INFLUENCE OF AGGRESSIVE MEDIA ON THE DURABILITY OF LIGHTWEIGHT CONCRETE

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Abstract: *The article provides information on increasing the resistance of concrete to aggressive environments.*

Key words: *concrete, dry climate, aggressive environment, impact, climate change.*

One of the important requirements for mortars and concretes based on mineral binders is their resistance to exposure to various aggressive environments. The fact that concrete and reinforced concrete products and structures based on Portland cement binder do not always turn out to be sufficiently durable when exposed to some natural waters was established quite a long time ago.

According to the theory of concrete corrosion there are three main types or types of corrosion. Scientific research and practical long-term observations have established that concretes based on Portland cement corrode quite quickly in soft, acidic waters and those containing some mineral salts.

In the study of corrosion processes of mineral binders and concretes based on them, the leading role belongs to well-known scientists from both the CIS countries and foreign countries: A.A. Baikov, N.A. Belelyubsky, P.P. Budnikov, A.V. .Kindu, V.M. Moskvin, S.D. Okorokov, V.V. Stolnikov, A.R. Shulyachenko, S.V. Shestoperov, Le Chatelier, Lafume, Torvolson, P. Tryun, F. Lee and others .

The works of these researchers made it possible to understand the causes of corrosion of binders and concretes, as well as to determine ways to reduce their impact and to determine ways to increase the durability of products and structures.

It has been established that the corrosion processes of Portland cement mortars and concretes under the influence of aggressive media of various compositions are caused by the following main factors:

Physical dissolution in soft fresh water of some components of hardened cement stone and, first of all, calcium hydroxide;

The interaction of the constituent parts of cement stone with free acids, alkalis and other compounds contained in water;

Exchange reactions between calcium oxide hydrates, other components of cement stone and salts contained in mineralized water.

It is known that the increase in the resistance of Portland cement, as the main component of mortars and concretes against the effects of aggressive environments, is associated with the introduction of active hydraulic additives into their composition. Increasing the resistance of cement with active (pozzolanic) additives against the action of sulfates and sea water has long been a subject of discussion and various hypotheses. However, there is still no consensus on explaining the reasons for the increase in the resistance of cement stone in concrete in an aggressive environment when adding additives.

Significant studies to determine the corrosion resistance and, accordingly, the durability of Portland cement with the addition of fly ash were carried out by V.V. Stolnikov, V.V. Kind [101], at VNIIG

them. B.E. Vedeneeva. They studied the resistance and durability of these binders in running soft water and sulfate-magnesian aggressive environment. It is concluded that the addition of 25-30% fly ash to Portland cement practically does not change its resistance to the leaching action of soft water and sulfate-magnesian aggression, but significantly increases its resistance to sulfate-amino-gypsum corrosion.

Based on the foregoing, we simultaneously studied the resistance of pure Portland clinker cement, as well as the resistance of Portland cement with the addition of fine fractions of fly ash from the Angrenskaya TPP in solutions of various salts.

Resistance was studied on mortar samples 40x40x160mm in size. After 28 days of hardening in humid conditions, the samples were placed in solutions of sodium sulfate, magnesium sulfate, sodium carbonate, and potassium chloride (Na_2SO_4; $MgSO_4$; Na_2CO_3; $CaCl_2$).

The concentration of aggressive solutions was adopted in accordance with the guidelines for determining the corrosion resistance of cements and concretes, developed in the laboratory of VNIIG named after. B.E. Vedeneeva. For comparison, the corresponding number of samples were left to harden in ordinary tap water.

Strength characteristics and Kc values of samples on cement-ash binder.

Table 4.3.1.

Rooms compositions	Water consumption ness, %	Bending strength after 6 months, kgf/cm2					Ultimate compressive strength after 6 months, kgf/cm2				
		In water	in solutions				В воде	in solutions			
			Na_2SO_4	$MgSO_4$	Na_2SO_4	$CaCl_2$		Na_2SO_4	$MgSO_4$	Na_2SO_4	$CaCl_2$
Composition 1	30	65	53	36	62	56	480	408	267	460	408
Composition 2	32	70	68	59	70	59	490	480	411	485	475
Composition 3	34	62	58	51	65	60	420	407	357	420	385

Table 4.3.2.

Tool life values -K_c

Composition 1	-	0,63	0,56	0,95	0,87	-	0,85	0,54	0,96	0,85
Composition 2	-	0,98	0,85	0,97	0,94	-	0,98	0,84	0,98	0,97
Composition 3	-	0,95	0,83	0,98	0,97	-	0,97	0,85	0,99	0,94

After keeping in solutions, within the recommended time, the samples were tested for bending, and their halves for compression. The ratio of flexural and compressive strengths of samples that have been in an aggressive environment and water for 6 months, or the so-called resistance coefficient Kc, characterizes the change in the strength characteristics of binders over time. The results of the tests carried out are shown in Table 4.3.2.

The results of the resistance of Portland cement with the addition of fly ash in water and in various aggressive environments suggest that it is possible that concretes on porous aggregates using this type of binder may have a certain resistance in the above aggressive environments. To obtain a clearer picture of the behavior of concretes on porous aggregates on cement-ash binders, sample cubes with a size of mm were made.

Table 4.3.3.

Values of the resistance coefficient-Kc in various aggressive environments.

Aggressive media and sample storage conditions	Binder composition, % portland cement -70 fly ash -30			Binder composition, % Portland cement -60 fly ash -40		
	Values of the resistance coefficient after, days.					
	K_c 28	K_c 90	K_c 180	K_c 28	K_c 90	K_c 180
1. in solution Na_2SO_4(10g/l)	0,98	0,96	0,94	0,99	0,99	1,0
2. in solution $MgSO_4$ (30g/l)	0,97	0,89	0,88	0,94	0,90	0,85
3. in solution Na_2CO_3(30g/l)	1,0	1,02	0,97	1,0	1,0	0,98
4. in solution $CaCl_2$ (30g/l)	0,98	1,0	1,0	0,98	0,98	0,97

With the ratios of Portland cement and fly ash equal to 70:30 and 60:40, and the types of aggressive media and their concentration corresponded to the tests.

The results of determining the resistance coefficient of concrete samples tested at different times are shown in Table 4.3.3.

The analysis of the obtained data characterizes that the MgSO4 solution should be considered the most aggressive medium, both for a pure Portland cement binder and for a mixed one. However, in a mixed binder, the durability coefficient is somewhat higher.

The observed more stable value of Kc in the CaCl2 solution should be explained by a decrease in the intensity of exchange reactions between soluble salts and Ca(OH)2 due to the binding of the latter by fly ash.

Taking into account the conclusions made by other researchers and the results of experiments, we consider these phenomena possible by the following factors:

- significant compaction of the mortar part as a result of the addition of fly ash:
- the properties of the fly ash itself: high dispersion, a high degree of vitrification and a certain hydraulic activity;
- change in the water demand of the mortar part as a result of the introduction of fly ash.

However, as many researchers note, one can speak of insufficient knowledge of the issue of the causes of the destruction of the solution component under the action of aggressive media. Obviously, in addition to the physical action of aggressive media, other forces also take place in solutions. A number of scientists (V.M. Moskvin, A.E. Sheikin and others) expressed an opinion about the effect of osmotic pressure forces on the cement stone. In addition, it is necessary to take into account the fact that mortars and concretes can be affected simultaneously by combined systems of aggressive environments, and not separately taken.

In our experiments, the task was to prove the possibility that mortars and concretes based on Portland cement with the addition of fly ash are more resistant to aggressive environments than those based on ordinary Portland cement.

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