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STUDY OF HEAT DISSIPATION PROPERTIES OF CEMENT STONE IN FINE-GRAINED CONCRETE

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ABSTRACT

This article describes the thermal insulation property of cement stone in fine-grained concrete. The water demand of cement stones based on fly-ash and chemical additives is small, therefore, according to the law and depending on the nature of additives, the heat release from cement stone is reduced.

The demand for energy resources in the world and the continuous growth of their cost require the introduction of energy-efficient materials and technologies, especially in construction. In this regard, it is important to increase the production volume of concrete used for the construction of buildings and structures in developed countries, including countries such as the USA, Germany, Japan, China, and Russia, to use industrial waste in production, to optimize the composition and properties of fine-grained concrete, to reduce their cost and to increase their efficiency. is gaining importance [1].

The heat release process that occurs during the hardening process of binders in fine-grained concrete is of great importance in large-scale concreting works. The heat release properties of cement stone depend primarily on its mineralogical composition, the duration of the hydration process, the softness of the aggregate, the amount of water added for mixing, and the ambient temperature.

The heat release properties of cement stone in fine-grained concrete during the hardening process are characteristic not only of cement, but also of the prepared concrete mixture, and depend on a number of factors: cement consumption, water-cement ratio, concrete mix mobility, hardening temperature, and other factors. The results of research conducted at the Leningrad Polytechnic Institute [1] at the Department of Building Materials show that the heat release from 1 m^3 of concrete (cal/g) is linearly dependent on the cement consumption and the mobility of the mixture. Compared to Portland cement-based mixtures with the same mobility, concrete mixtures based on fly ash and plasticizer chemical additives have a lower water requirement, therefore, according to the law and depending on the nature of the additives, the heat release from the mixture decreases. This is also confirmed by the results of research conducted by V.V. Stolnikov on the heat release in Portland cement and fly ash-based concrete

[2]. According to the results of this research, when part of the cement was replaced with fly ash, the heat release during concrete hardening decreased significantly.

In our research, the heat release during hydration of fine-grained concrete mixtures based on Portland cement, fly ash and MEGAPLAST SC-7 PC-08 superplasticizer was determined, depending on the homogeneity and amount of the additive.

In this case, GOST 310.5-80. Cements. Heat release during cement hydration was determined by the thermos method for determining the heat of hydration. The tests were carried out on a mixture based on cement-ash-additive with a composition of 1:2 (binder-marble processing waste), the duration of the tests was 7 days [3].

Water was added to the mixture in an amount of 2% more than required for mixtures of normal viscosity with a viscous consistency. The characteristics of the mixtures used in the research are given in Table 1.

Table 1

It was used to determine the heat release property description of cement stone

Compositions t/r	The content of binders, by mass, %			Mixture composition, by mass (binder-marble processing waste)	Water/ cement
	Portland cement	Fly ash	MEGAPLAST SC-7 PC-08 (in liquid form)		
1	100	-	-	1:2	0,39
2	85	15	2	1:2	0,40
3	80	20	2	1:2	0,40

Table 2 (see Figure 1) shows the results of heat release during hydration of Portland cement and cement-ash-additive based binders.

It can be seen that the addition of fly ash to Portland cement used for fine-grained concrete reduced heat release. Increasing the amount of fly ash decreased the heat release index. The hydraulic activity of fly ash-based portland cement has a significant effect on its heat release index [4].

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Figure 1. A sheet of experimental work

In experimental studies, when 20% of Portland cement was replaced with fly ash, the heat release was significantly reduced. However, the hydraulic activity of fly ash did not significantly affect the heat release parameters of Portland cement at a 5-day period. This effect became more noticeable at later stages of the mixture's hardening.

Table 2

During the period of hydration of the binders heat dissipation indicators

Duration of test work, hours	1 gram (cal/g) of binder for compositions, heat release rates of hydration for a given fraction of time		
	1	2	3
0	-	-	-
5	36	31	29
15	38	35	31
24	41	38	36
48	52	46	43
72	62	52	48
96	71	59	53
120	75	63	58
144	79	66	61
168	83	70	62

In the research work, when the concentration of $Ca(OH)_2$ reached a certain value, an active interaction of fly ash with it occurred, which resulted in the activation of the ash. These particles interacted primarily with $Ca(OH)_2$, which is released during the hydration of clinker

minerals. Heat was released in the reaction. First of all, the main role in the release of heat is played by the constituents of cement, and by replacing part of it with ash, the cement consumption was reduced, and as a result, heat release also decreased [4].

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