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DURABILITY OF LIGHTWEIGHT CONCRETE IN AGGRESSIVE ENVIRONMENTS

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Annotation:
A One of the important requirements for solutions and concretes based on mineral binders is their resistance to the effects of various aggressive media on them. The fact that concrete and reinforced concrete products and structures based on Portland cement binder are not always durable enough when exposed to some natural waters has been established for a long time.

Keywords: cement concrete pavements, Portland cement, strength, quality destruction, reconstruction.

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 on Portland cement are quickly corroded in soft, acidic waters and containing some mineral salts. The research work made it possible to understand the causes of corrosion of binders and concretes, as well as to determine ways to reduce their impact and 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 oxide hydrate ;

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

-Exchange reactions between calcium oxide hydrate, 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 media is associated with the introduction of active hydraulic additives into their composition. Increasing the resistance of cement with active (pozzolan) additives against the action of sulfates and seawater has long been the subject of discussion and the promotion of various hypotheses. However, there is still no consensus on explaining the reasons for increasing the resistance of cement stone in concrete in an aggressive environment when additives are administered.

Significant studies to determine the corrosion resistance and, accordingly, the durability of Portland cement with the addition of fly ash were conducted by V.V.Stolnikov, V.V.Kind [1, 2, 3, 4, 5], at VNIIG named after B.E.Vedeneev. They investigated the durability and durability of these binders in flowing soft water and sulfate-magnesia aggressive environment. It is concluded that the addition of 25-30% fly ash to Portland cement practically does not change its resistance against the leaching action of soft water and sulfatomagnesial aggression, but significantly increases its resistance against sulfatoaminate gypsum corrosion

Based on the above, we simultaneously investigated the resistance of pure clinker Portland cement, as well as the resistance of Portland cement with the addition of small ash fractions-Unosangrenskaya GRES in solutions of various saltsй.

Resistance was studied on solution samples with a size of 40x40x160 mm. After 28 days of hardening in wet conditions, the samples were placed in solutions of sodium sulfate, magnesium sulfate, sodium carbonate and potassium chloride.(Na_2 SO_4;$MgSO_4$; Na_2CO_3; $CaCl_2$).

The concentration of aggressive solutions was adopted according to the instructions for determining the corrosion resistance of cements and concretes developed in the laboratory of the B.E.Vedeneev VNIIG. 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 1.

Train numbers	Water consumption, %	Bending strength after 6 months, kgs/sm^2					Compressive strength after 6 months, kgs/sm^2				
		В воде	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 2. Values of the resistance coefficient -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 holding in solutions, within the recommended time, the samples were tested for bending, and their halves for compression. The ratio of bending and compressive strength 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 are shown in the table 1, 2, 3.

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 concrete on porous aggregates with the use of this type of binder may have a certain resistance in the above aggressive environments. In order to obtain a clearer picture of the behavior of concrete on porous aggregates on cement-ash binders, samples-cubes of mm size were made.

Table 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, day.					
	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 coefficient of resistance of concrete samples tested at various times are shown in Table 4.3.3.

Analysis of the data obtained characterizes that the most aggressive medium should be considered a solution of MgSO4, both for pure Portland cement binder and mixed. However, in a mixed binder, the resistance coefficient is slightly higher.

The observed more stable value of Kd in 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, high degree of vitrification and a certain hydraulic activity;
- a change in the water demand of the solution part as a result of the introduction of ash-entrainment.

However, as many researchers note, we can talk about insufficient knowledge of the causes of the destruction of the mortar component under the influence of aggressive media. Obviously, in addition to the physical action of aggressive media in solutions, there are other forces. A number of scientists (V.M.Moskvin, A.E.Sheikin, etc.) expressed their opinion about the effect of osmotic pressure forces on cement stone. In addition, it is necessary to take into account that solutions and concretes can be affected simultaneously by combined systems of aggressive media, and not separately taken.

In our experiments, the task was to prove the possibility that solutions and concretes on Portland cement with the addition of fly ash are more resistant to aggressive media than on conventional Portland cement.

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