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TYPES OF ANTIFREEZE ADDITIVES IN REINFORCED CONCRETE PRODUCTS AND STRUCTURES USING REINFORCEMENT

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Abstract: In the construction of prefabricated monolithic structures, in the production of concrete and reinforced concrete structures at construction sites and landfills, it is possible to monolithize the seams of prefabricated structures, concrete with antifreeze additives despite low temperatures (up to -25 °C). In addition, when concreting in winter, care should be taken when using special types of concrete: those used in high-strength and aggressive environments. It is well known that premature freezing of concrete, as well as the use of certain admixtures, can affect the performance characteristics of concrete, particularly its durability.
Key words: Precast-monolithic, construction, reinforced concrete, reinforced concrete construction, antifreeze, concrete, temperature, freezing.
Аннотация: При строительстве сборно-монолитных конструкций, при производстве бетонных и железобетонных конструкций на строительных площадках и свалках возможна монолитизация швов сборных конструкций, бетона с антифризными добавками, несмотря на низкие температуры (до -25 °C).). Кроме того, при бетонировании зимой следует соблюдать осторожность при использовании специальных видов бетона: применяемых в высокопрочных и агрессивных средах. Общеизвестно, что преждевременное замерзание бетона, а также применение некоторых добавок могут повлиять на эксплуатационные характеристики бетона, в частности на его долговечность.
Ключевые слова: Сборно-монолитное строительство, железобетон, железобетонные конструкции, антифриз, бетон, температура, замерзание.

Monolithic is widely spread in modern construction technologies in the world. Concreting of monolithic structures is also possible in winter with certain restrictions and recommendations. With the use of additives, concrete and mixtures can be used for: construction of prefabricated monolithic structures, monolithic joints of prefabricated structures in the production of concrete and reinforced concrete structures on construction sites and landfills. Despite the low temperature (up to -25 °C), concrete with some antifreeze additives gradually but systematically gains strength due to the hydration of cement, however, according to a number of authors, cement hydration is not achieved. Occurs at temperatures below zero, and therefore hardening of concrete does not occur. Today, almost any structure can be concreted at sub-zero temperatures. Constructions built in winter can be divided into two groups:

1. The use of thin-walled structures (floor slabs, columns, walls), heating and accelerating additives allows to obtain minimum and in some cases class strength already on the 2nd day.

2. When concreting massive structures (foundation slabs), artificial heating of concrete and exothermic binder can be used, which allows concrete to "self-heat" to a temperature of about 50-60 ^{0}C with proper preparation of forms.

In addition, when concreting in winter, care should be taken when using special types of concrete: those used in high-strength and aggressive environments. It is well known that premature freezing of concrete, as well as the use of certain admixtures, can affect the performance characteristics of concrete, particularly its durability.

The use of antifreeze additives in reinforced concrete products and structures using reinforcement is also limited, because some types of additives (for example, chlorides) can cause corrosion.

Antifreeze additives and their compatibility with other materials. Effect on durability of concrete:

As mentioned above, when concreting with the use of chemical additives, taking into account the field of their application, antifreeze additives are divided into several groups:

- additives (electrolytes, alcohols) that lower the freezing point of free water in concrete and have a slight effect on the hardening kinetics of concrete.
- additives (potassium, chlorides, nitrates, nitrites, urea) that have the properties of antifreeze and are able to accelerate the hardening and hardening processes of cement.
- substances that have weak antifreeze properties, but accelerate the hardening and hardening of cement; at the same time, such additives cause strong heat generation and hardening of concrete at the initial stage of setting the concrete mixture (iron III and aluminum sulfates).
- in modern conditions, you can often find complex antifreeze additives based on a plasticizer with antifreeze and accelerator properties, which allows to simplify the technological process of concrete mixture production to some extent due to the use of one additional dispenser.

Accordingly, today it is possible to distinguish many different materials used for the production of antifreeze additives (AA) (Table 1).

Table 1

Types of substances used in the production of AA:

Substance	**Designation**	**Chemical formula**
Sodium chloride	NaCh	NaCl
Sodium nitrite	NaN	$NaNO_2$
Sodium nitrate	NaN	$NaNO_3$
Sodium formate	NaF	NaCOOH
Sodium acetate	NaA	CH_3COONa
Potass	P	K_2CO_3
Ammonium hydroxide	AG	NH_4OH
Ammonium nitrate	AN	NH_4NO_3
Calcium chloride	CaX	$CaCl_2$
Calcium nitrate	CaN	$Ca(NO_3)_2$
Calcium formate	CaF	$Ca(HCO_2)_2$
Urea	U	$CO(NH_2)_2$
Calcium nitrite-nitrate	KNN	$Ca(NO_2)_2$+$Ca(NO_3)_2$
Ammonia	A	NH_3
Sodium thiosulfate and radonite		$Na_2S_2O_3$,NaSCN
Calcium thiosulfate and radonite		$Ca_2S_2O_3$,$Ca(SCN)_2$

Additives based on these substances have different effects on the properties of the concrete mixture and the durability of concrete. Depending on the composition of the cement, the type of

filler and, first of all, the working environment, it is recommended to use one or another antifreeze additive or a combination with other additives (plasticizer, air permeable).

Since many antifreeze additives are setting and hardening accelerators, a number of problems can be encountered in maintaining the workability of concrete or mixtures. To smooth out this effect, as well as to increase performance, many supplement manufacturers recommend the use of built-in fillers.

In modern conditions, plasticizing additives are almost always used in the production of concrete and reinforced concrete structures. Often, antifreeze additives are well compatible with plasticizer additives and do not cause deterioration of the properties of the mixture, but before using any complex, it is necessary to check the compatibility of the additives in each specific composition.

In some cases, air-entraining additives are added to the mixture (for example, to increase frost resistance, to prevent delamination and plasticization), and such additives are usually well compatible with antifreeze additives. Currently, there are many manufacturers of additives for concrete and mixtures on the market, and almost each of them has a complete set of additives for different purposes. Based on this, additives from the same manufacturer are usually completely compatible.

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