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STUDY OF THE EFFECT OF ETHYLENE-PROPYLENE POLYMER ON THE PROPERTIES OF MATERIALS OBTAINED ON THE BASIS OF CLINKER-LESS ADHESIVE

R.J.Mammadova, L.N.Hasanova
rcmamedova@cmail.com, lala.hasanova1962@gmail.com

Abstract. In the modern cement industry, the production of low-clinker and clinker-free binders, which require lower fuel and energy costs and have 2-2.5 times less capital investment than portland cement, is economically efficient. However, the brand of clinker-free binder is lower and its weather resistance is poor.

In the present research work, the preparation of concrete based on clinker-free adhesive was carried out using the method of mathematical planning of experiments. This method allows to determine in advance the adhesive consumption and water/adhesive ratio for obtaining any brand of concrete. It was found by research that the strength of expanded clay concrete obtained on the basis of clinker-free adhesive at the same adhesive consumption is higher than the strength of heavy concrete. Therefore, taking into account the feasibility of preparing expanded clay concrete on the basis of clinker-free adhesive, expanded clay concrete was chosen as the object of action of ethylene-propylene polymer. It was found that with the participation of ethylene-propylene polymer, a slight change in the average density occurs, the formation of a dense structure due to the distribution mechanism of particles in a uniform volume, as a result of which the resistance of concrete to deformation and corrosion increases.

Keywords: *clinkerless adhesive, expanded clay concrete, glass zeolite, ethylene-propylene polymer, H-heptane, sand, late*

Introduction. It has been established that a 1.5% solution of ethylene-propylene polymer (16% solution in heptane) added to expanded clay concrete acts as a lubricant for the liquid phase, increasing the fluidity of the mixture and reducing the water/binder ratio. Under the influence of ethylene-propylene polymer (16% solution in heptane), the strength of expanded clay concrete increases by approximately 15...25%. This is due to a decrease in the total and capillary porosity of the cement stone. Therefore, after 50 cycles, the strength limit of concrete without additives decreases by 2...2.5 times, and the coefficient of forging resistance is 0.41, while when ethylene-propylene polymer (16% solution in heptane) is added, the strength remains at the previous level, and the coefficient of forging resistance is 0.94-0.98.

Effect of EP polymer on concrete frost resistance

Table 1.

№	Material consumption, kg				EP polymer, %	Cone collapse, sm	Compressive strength limit before testing, MPa	Frost resistance, period	Compressive Strength limit, MPa		K_{max}
	adhesive	sand	expanded clay	water					After the	during the supervision	
1	350	550	480	305	-	2	7,0	50	3,0	7,3	0,41
2	350	550	480	300	1,5	2	8,8	50	8,8	9,3	0,94
3	350	550	480	303	2,5	2	8,0	50	8,6	9,0	0,95
4	350	550	480	306	3,0	2	7,2	50	7,4	7,5	0,98

Experimental part. First, a solution of ethylene-propylene polymer (16% solution in heptane) is prepared. Then the working solution is mixed with clinker-free adhesive and added to it. Then, after storing the prepared samples for 7 days in air-humid conditions and 21 days in water, their physicochemical properties were determined and it was found that adding ethylene-propylene polymer (16% solution in heptane) increases the resistance of concrete to deformation and corrosion, and its strength increases by 20-25%.

Results and their discussion. The deformation resistance of concrete was carried out according to GOST 10060-81. The deformation resistance was determined by 50 cycles of freezing the samples to -15...20ºC and then heating them to 20ºC and thawing them. The results of the experiment are given in Table 1.

Aydag zeolite was used as the volcanic rock. The tests were conducted on 10x10x10cm samples soaked in water after being stored in air-humid conditions for 28 days.

As can be seen from the table, after 50 cycles of freezing and thawing, the strength of expanded clay concrete without additives decreases by 2...2.5 times and the coefficient of forging resistance becomes 0.41. In the case of ethylene-propylene solution (16% solution in heptane), the strength of the samples after 50 cycles remains at the same level and the coefficient of forging resistance increases, reaching 0.94...0.98. As the amount of the additive increases, the coefficient of forging resistance also increases.

To test the sulfate resistance of expanded clay concrete, ethylene-propylene polymer (16% solution in heptane) was added to the concrete during mixing with water, and also impregnated onto the samples after 28 days of hardening. In order to test the sulfate resistance, the samples were hardened normally for 28 days. The hardened samples were immersed in an aggressive medium (Na_2SO_4) with a concentration of 3000 mg/l and 5000 mg/l and tested after 6 and 12 months. The dimensions of the tested samples were 4x4x16 cm.

Sulfate resistance is assessed by the resistance coefficient. This coefficient is characterized by the ratio of the strength after storage in an aggressive environment for various times to the strength of control samples stored in ordinary water (table 2).

As can be seen from Table 2, the strength of the composition without additives drops sharply after both 6 and 12 months. When the amount of SO_4^{-2} ions is 5000 mg/l, the sample after 12

months almost completely disintegrates and becomes unusable. When a solution of ethylene-propylene polymer (16% solution in heptane) was added to the concrete composition at a rate of 1.5% of the amount of the adhesive, the sulfate resistance increased sharply. When a solution of ethylene-propylene polymer (16% solution in heptane) was impregnated onto the hardened samples, the strength of the samples did not change at all after 6 months. After 12 months, it decreased slightly. Thus, the polymer layer prevents the aggressive effect of sulfates.

Effect of EP polymer on sulfate resistance of concrete

Table 2.

№	Amount of EP polymer, %	Amount of SO_4^{-2} ion in Na_2SO_4 solution, mg/l	Durability factor	
			6 month	12 month
1	without addition	3000	0,40	0,30
		5000	0,30	0,15
2	1,5%-with addition	3000	0,80	0,72
		5000	0,70	0,61
3	EPpolymer impregnated samples	3000	1,40	0,96
		5000	0,90	0,83

Conclusion. Thus, as can be seen from the tables, studies conducted to determine the effect of ethylene-propylene polymer on the durability of clinker-free adhesives have shown that, while the frost and corrosion resistance of expanded clay concrete prepared without additives decreases sharply, the frost resistance coefficient of additives after 50 cycles is 0.94...0.98. The sulfate resistance coefficient is 0.70...0.80 when the solution of ethylene-propylene polymer is included in the composition of expanded clay concrete, and 0.90...1.04 when it is impregnated on the samples.

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