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Effects Of A Dry Hot Climate And Salt Aggression On The Permeability Of Concrete

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ABSTRACT

The article presents the results of studies carried out to determine the capillary absorption (Wvs) of a saline solution during evaporation and to establish a cyclic temperature regime. It has been established that for a reliable assessment of the capillary permeability of concrete in a dry hot climate, it is sufficient to subject the samples to 60 cycles of preliminary alternating heating and cooling, followed by testing in a climatic chamber for capillary absorption of a salt solution at a temperature of 40 ° C and a relative humidity of 30%.

KEYWORDS

Salt aggression, dry hot climate, method of testing concrete for capillary permeability, cyclic temperature conditions, saline solutions, capillary absorption index.

INTRODUCTION

In world practice and in the republic, there is an urgent direction to provide the construction industry with high-quality materials and structures, including those that increase the corrosion resistance of buildings, structures and its structures, especially in conditions of the impact of salt aggression, which is most significant for the republic. As you know, the corrosion resistance of concrete cement stone depends, on the one hand, on the chemical resistance of its constituents in relation to an aggressive agent (for example, SO42- ion), and on the other, on the rate of penetration of the solution of this aggressor into the cement stone [1].

Under the conditions of corrosive action of aggressive salt media on cement concrete, it is especially important to quickly assess the capillary permeability of concrete under conditions of evaporation and absorption of

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saline water, as well as to predict the salt resistance of concrete. However, to date, the existing methods are imperfect, which in practice creates difficulties in assessing the comparative efficiency of the use of various compositions or technological methods for preparing concrete to increase its salt resistance [2].

When exposed to a salt aggressor and active evaporation of saline solutions in a dry hot climate of the republic, when assessing the capillary permeability of a cement stone, the need to take into account the climatic effect is dictated.

According to the author, the test method for capillary suction of a salt solution during evaporation should take into account the occurrence of additional defects in the structure of concrete when the samples are kept in a dry hot climate and ensure that the temperature and relative humidity are consistent with climatic factors. In this case, concrete samples should be tested, and not mortar (due to distortion of the results of determining capillary permeability).

Method for testing concrete for capillary permeability. Comparative experiments.

In order to substantiate the method of testing concrete for capillary permeability during evaporation of saline solution, comparative experiments were carried out using 4x4x4x16cm beams made of concrete and its mortar part. Samples were made from a concrete mixture with a mobility of O.K. = 2 cm. Cement consumption 290,360,430 kg / m3 and W / C equal to 0.61; 0.51; 0.45 with the ratio of the components (C: P: U): 1) 1: 2.31: 4.57; 2) 1: 1.72: 3.41; 3) 1: 1.26: 2.50.

Mortar mixtures of composition (C: P) 1) 1: 2.31; 2) 1: 1.72; 3) 1: 1.26 with a mobility of 2 cm at a W / C equal to 0.5; 0.47; 0.45.

The technique is based on assessing the ability of concrete to absorb a saline solution in direct contact with the surface of a liquid aggressive medium after cyclic temperature exposure to 4x4x4x16cm beam specimens and stabilization of the defectiveness of its structure. [1-7].

In accordance with this method, the determination of the value of capillary suction is carried out in the following test mode: 8 h blowing with warm air and 16 h - cooling in a climatic chamber (the accepted differences are necessary for phase transitions of salt solutions in the zone of the evaporating surface of the samples).

The amount of aggressive solution absorbed by the concrete sample for a certain period of time (Wws,%) is taken as the indicator of capillary absorption.

The criterion for assessing the defectiveness of the structure was the porosity of concrete samples.

The above technique applies to the assessment of the capillary permeability of concretes prepared on Portland cements according to GOST requirements under conditions of contact with an aggressive mineralized medium in the presence of an evaporating surface.

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Using this technique, in a short period of time, it is possible to establish the effectiveness of various technological factors to increase the resistance of concrete under conditions of capillary absorption of salt solutions, in particular, the role of the mineralogical composition of cement, the composition of concrete, the type of chemical modifier, the initial density of concrete, aggregates. [1-10].

DISCUSSION OF EXPERIMENTAL RESULTS

As expected, the highest capillary absorption (Wws) of the saline solution during evaporation occurs at 40 ° C and a relative humidity of 30%, regardless of the type of cement.

The dependence of the capillary absorption of concrete at a 5.5% sodium sulfate solution is shown in Table 1.

Dependence of capillary absorption of concrete at 5.5% sodium sulfate solution on the number of cycles of preliminary temperature exposure to samples

Table 1

Cement consumption, kg / m3	$W_{вс}$, % after exposure to temperature, cycles				
	0	20	40	60	80
290	$\frac{3,61}{100}$	$\frac{3,46}{90}$	$\frac{4,04}{112}$	$\frac{4,40}{122}$	$\frac{4,43}{123}$
360	$\frac{3,12}{100}$	$\frac{2,96}{95}$	$\frac{3,68}{118}$	$\frac{4,05}{130}$	$\frac{4,08}{131}$
430	$\frac{2,54}{100}$	$\frac{2,36}{93}$	$\frac{3,17}{125}$	$\frac{3,50}{138}$	$\frac{3,54}{139}$

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Dependence of capillary absorption of concrete in a sulfate-chloride solution after preliminary temperature exposure to samples

Table 2

Cement consumption, kg / m3	$W_{вс}$, % after exposure to temperature, cycles				
	0	20	40	60	80
2,5 % + 4,5%					
290	3,87 / 100	3,75 / 97	4,41 / 114	5,01 / 129	5,03 / 130
360	3,23 / 100	3,03 / 94	3,84 / 119	4,41 / 137	4,44 / 130
430	2,61 / 100	2,40 / 92	3,31 / 127	3,74 / 143	3,77 / 144
5,5 % + 5,5 %					
290	4,05 / 100	3,97 / 98	4,66 / 115	5,21 / 130	5,25 / 131
360	3,42 / 100	3,25 / 95	4,10 / 120	4,72 / 138	4,75 / 139
430	2,70 / 100	2,57 / 93	3,53 / 128	3,91 / 145	3,94 / 146

The preliminary cyclic thermal effect contributes to the growth of Wvs of the solution by 21-36%, and of concrete by 24-41%, which is probably associated with an increase in internal temperature stresses arising in concrete and, therefore, a large defectiveness of its structure. [5-10].

The influence of the preliminary cyclic temperature effect on concrete samples is enhanced when tested in sulfate-chloride solutions. With the complication of the

composition of the saline solution, Wvs increases by 30-46%.

The complication of the composition of the saline solution and the increase in the concentration of ions stimulate the process of capillary absorption, and the preliminary

cycling effect on the samples makes this difference even more noticeable.

The established kinetics of capillary absorption when testing concrete according to the adopted method indicates that after 3 months the value of capillary absorption remains practically constant. It was found that Wws of solution samples, depending on the consumption of cement, is 20-33% higher than that of concrete.

SUMMARY

Thus, for a reliable assessment of the capillary permeability of concrete under FLC conditions, it is sufficient to subject the samples to 60 cycles of preliminary alternating heating and cooling, followed by testing in a climatic chamber for capillary absorption of a salt solution at a temperature of 40 ° C and a relative air humidity of 30%.

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