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USAGE OF CONCRETE ADDITIVES CEMENT SETTING RETARDERS ON THE COLD JOINT OF CONCRETING

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Continuous concreting in the production of concrete work can not always be ensured. Therefore, during breaks, due to both technological and organizational factors, arrange cold joint. One of the possible technological solutions in such cases may be the introduction of setting retarder into the concrete mix.

To ensure solidity, the process of concrete casting must be conducted continuously. However, this is possible with minor amounts of work and for the construction of relatively simple carcass. But in other cases it is difficult to avoid breaks in the laying of the concrete mix, and therefore on construction sites are forced to resort to the device, the so-called "cold joint".

Their device is associated with certain difficulties and requires additional expenditures of working time, as for reliable adhesion of a new concrete with an old one, it is necessary to treat carefully the surface of previously laid concrete [1]. All this complex of works can be avoided if you conduct concreting continuously or with such breaks during which the process of setting the previously laid mixture has not yet begun.

One of the possible technological solutions in such cases may be the introduction of retarders and hardening of concrete into the concrete mix. Such a reception should be carried out taking into account the intensity of concrete work and the supply of concrete mix to the place of installation. Another important direction in the use of setting retarding agents is related to the need of transporting the concrete mixture over long distances, as well as preservation of the technological properties of the mixtures in the case of forced breaks during concrete work.

The mechanism of action of additives-retarders setting and hardening of concrete [2, 3] is to slow down the hydration and hydrolysis of clinker minerals, i.e., causes a delayed release of free lime into the solution and slows down the processes of coagulation and the convergence of grains of cement and its hydrated newgrowths. As a result, the intensity of the setting of clinker cements slows down. Setting of cement paste can be slowed down and as a result of the action of additives that, without interfering with the hydration and hydrolysis of the clinker minerals, quickly bind free lime released from C_3S (tricalium silicate). Retardation is also caused by the influence of individual electrolytes, which, depending on their content in the water-cement paste, can prevent the coagulation of the colloidal groutand hydrated newgrowths. According to the requirements of reliability, setting retarder should increase the time of slump loss of the concrete from the initial value to 2 cm 2 times or more (at an ambient air temperature (20 ± 2) ° C). For additives that slow down the curing of concrete and mortar, the criterion is the reduction of concrete strength by 30% or more in the age of up to 7 days. At the same time, at project age, after 28 days, the strength of concrete increases and the transmissibility decreases [4].

Retardation of saccharine on the cement setting process is due to its interaction with hydrate of lime, formed during the hydrolysis of tricalcium silicate. At the same time, firstly, for some time a supersaturated hydrate of lime solution does not form, which slows down the process of crystal formation; secondly, colloids of tricalcium sugars form a long-existing coagulation structure with thixotropic properties. Over time, due to the creation of a supersaturated $Ca(OH)_2$ solution in the water-cement paste, crystallization processes begin, and the colloids age irreversibly (the syneresis of the colloids), dehydrate and compact. Both of these processes proceed simultaneously and lead to the creation of a crystallization-coagulation structure, which imparts the properties of a solid body to the water-cement paste [5]. An effective set setting retarder at a temperature of 90 ... 160 °C is a concrete of apple acidand sodium dichromate.

Construction practice has some experience in the use of the following types of retarders for setting and hardening concrete and mortar mixes (Table 1).

In addition to those specified as additive retarders for concrete mixtures and concrete hardening, medium- and slightly plasticizing additives of increased concentration can be used. Setting retarders are quite effective in small concentrations, while the slower setting is caused by the adsorption of additives on cement hydration products, especially hydrate of lime $Ca(OH)_2$ (slaked lime), as well as on the surface of the raw non-hydrated minerals. Most of the introduced retarding agent is spent on aluminate phases of cement, therefore the effect of retarder is more pronounced in low-aluminate cements, as well as in cements with a minimum content of alkalis, since the latter destroy the retarder. It should be borne in mind that in many cases slowing the concrete setting based on Portland cement is a side effect of the introduction of other targeted additives, and their effect

may be very significant. For example, setting up time retardation may be the result of the introduction of water reducing admix, water-retaining and thickening agents, etc. [6]

Table 1. – Additives retarders setting and hardening

Additive	General characteristics	Gauging	Advantages and disadvantages	Application area
1	2	3	4	5
Nitrilotrimethyl phosphonicacid	White crystalline powder.	0,02...0,15% masses of cement.	Advantages: – easily soluble in water and not soluble in organic solvents. – additive is effective for all types of cement, including high-alumina. – has a plasticizing effect. – does not cause corrosion of reinforcement. – low toxicity. – low cost. Disadvantages: – overdose may provoke cement strength degradation	– production of site concrete in a dry hot climate. – construction of massive monolithic construction. – to ensure good joining of concrete laid at different times. – preparation of concrete transported over long distances.
Mother liquor production nitrilotrimethylphosphonic acid RCB-500	Powder.	0,02...0,15% masses of cement.	Advantages: – has a plasticizing effect. – does not cause corrosion of reinforcement.	- apply in monolithic construction. -for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances
Sugarmolasses	A thick, viscous liquid of dark brown color.	0,05...0,3% masses of cement.	Advantages: – it is well dissolved in water. – there is a slow development of strength in concrete and matrix up to 7 days old. – has a plasticizing effect. Disadvantages: – do not apply to prefab reinforced concrete.	- apply in monolithic construction. - concreting massive structures. -for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances in a dry hot climate.
Milkserum	Yellow liquid.	1,5...3% masses of cement.	Advantages: – It has a strong inhibitory effect when added directly to the concrete. – has a plasticizing effect. – does not cause corrosion of reinforcement. – does not reduce the freeze-thaw resistance.	- apply in monolithic construction. -for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.

Continued Table 1

1	2	3	4	5
Sodiumgluconate	Finely crystalline powder or granules from white to brown.	0,05...0,25% masses of cement.	Advantages: - possesses the plasticizing and water-retaining action. - completely biodegradable. - let's well dissolve in water.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.
Sulfiteyeastmash	Viscous dark brown liquid or dark brown solid mass.	0,1...0,6% masses of cement.	Advantages: - has a plasticizing effect. - it is well dissolved in water. Disadvantages: - do not use in the manufacture of prestressed structures. - concrete strength reduction. - low toxicity.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.
Ethyl- or methyl Siliconate Sodium	Transparent liquids from pale yellow to brown.	0,05...0,15% masses of cement.	Advantages: - has a plasticizing effect. Disadvantages: - Do not use in the manufacture of prestressed structures.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.
sulfite-celluloseliquor	Liquid consistencyand solid.	0,1...0,6% masses of cement.	Advantages: - has a plasticizing effect. - it is well dissolved in water.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.
Additives of foreign manufacturers				
Addiment VZ 2		0,2...0,7% masses of cement.	Advantages: - has a plasticizing effect. - does not cause corrosion of reinforcement.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances. - for operation at high temperatures. -used for prestressed concrete.

End Table 1

1	2	3	4	5
Addiment VZ 6		0,2..1,7% masses of cement.	Advantages: - has a plasticizing effect.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.
Peramin R	Clearsolution	0,2…1,0% masses of cement.	Advantages: - has a plasticizing effect. - does not cause corrosion of reinforcement.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.
Pozzolith 100-XR	Liquid from brown to black.	0,2…0,3% masses of cement.	Advantages: - has a plasticizing effect.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.
Cementol Retarde		0,2…0,8% masses of cement.	Advantages: - has a plasticizing effect.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.
Sika Retarder	Yellowish brown liquid.	0,2…2,0% masses of cement.	Advantages: - has a plasticizing effect. - compatible with all types of Portland cement, including slag Portland cement.	- apply in monolithic construction. - for ensuring good joining of concrete laid at different times. - preparation of concrete transported over long distances.

The mode of its administration also affects the retarding ability of an organic compound. If the setting retarder is introduced into the concrete after 2 ... 4 minutes after mixing, the setting time is extended by 2 ... 3 hours compared with the time obtained with the introduction of the modifier with mixing water. The most widely used in practice are slow-acting hydrocarbon acids or their salts, such as citrates or heptonates, as well as calcium or sodium lignosulfonates. [7]

The effect of these setting retarder on the strength and longevity of concrete, depending on the kinetics of the formation of a cement stone structure in their presence and on their participation in chemical reactions, cannot be predicted. Therefore, the content of setting retarder in concrete or matrix is established experimentally with simultaneous testing of compressive strength in accordance with the requirements of current regulatory documents.

REFERENCES

1. Шпилевская, Н.Л. Разработка организационно-технологической документации на бетонирование массивных фундаментных плит / А.П. Шведов, Н.Л. Шпилевская // Вестн. Полоц. гос. ун-та. Сер. F, Прикладные науки. Строительство. – 2018. – С. 55–62.
2. Обзор замедлителей схватывания бетонного раствора. [Электронный ресурс]. – Режим доступа: http://cemgid.ru/obzor-zamedlitelej-sxvatyvaniya-betonnogo-rastvora.html. – Дата доступа: 10.01.2019.
3. Справочник строителя. Добавки, регулирующие схватывание и твердение. [Электронный ресурс]. – Режим доступа: http://baurum.ru/_library/?cat=additives_adjusting_firm&id=321-. – Дата доступа: 10.01.2019.
4. Кадирова, Д.Ш. Добавки к растворам и бетонам : консп. лекций / Д.Ш. Кадирова. – Ташкент : Ташкент. архитектурно-строит. ин-т, 2015. – 173 с.
5. Батраков, В.Г.Модифицированные бетоны. Теория и практика / В.Г. Батраков. – 2-е изд. – М., 1998. – 768 с.
6. Корнеев, В.И. Ускорители и замедлители схватывания и твердения цементных сухих строительных смесей / В.И. Корнеев // Конференция BALTIMIX. Доклады, 2003.
7. Тейлор, Х. Химия цемента / Х. Тейлор ; пер. с англ. – М. : Мир, 1996. – 560 с.