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MOISTURE LOSS FROM FRESHLY LAID CONCRETE DEPENDING ON THE TEMPERATURE AND HUMIDITY OF THE ENVIRONMENT

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Abstract. *This article highlights the issues of studying moisture loss from freshly laid concrete depending on the temperature and humidity of the environment, presents the results of studies of various film-forming compositions used to protect freshly laid concrete from moisture loss.*

Keywords: *climate, temperature, humidity, concrete, cement, film-forming compounds, water- cement ratio, loss of kinetics, protection.*

INTRODUCTION

Areas with a dry and hot climate are characterized by low relative air humidity in the daytime (up to 15-30%) and high temperatures exceeding 40 ° C in the shade. At the same time, cyclic changes in relative air humidity during the day reach 70% or more, and daily temperature drops on the surface of structures heated during the day by direct solar radiation lie in the range of 30–50°C [1].

The process of dehydration of hardening concrete in a dry and hot climate at an early age is the most characteristic feature of keeping it in an environment with high temperature and low humidity. Therefore, the question of studying the intensity of concrete dehydration and the time of stabilization of moisture loss, i.e. the study of the kinetics of moisture loss is important for creating favorable temperature and humidity conditions for curing concrete [2].

RESEARCH MATERIALS AND METHODOLOGY

In these studies, the question of the influence of changes in temperature and humidity conditions on the moisture-proof properties of film-forming materials was studied.

The main studies were carried out on heavy concrete of class B 25 (corresponding to grade M300) of the following composition: 1:2.25:3.38. The water-cement ratio of the concrete mixture was 0.57; cone draft 4-5 cm (concrete of such grades and composition is widely used in Central Asia in the construction of engineering structures and industrial buildings). And preliminary studies were carried out on samples prepared from a cement-sand mortar with W/C = 0.45. The composition of the sand-cement mortar was adopted as 1:3, since studies have shown that a change in the proportion of sand does not have a noticeable effect on the kinetics of moisture loss and this composition is most often used in construction.

As a binder in the preparation of concrete and cement-sand mortars, Portland cement grade M400 from the Kuvasay cement plant (Uzbekistan) was used with the following characteristics: normal density 25.87; the beginning of setting - 2 hours 34 minutes, the end of setting - 3 hours 50 minutes. Mineralogical and chemical composition of cement are given in tables 1 and 2.

Table 1

Mineralogical composition of Portland cement

Manufacturer	Content, in %			
	C_3S	C_2S	C_3A	C_3AF
Kuvasay cement plant	56	16	7	16

Table 2

Chemical composition of Portland cement, in %

SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	SO_3	K_2O	Na_2O	Пппп
227,62	33,07	66,88	53,11	5,07	3,46	0,70	0,41	00,48

Granite crushed stone with a fraction of 5–20 mm was used as a coarse aggregate, and quartz river sand with a fineness modulus of 1.8–2.0 was used as a fine aggregate.

The following compositions were taken as the main film-forming materials for research:

- water-soluble composition (WRC) based on acetone-formaldehyde resin [3];
- water-dispersed composition (WDC) based on styrene-butadiene latexes BS-85M and BS-60M [4];
- composition (CP) based on lacquer brand HP-734 - a solution of chlorosulfonated polyethylene in xylene (solvent, toluene, stabilized with epoxy resin) [5].

RESULTS OF THE STUDY

The research was carried out in the following way. Samples-cubes, 150x150x150 mm in size, were prepared from a cement-sand mortar. Film-forming materials were applied to the surface of freshly prepared samples with a paint sprayer (consumption 400 g/m2). The prepared figurines were placed in various conditions of keeping - in a climatic chamber with t=60°C and =30%; and with t=40°C=30%; into the chamber of normal hardening (t=20°C; =95-98%).

The kinetics of moisture loss in the samples was studied by the following new method.

This technique allows studying the effect of film-forming materials on the kinetics of moisture loss and consists in determining moisture loss for a given time from cement-sand mortar samples after applying film-forming materials to their surface.

To study the kinetics of moisture loss from the cement-sand mortar, the samples are weighed after 1, 2,...,7 and 24 hours after applying the film-forming material and placing them in the holding chamber. Calculation of moisture loss kinetics is carried out according to the following formulas:

Mixing water losses from samples of cement-sand mortar when using a film-forming material (FP) are determined by the following formula:

$$B_{п} = \frac{m_{п}}{b+g} * 100\% \quad (1)$$

where mp is the loss of mixing water from the samples after applying the film-forming material, in g

$$m_п = a_1 - a_7 - g \quad (2)$$

$a_1 -$ sample weight after applying the film-forming material, in g;

$a_7 -$ sample weight at the time of moisture loss determination, in g;

$7 -$ time for determining moisture loss, h;

$g -$ the amount of water (solvent) contained in the film-forming material, in g;

$b -$ the amount of mixing water in the sample, in g;

$$b = \frac{(a_0 - P - \Phi) * V}{100} \quad (3)$$

$a_0 -$ weight of the sample before applying the film-forming material, in g;

V- the amount of mixing water in the formulation of the cement-sand mortar, in%

$P -$ weight of paraffin embedded along the edges of the sample, in g;

$\Phi -$ weight of the form, in g.

For control samples, the mixing moisture loss (B) is determined by the formula:

$$B = \frac{m}{b} * 100 \quad (4)$$

Where $m -$ mixing water losses from samples (without film-forming material, in g)

$$m = a_{1-a_7} \quad (5)$$

The results of the calculation were entered into a table and a graph of moisture loss from the cement-sand mortar was plotted depending on the time and conditions of exposure, as well as the type of film-forming material. The technique makes it possible to study the kinetics of moisture loss of a cement-sand mortar, when using film-forming materials as moisture-proof coatings.

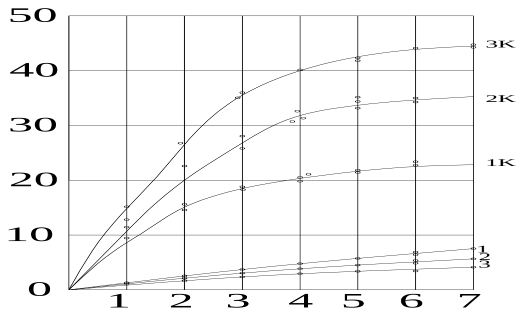

Fig.1. Kinetics of moisture loss from concrete samples depending on the temperature and humidity conditions of keeping

1k, 2k and 3k samples without coating;

1, 2 and 3 - samples under VRK, VDK, KhP;

1 and 1 k - chamber of normal hardening;

2 and 2 k - climatic chamber /t=40°C; φ =30%/,

3 and 3 k - climatic chamber /t=60°C; φ =30%/.

From the graphs in Fig. 1 it can be seen that the protective ability of the compositions with an increase in temperature and a decrease in the humidity of the environment deteriorates somewhat.

The value of moisture loss from the samples was determined after 7 hours of exposure. Table 3 shows the results of determining the influence of temperature and humidity conditions on the protective ability of film-forming materials.

Table 3

Influence of temperature and humidity conditions on the protective ability of film-forming materials

№	Compositions	Moisture loss, % after 7 hours of storage in the chamber		
		normal hardening t=20°C, φ =95-98%	Climatic	
			t=40°C, φ =30%	t=60°C, φ =30%
1	VRK	3,00	4,60	6,71
2	VDK	3.49	5.02	6.60
3	HP	3.01	4.10	6.29
4	Concrete without care	22.79	35.66	44.00

From the data given in the table, it can be seen that with an increase in the holding temperature, the protective ability of the film-forming materials deteriorates. However, this deterioration is within the permissible norm of moisture loss (up to 10%). At the same time, significant moisture losses are observed in untreated concrete: with normal hardening 22.79%, in the climatic chamber 33.66 and 44%.

CONCLUSION

According to moisture loss, one can judge the strength of concrete. When using film-forming compounds in concrete, cement hydration occurs under favorable conditions, which contributes to the achievement of grade strength. In the absence of care in concrete as a result of significant moisture loss, cement hydration decreases, resulting in a decrease in strength (sometimes up to 50%) [6].

Analyzing the results of experimental studies, it can be concluded that with an increase in the holding temperature, the protective ability of film-forming materials deteriorates, but the amount of moisture loss does not exceed the permissible value.

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