect on the viscosity of self-compacting concrete.

As we already know from the example of naphthalene and melamine sulfonates, the polymer molecule is adsorbed by the surface of the cement grain due to its negative electric charge. In this case, sulfonates are rapidly and almost completely absorbed, while plasticizers can purposefully control their adsorption properties by changing the amount of carboxylate groups. In addition to dispersion due to the electrostatic repulsion of the cement grains, these grains are also kept at a distance from one another due to long side chains.

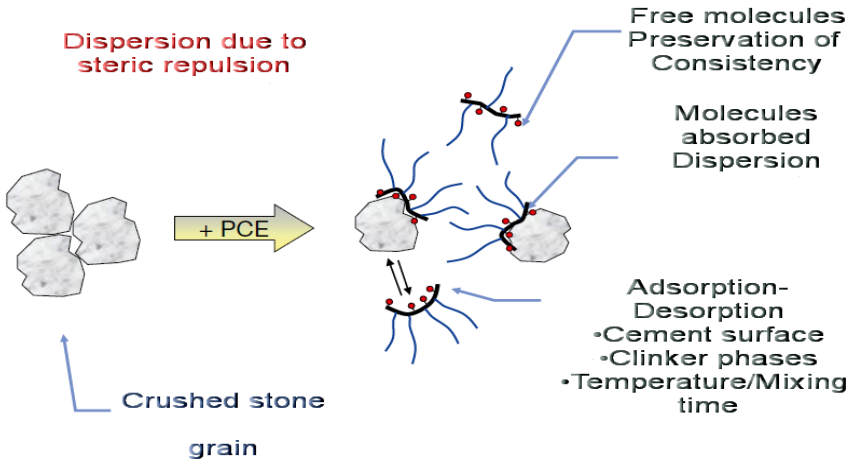


Figure 2: **The principle of operation of the PCE superplasticizer: dispersion due to steric repulsion**

The determining factor in the effectiveness of a superplasticizer based on polycarboxylate esters is its adsorption properties. These properties depend primarily on the molecular structure of the polymer, the chemical conditions in the pore solution, and the physicochemical properties of the cement surface.

RESULTS

The high charge density, that is, a large number of carboxylate groups in the main chain, leads to rapid and complete adsorption of polymers. This is facilitated by the rapidly reacting surface of the cement grain, with the dominant role played by the C3A phases. The reactivity of the cement surface is affected by the content

of sulfate ions in it. The content of sulfate ions in the pore solution is critical.

The mechanism of action of superplasticizers is still not completely clear today, but, nevertheless, the following facts can be considered established:

• superplasticizer molecules reduce the surface tension at the liquid-solid interface, while most surfactants reduce the surface tension at the gas-liquid interface. This circumstance is precisely due to the reduced air entrainment into the concrete mixture in the presence of superplasticizers;

• superplasticizer molecules have a dispersing effect on binder particles. As a result, the proportion of fine fractions in the presence of superplasticizers doubles, which increases the cementitious properties of the cement;

• the duration of the plasticizing action of superplasticizers is much shorter than that of conventional surfactants, which is associated with the structural features of the superplasticizers molecules and the value of their molecular weight;

• The additives of many superplasticizers have less effect on the rate of cement hydration compared to conventional surfactants.

Influencing the processes of structure formation, especially at the initial (coagulation) stage, superplasticizers change the rheological properties of the cement system, help to reduce its water demand, which is further reflected in the parameters of the crystallization structure.

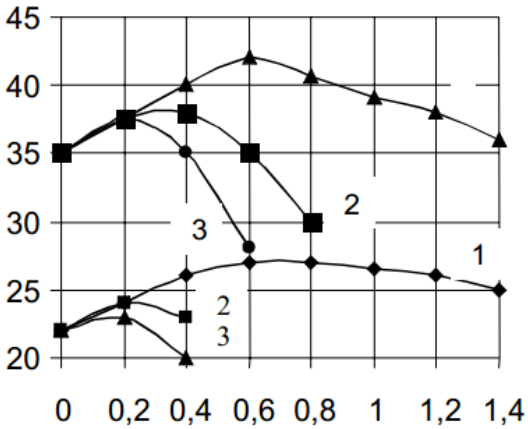


Figure 3: Effect of dosage plasticizers for concrete strength

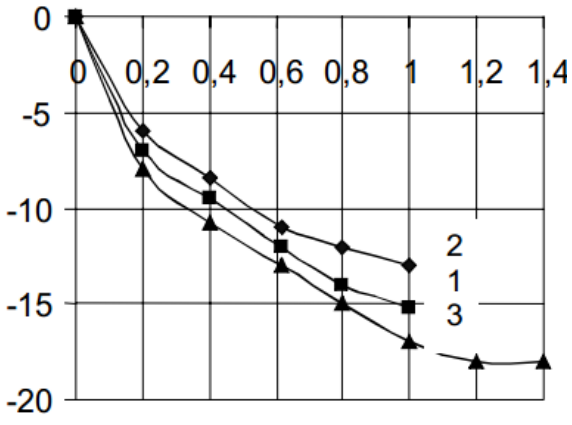


Figure 4: Influence of dosage of plasticizers on the water-reducing effect

In accordance with the classification of additives in accordance with GOST 24211, superplasticizers belong to additives that regulate the properties of concrete mixtures, and in the group of plasticizing additives they occupy the first place. This is due to the extremely high effect of liquefying the concrete mixture without reducing the strength of the concrete at all times of the test.

CONCLUSION:

Along with the production of prefabricated reinforced concrete, superplasticizers have also conquered the production of ready-mixed concrete in recent years. High efficiency and consistency retention are important technical arguments for the use of these superplasticizers. In addition, the possibility of producing softer concretes, up to self-compacting concrete, offers great economic potential. An example is the construction of an object near the entrance to an office center, as well as the laying of a protective layer of concrete at a construction site. For demonstration purposes, concrete of regular, hard consistency was used once and self-compacting concrete was used once.

Plasticizers based on polycarboxylate esters, due to their special mechanism of action and flexible chemical structure, allow manufacturers of concrete additives to use these special properties, taking into account areas of application. In the production of precast concrete, the share of PCE additives used on the Western European market is already more than 50%. With regard to ready-mixed concrete, these products are currently used mainly for the production of self-compacting concrete and their potential is far from being exhausted. These examples show that base plasticizers can also contribute to cost-effective and high-quality performance of specifications and make concrete an attractive, inexpensive and promising building material.ive layer of concrete at a construction site.

REFERENCES:

1. V.S.Izotov, Y.A. Sokolova “Химические добавки для модификации бетона” Монография Москва 2006

2. Руководство по применению химических добавок в бетоне. М.:Стройиздат,1985.
3. Davlyatov S. M., Makhsudov B. A. Technologies for producing high-strength gypsum from gypsum-containing wastes of sulfur production-flotation tailings //ACADEMICIA: An International Multidisciplinary Research Journal. – 2020. – Т. 10. – №. 10. – С. 724-728.
4. Akramov H.A. Makhsudov B.A. The performance of chemical additives and the effect on the properties of concrete // Theoretical & Applied Science: International Scientific Journal -2021 C. 1177-1180
5. ГОСТ 24211-2003. Добавки для бетонов и строительных растворов. Общие технические условия.
6. Shakirov T. T. POROUS AGGREGATE FOR LIGHTWEIGHT CONCRETE BASED ON QUARTZ PORFIRE AND CARBON MINING WASTE // CHEMISTRY AND CHEMICAL TECHNOLOGY: ACHIEVEMENTS AND PROSPECTS. - 2018 .-- S. 528.1-528.4.
7. О.Б.Тараканов “Химические добавки и растворы и бетоны” Пенза. ПГУАС 2016.