

## THE EFFECT OF COMPLEX ANTI - FROST ADMIXTURES ON CONCRETE PROPERTIES

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Today, the demand for energy resources and the constant increase in their cost are of great importance in the development of the global building materials industry. The need to introduce energy-saving materials and technologies is increasing. In modern construction practice, concrete occupies a special place as the main structural material of buildings and structures.

In the world's leading scientific laboratories, research is being conducted to create new methods for ensuring the strength of concrete at cold temperatures. In particular, it is necessary to develop effective compositions of heavy concrete in cold temperatures to ensure the strength of monolithic reinforced concrete structures. These issues will ultimately allow to increase the design strength of concrete, ensure the durability of buildings, reduce cement consumption and increase economic efficiency in construction.

Large-scale research and measures are being carried out to develop the building materials industry of the Republic of Uzbekistan, effectively use existing types of building materials, properly organize the concreting process and improve the properties of concrete in temperature conditions. Within the framework of these measures, such tasks as "Doubling the production volume of building materials" and "Introducing innovative energy-efficient technologies" are envisaged. For the successful implementation of these tasks, scientific research aimed at developing effective compositions of heavy concrete for the winter concreting process using local raw materials and their production technology is of great importance.

### **Strength of concrete in cold conditions**

Concrete, especially in winter, can face significant problems in cold weather conditions due to its physical and chemical properties. The effect of cold on the structure of concrete depends on conditions such as low temperatures, atmospheric humidity, dryness, and wind speed. These factors can compromise the expected strength and durability of concrete.

occurs through a chemical reaction between water and cement, a process called "hydration". At cold temperatures, the hydration process is slowed down, which negatively affects the tensile properties of concrete. If the temperature is below 5 °C, the hydration process may not be complete, which slows down the process of building up the strength of concrete. Also, at cold temperatures, the functionality of cement and the agglomeration process are complicated, which can affect the movement of fluids and aggregates, which are important for high tensile strength within concrete. If these processes are disrupted, the strength and service life of concrete can be negatively affected.

The freezing process of water inside concrete can cause major problems. When water freezes, it expands, which increases the pressure inside the concrete. As a result, increased pressure can reduce the strength of the concrete and cause deformation. Repeated freezing and thawing processes can cause micro-level damage and also cause changes in the strength of the concrete.

Complex additives designed to protect concrete from frost are important in maintaining the quality of building materials and ensuring their long-term performance. These additives are mainly aimed at protecting concrete from freezing, increasing its strength, strengthening its structure and reducing water permeability. Let's take a closer look at these tools .

**Antifreeze additives.** Antifreeze admixtures, when added to concrete, help lower the freezing temperature and increase the efficiency of the hydration process. Their main function is to prevent freezing and maintain the fluid balance within the concrete.

- Antifreeze admixtures, such as sodium nitrate ( $\text{NaNO}_3$ ) and calcium nitrate ( $\text{Ca}(\text{NO}_3)_2$ ), lower the freezing point of water in concrete. These chemicals combine with their hydraulic properties to slow the freezing process of liquids. This allows the liquids to remain in place and the hydration process to occur at an optimal temperature.
- Antifreeze additives are mainly used in areas where the expected cold temperature is below  $0^\circ\text{C}$  . They are required in areas where construction work is carried out in the winter. These additives accelerate the hardening process of concrete in cold conditions and have a positive effect on strength.

**Polymer aqueous emulsions.** Polymer aqueous emulsions play an important role in increasing the hardness and improving the deformation resistance of concrete. These emulsions reduce the water permeability of concrete and ensure its long-term performance.

- Polymers, such as vinyl acetate or acrylic esters, when added to concrete structures, form strong binders. These binders fill the voids within the concrete , resulting in a water-resistant and strong concrete structure. Polymers form strong binders, improving the mechanical and physical properties of concrete , as well as increasing its resistance to deformation.
- and coating works in winter or wet weather conditions . They are also used in the preparation of asphalt concrete and prefabricated structures. Polymer emulsions provide opportunities to improve the quality and level of perfection of concrete.

**Black granulated materials.** Black granulated materials, such as basalt, graphite, or other natural materials, help strengthen the internal structure of concrete. These materials increase the density of concrete and reduce the risk of damage in cold conditions.

- The specific properties of black granulated materials are that when mixed with concrete materials, they enhance the densification process and increase internal strength. They provide a strong microstructure and lead to significant changes at the surface level. These granulations are especially necessary in cases of significant loads and impacts, such as in marine and winter conditions.

• Black granulated materials are used in the effective construction of heavy-duty and cold-weather construction projects, such as bridges, highways, and railways, as well as engineering structures. They are also widely used in various infrastructures, such as culverts, sewer systems, and other areas.

**"Concrete Strong 17" superplasticizer**. Such superplasticizers play a very important role in improving concrete. The superplasticizer "Beton Strong 17" mainly consists of the following components:

- **Polymers:** Large molecular structures, such as polyacrylamide or polyvinyl alcohol, interact with the fluidity of the concrete mix, helping to improve fluidity.
- **Surfactants:** They reduce the surface area of a liquid and reduce the adhesion of liquids to each other.
- **Particles:** There may be other additives, such as gypsum, solids, etc.

These superplasticizers are mainly used for the following purposes:

- When added to concrete mix, it improves the consistency of concrete and also reduces water consumption. This reduces the negative impact of excess water on concrete quality.
- A superplasticizer adds fluidity and plasticity to concrete, making it easier to mix and work.
- They increase the density of concrete and improve its strength. They solve the problem of low mobility (segregation) in concrete, which makes structures easier and allows for faster and more efficient production.

The importance of superplasticizers in construction consists of the following aspects:

- Concrete prepared with superplasticizers is more resistant to additional stress and strain, which ensures long-term performance of the structure.
- Concrete produced with their help can have a smooth and uniform surface, which satisfies aesthetic requirements, for example, in architectural design.
- for reduced water consumption, energy savings, and rational use of resources, which increases the efficiency of the construction process.
- Superplasticizers make the concrete mix more fluid, which makes it easier to pour and reduces production times.
- In some cases, such as when preparing concrete in hot climates or in situations where rapid construction is required, superplasticizers can help with workability.

There are many effective tools for protecting concrete from frost, such as antifreeze additives, polymer water emulsions and black granulated materials. Superplasticizers, such as "Beton Strong 17", are essential to meet the requirements required in the initial construction processes. They not only increase the strength by retaining water in the concrete mix, but also help to make architectural designs more attractive. Each of them, with its own unique mechanism of action, ensures the strength and long-term performance of concrete.

#### List of used literature:

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