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THE CAPILLARY PERMEABILITY OF CONCRETE IN SALT MEDIA

Abstract: *The article describes a method for testing concrete for capillary permeability. The results of the studies carried out to determine the capillary absorption (Wvs) of the saline solution during evaporation and the establishment of the cyclic temperature regime for the conditions of the dry hot climate of Uzbekistan are presented.*

Key words: *salt aggression, dry hot climate, method of testing concrete for capillary permeability, cyclic temperature conditions, salt solutions, capillary absorption index.*

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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 under the influence of the most significant for the republic complex sulfate-magnesia-chloride aggression of surface and subsoil waters.

Corrosion of concrete can occur due to the decomposition of hydrated clinker minerals in the cement stone, as well as due to the appearance in concrete of internal stresses caused by crystallization of corrosion products in the pores of the cement stone.

The destruction of concrete due to the decomposition of hydrated neoplasms is due to the removal of their dissolved components from the pore fluid, causing an imbalance between the cement stone and its liquid phase.

The corrosion process resulting from the crystallization of corrosion products in the pores of a cement stone is associated with the kinetics of the formation of these products and the properties of the structure they create.

In this case, the corrosion resistance of the concrete cement stone depends both on the chemical resistance of its constituents in relation to an aggressive agent (for example, the SO_4^{2-} ion), and on the rate of penetration of the solution of this aggressor into the cement stone [1].

Aggressive salt medium penetrates into the cement stone through the system of capillary pores in the form of an aqueous solution under the action of the so-called capillary pressure, which reaches especially high values for small pores.

The corrosion resistance of concrete is known to be related to the capillary permeability of the concrete. In this case, the capillary permeability of concrete depends on the cement consumption, the parameters of the pore structure, the composition of the saline solution and the test conditions. The capillary absorption of concrete naturally increases as the composition of the saline solution becomes more complex. This can be explained by a higher concentration of ions in sulfate-chloride solutions and a relatively large accumulation of salts in the pores of the concrete.

Under conditions of the 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 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 [2-7].

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 [8-14].

According to the authors, 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) [15-23].

Method for testing concrete for capillary permeability. Comparative experiments.

In order to substantiate the method of testing concrete for capillary permeability during the evaporation of the saline solution, comparative experiments were carried out using 4x4x4x16cm beams made of concrete and its mortar part. The samples were made from a concrete mixture with mobility of O.K. = 2 cm. Cement consumption 290, 360, 430 kg /m^3 and W /C equal to 0.61; 0.51; 0.45 with a ratio of 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.

Following 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 (W_{ws},%) 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 with Portland cement according to GOST requirements under conditions of contact with an aggressive mineralized medium in the presence of an evaporating surface.

Using this technique, in a short period, 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 [24-27].

The investigated concrete samples of at least three for each composition are formed from a concrete mixture of a laboratory or production composition that meets the requirements of GOST 10181.0-81.

The modes of compaction and hardening are similar to those adopted for the production of concrete and reinforced concrete structures. The test is carried out on specimens-beams measuring 4x 4x 16 cm 28 days after heat and humidity treatment or holding in a normal hardening chamber (at a temperature of 20 ± 3°C and relative humidity of at least 90%). The concentration of an aggressive saline solution is taken depending on the specific operating conditions of concrete and reinforced concrete structures.

Discussion of experimental results.

As expected, the highest capillary absorption (W_{ws}) of the saline solution during evaporation occurs at 40 °C and 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.-Dependence of capillary absorption of concrete at 5.5% sodium sulfate solution.

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

The dependence of the capillary absorption of concrete in a sulfate-chloride solution after preliminary temperature exposure to the samples is shown in Table 2.

Table 2. - Dependence of the capillary absorption of concrete in a sulfate-chloride solution after preliminary temperature exposure

Cement consumption, kg/m³	*W_{ws},% after temperature exposure, 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

At the initial stage of capillary absorption and evaporation of the saline solution, the expansion rate is low (the conditions for the development of maximum hydrostatic pressure values have not been created), then the relative expansion deformations increase. At the same time, the capillary absorption of saline solutions naturally decreases with increasing test duration. At the same time, there is a clear relationship between the relative expansion deformations (ε), the value of the bending strength drop (R_{ben}) and the depth of concrete destruction with capillary permeability (W_{vs}). So the more W_{ws}, the higher ε and the depth of destruction, and the decrease in R_{ben}.

The preliminary cyclic thermal effect contributes to the growth of W_{vs} 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.

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, W_{vs} increases by 30-46%.

Complicating the composition of the saline solution and increasing the concentration of ions stimulates the process of capillary absorption, and the preliminary cyclic 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 W_{ws} of solution samples, depending on the consumption of cement, is 20-33% higher than that of concrete.

The determination of the resistance coefficient is usually calculated from the ratio of the tensile strength of concrete in bending after testing the samples for capillary suction to the tensile strength of concrete in bending after holding the samples under normal conditions at 28 days of age. According to the results of the experiments, it was found that the salt resistance coefficient after one year of testing is generally within the established requirement and is equal to 0.85.

Summary.

Thus, the proposed test method for capillary suction of a salt solution during evaporation makes it possible to take into account the occurrence of additional defects in the structure of concrete when holding samples in a dry hot climate and to ensure that the temperature and relative humidity correspond to climatic factors. 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 relative air humidity of 30%.

References:

1. Bartashevich, A. A., & Rudh, B. V. (1970). Putan LA To the Mechanism of Salt Physical Corrosion. *Protection of Building Structures in Aggressive Environments of Chemical and Petrochemical Industries/St. CBT, M*.
2. Mikhalchuk, P. A., & Ryabchun, S. A. (1988). Nature and rate of corrosion destruction of concrete under conditions of capillary suction and evaporation of highly mineralized media. *ST/NIIZhB, M*, 20-28.
3. Razzakov, S. Zh., Abdullaev, I. N., & Rahmanov, B. K. (2020). Sostavnye komponenty deformirovanija i razrushenija sinteticheskih tkanyh lent dlja gruzozahvatnyh prisposoblenij v stroitel`stve.
4. Goncharova, N. I., Abobakirova, Z. A., & Kimsanov, Z. (2019). Technological Features of Magnetic Activation of Cement Paste" Advanced Research in Science. *Engineering and Technology*, *6*(5).
5. Kimsanov, Z. O. O., Goncharova, N. I., & Abobakirova, Z. A. (2019). Izuchenie tehnologicheskih faktorov magnitnoj aktivacii cementnogo testa. Molodoj uchenyj, (23), 105-106.
6. Abdullayev, I., & Umirzakov, Z. (2020). Optimization of bag filter designs (on the example of cement plants in the fergana region of the republic of Uzbekistan). *Zbirnik naukovih prac` ΛΟΓΟΣ*, 31-34.
7. Goncharova, N. I., Abobakirova, Z. A., & Mukhamedzanov, A. R. (2020, October). Capillary permeability of concrete in salt media in dry hot climate. In *AIP Conference Proceedings* (Vol. 2281, No. 1, p. 020028). AIP Publishing LLC.
8. Karataev, G. I., Markov, A. R., Sinjashina, L. N., Miller, G. G., Klicunova, N. V., Titova, I. V., ..., & Amelina, I. P. (2008). Sravnitel`noe izuchenie roli yada, inva I rsal-genov v patogennosti yersinia pseudotuberculosis. *Molekuljarnaja genetika, mikrobiologija i virusologija*, (4), 10-18.
9. Ivanovna, G. N., & Asrorovna, A. Z. (2019). Technological features ofmagnetic activation of cement paste. *European science review*, *1*(1-2).
10. Goncharova, N. I., Zikirov, M. S., & Kimsanov, Z. O. O. (2019). Aktual`nye zadachi proektirovanija obshhestvennyh i zhilyh kompleksov v centre Fergany. *Molodoj uchenyj*, (25), 159-161.
11. Goncharova, N. I., Madaminov, N. M., & Kimsanov, Z. O. O. (2019). Raw architecture of the people's housing of Uzbekistan. *Molodoj uchenyj*, (26), 104-107.
12. Goncharova, N. I., Raxmanov, B. K., Mirzaev, B. K., & Xusainova, F. O. (2018). Properties of concrete with polymer additives-wastes products. *Scientific-technical journal*, *1*(2), 149-152.
13. Goncharova, N. I., Abobakirova, Z. A., Abdurahmonov, D. M., & Hazratkulov, U. U. (2016). Razrabotka solestojkogo betona dlja konstrukcij s bol`shim modulem otkrytoj poverhnosti. *Molodoj uchenyj*, (7-2), 53-57.
14. Goncharova, N. I., & Abobakirova, Z. A. (2021). Reception mixed knitting with microadditive and gelpolimer the additive. *Scientific-technical journal*, *4*(2), 87-91.
15. Goncharova, N. I., & Turopov, M. (2019). Optimization of the structure of cement concrete with activated liquid medium. *Scientific-technical journal*, *22*(3), 60-64.
16. Abdullayev, I. N., & Marupov, A. A. (2020). Analysis of land in protected areas of high-voltage power lines (transmission lines) on the example of the Fergana region. *Scientific Bulletin of Namangan State University*, *2*(4), 107-114.
17. Bahromov, M. M., Rahmonov, U. Zh., & Otaboev, A. B. U. (2019). Vozdejstvie sil negativnogo trenija na svau pri prosadke gruntov. *Problemy sovremennoj nauki i obrazovanija*, (12-2 (145)).
18. Goncharova, N. I., Abobakirova, Z. A., & Muhamedzjanov, A. R. (2020). *Jenergosberezhenie v tehnologii ograzhdaushhih konstrukcij*. In Jenergo-resursosberegaushhie tehnologii i oborudovanie v dorozhnoj i stroitel`noj otrasljah. (pp. 107-112).
19. Abobakirova, Z. A. (2021). Regulation Of The Resistance Of Cement Concrete With Polymer Additive And Activated Liquid Medium. *The American Journal of Applied sciences*, *3*(04), 172-177.
20. Abobakirova, Z. A. (2021). Reasonable design of cement compositionfor refactory concrete. *Asian Journal of Multidimensional Research*, *10*(9), 556-563.
21. Mirzaakhmedova, U. A. (2021). Inspection of concrete in reinforced concrete elements. *Asian Journal of Multidimensional Research*, *10*(9), 621-628.
22. Umarov, S. A. (2021). Development of deformations in the reinforcement of beams with

composite reinforcement. *Asian Journal of Multidimensional Research*, *10*(9), 511-517.
23. Nabiev, M., GM, G. S. Q., & Sadirov, B. T. (2021). Reception of improving the microclimate in the houses of the fergana valley. *The American Journal*.
24. Djurayevna, T. N. (2020). Influence Of Surface Additives On Strength Indicators Of Cement Systems. *The American Journal of Applied sciences*, *2*(12), 81-85.
25. Mirzajonovich, Q. G., Ogli, A. U. A., & Ogli, X. AM (2020). Influence Of Hydro Phobizing Additives On Thermophysical Properties And Long-Term Life Of KeramzitObetona In An Aggressive Medium. *The American Journal of Engineering and Technology*, *2*(11), 101-107.
26. Gayradjonovich, G. S., Mirzajonovich, Q. G., Tursunalievich, S. B., & Ogli, X. A. M. (2021). Corrosion State Of Reinforced Concrete Structures. *The American Journal of Engineering and Technology*, *3*(06), 88-91.
27. Ogli, X. A. M. (2021). Construction Of Flexible Concrete Elements In Buildings. *The American Journal of Engineering and Technology*, *3*(06), 101-105.
28. Djurayevna, T. N. (2020). Building Materials Determined In The Architectural Monuments Of Central Asia. *The American Journal of Applied sciences*, *2*(12), 77-80.
29. Egamberdiyev, B. O. (2020). A Practical Method For Calculating Cylindrical Shells. *The American Journal of Engineering and Technology*, *2*(09), 149-158.
30. Davlyatov, S. M., & Makhsudov, B. A. (2020). Technologies for producing high-strength gypsum from gypsum-containing wastes of sulfur production-flotation tailings. *Academicia: An International Multidisciplinary Research Journal*, *10*(10), 724-728.
31. Adilhodzhaev, A., Igamberdiev, B., Kodirova, D., Davlyatov, S., Marufjonov, A., & Shaumarov, S. (2020). The study of the interaction of adhesive with the substrate surface in a new composite material based on modified gypsum and treated rice straw. *European Journal of Molecular & Clinical Medicine*, *7*(2), 683-689.
32. Akhrarovich, A. K., & Muradovich, D. S. (2016). Calculation of cylindrical shells of tower type, reinforced along the generatrix by circular panels. *European science review*, (3-4).
33. Akramov, H. A., Davljatov, Sh. M., & Hazratkulov, U. U. (2016). Metody rascheta obshhej ustojchivosti cilindricheskih obolochek, podkreplennyh v prodol`nom napravlenii cilindricheskimi paneljami. *Molodoj uchenyj*. (7-2), 29-34.
34. Usarov, M. K., & Mamatisaev, G. I. (2020, November). Calculation on seismic resistance of box-shaped structures of large-panel buildings. In *IOP Conference Series: Materials Science and Engineering* (Vol. 971, No. 3, p. 032041). IOP Publishing.
35. Usarov, M., Ayubov, G., Mamatisaev, G., & Normuminov, B. (2020, July). Building oscillations based on a plate model. In *IOP Conference Series: Materials Science and Engineering* (Vol. 883, No. 1, p. 012211). IOP Publishing.