The American Journal of Applied sciences
(ISSN – 2689-0992)
Published: April 30, 2021 | **Pages:** 172-177
Doi: https://doi.org/10.37547/tajas/Volume03Issue04-24

IMPACT FACTOR
2021: 5. 634
OCLC - 1121105553

Regulation Of The Resistance Of Cement Concrete With Polymer Additive And Activated Liquid Medium

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ABSTRACT

The article presents the results of studies of cement concrete with a polymer reagent and an activated (magnetically treated) liquid medium. A decrease in the total and capillary porosity of the cement stone and an increase in microporosity up to 18% indicate an increase in the resistance of concrete in aggressive environments.

KEYWORDS

Cement concrete, polymer additive, magnetically treated water, aggressive environment, increased durability.

INTRODUCTION

As you know resistance of concrete - its ability to resist the action of the external environment is determined, first of all, by its structure. In this case, special attention is paid to excess moisture, as the most important factor in terms of the formation of porosity of the cement stone and its strength. It is the porous structure of the cement stone that determines its permeability and resistance to aggressive media [1-11].

Thus the structure of the pore space of concrete, the permeability of concrete was studied by V.M. Moskvin and he classified the pores in concrete according to their location in its volume into three types: pores of cement stone, pores of aggregates and contact priests at the interface between cement stone and aggregate.

According to the size of the pores in concrete, they differ in groups [2]: the first group of pores <50 A0; the second group - micropores 50-1000 A0; the third group consists of micropores with a radius> 1000 A0 - such pores are the main pathways for the movement of the liquid and gaseous phases in concrete. According to [3-8], under the aggressive action of sulfate solutions, destructive processes occur mainly in pores with an equivalent radius of more than 5000, and sufficient corrosion resistance can be achieved by creating a finely dispersed structure with a predominant content of microcapillaries less than the specified size.

V.M. Latypov [4] studied the effect of porosity on the sulfate resistance of cement stone and concrete and concluded that capillaries and macropores practically do not participate in the accumulation of salts and most of them are deposited in microcapillaries that form “effective porosity”.

However, the resistance of concrete under conditions of salt crystallization during capillary absorption and evaporation is inversely proportional to open porosity. Closed pores increase the resistance of the material. That is, replacing open porosity with small closed pores and reducing the value of through porosity should significantly increase the resistance of concrete under conditions of capillary suction and intense evaporation of saline solutions. Studies [4-11] have shown that the increased corrosion resistance of concretes based on porous aggregates is explained, first of all, by the fact that the pores of this concrete are mostly closed and have a size of 1 micron; waterproof pores. Thus, the distribution of pores in concrete should be considered not only by size and shape, but also by the nature of porosity: closed, capillary, through.

Besides one of the important methods of controlling the structure formation of cement stone, improving the characteristics of concrete obtained on its basis is a directed change in the physicochemical properties of mixing water.

Moreover the liquid phase, which is a saturated aqueous solution of an alkaline composition, is the main structural unit of the dough, which ensures its adhesion to wetting and sticking to the filler [5]. The adsorption of water molecules by the surface of mineral particles is realized due to hydrogen bonds and donor-acceptor phenomena. Water is an active chemical component, which, together with cement, participates in all processes of structure formation of a cement gel. Its structure depends on its properties, which are manifested at all stages of interaction with Portland cement particles. The study of the rate of cement hydration showed that when using magnetized water, cement is hydrated to a much greater extent than when using ordinary water, which contributes to obtaining a denser stone structure [6]. The efficiency of magnetic water treatment increases when combined with other technological methods [6].

It was found that the mode of electrochemical activation has a great influence on the hardness of water and the concentration of hydrogen ions. So, when water is treated with only a magnetic field or only with an electric current, the pH rises and the hardness decreases.

With joint action, the sequence of treatment has a great influence: if first the treatment is carried out with an electric current, and then with a magnetic field, the pH of the water decreases, in the reverse order, it increases. The increased operational stability of materials prepared using magnetically and electrochemically activated aqueous solutions has been established.

Revealed increased resistance in an aggressive environment of materials obtained in water treated with a magnetic field. When using mixing water, activated by an electric current, as well as jointly by an electric current and a magnetic field, the frost resistance of materials increases by 18 - 40%.

The researches of S.A. Vshivkov. and others [7] found that the imposition of a magnetic field leads to an increase in viscosity, which indicates the orientation of macromolecules and their associates relative to the lines of force and the aggregation of these particles. The degree of swelling of hydrogels in water is determined by the density of the polymer network, which is set during the synthesis.

Thus, in the formation of systems consisting of cement, filler, additives and water, the concept of P.G. Komokhovshould be considered as important parameters for their study. [11]: the chemical nature of the solid phase surface; type and amount of impurities; size, shape and distribution of hardening particles; thermodynamic state of the solid phase system; internal residual stresses and stored elastic energy during cement hydration; adhesion and interaction between particles in the composite matrix; the degree of predominance of adhesion or cohesion forces between the matrix and concrete aggregates; the degree of porosity, taking into account the size, geometry and distribution of pores in the matrix and in the volume of the entire concrete structure.

METHOD OF TESTING CONCRETE FOR CAPILLARY PERMEABILITY. COMPARATIVE EXPERIMENTS.

The pore structure of the cement stone was investigated with the addition of POLY-ANS polymer reagent and magnetically treated water. The activation of water was carried out with discrete magnetic treatment, which is associated with the rupture of shells of hardening products on the surface of the grains. The porosity was investigated using a mercury porosimeter.

The characteristics of the pore structure of the cement stone were determined after 28 days of specimen hardening under normal conditions Table 1.

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Influence of POLY-ANS additives and an activated liquid medium on the characteristics of the pore structure of a cement stone.

Table 1.

1	Supplement type and dosage	Total porosity, см³/г.10²	Radial distribution of pores					
			$10\text{-}10^2$		$10^2\text{-}10^3$		$10^3\text{-}10^4$	
			см³/г	%	см³/г	%	см³/г	%
Norm.	-	7,6	0,25	3,2	5,1	67,1	2,25	29,6
	0,04% POLY– ANS	6,3	0,33	5,4	4.06	64,5	1,90	30,1
	0,02% POLY– ANS	5,9	0,38	6,4	3,7	62,4	1,87	31,2
With activator By water	0,04% POLY– ANS	5,4	0,31	5,9	4.36	62,0	1,93	31,1
	0,02% POLY– ANS	5,0	0,30	6,8	3,95	61,4	1,95	33,2

DISCUSSION OF RESULTS OF EXPERIMENTS

The analysis of the data obtained indicates that the improvement in the characteristics of the pore structure of the cement stone is associated with an increase in the specific surface of the neoplasms in combination with a reduced water demand due to the effect of "structure ordering" during magnetic treatment of water. The imposition of a magnetic field leads to an increase in viscosity, which indicates the orientation of macromolecules and their associates relative to the lines of force and the aggregation of these particles. The study of the rate of cement hydration showed that when using magnetized water, cement is hydrated to a much greater extent than when using ordinary water, which contributes to obtaining a denser stone structure. The plastic strength of the cement composition in the case of mixing with magnetized water begins to actively grow almost immediately after mixing. At the same time, a faster dispersion of particles to micron sizes was noted. The study of the rate of cement hydration showed that when using magnetized water, cement is hydrated to a much greater extent than when using ordinary water, which contributes to obtaining a denser stone structure

Neverthelessthe total and capillary porosity of the cement stone decreases the more, the higher the plasticizing ability of POLY-ANS additives, and the microporosity increases according to their stabilizing effect. In particular, the total and capillary porosity of the cement stone with POLY-ANS additives in comparison with the standard is reduced by about 1.5 times. The increase in the volume of micropores in this case is up to 18%.

SUMMARY

Thus, the possibility of adjusting the resistance of cement concrete with a polymer additive and an activated liquid medium has been shown in order to increase its resistance in aggressive environments.

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