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NFLUENCE OF TECHNOLOGICAL FACTORS ON THE PROPERTIES OF CONCRETE MIX AND CONCRETE

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ABSTRACT

The article studies the influence of technological factors on the properties of concrete mix and concrete, calculates the compositions of concrete by the calculation and experimental method, determines the compressive strength of concrete from the method of introducing the chemical additive KJ-3, as well as the effect of cement consumption on the strength of concrete with the addition of KJ-3.

Introduction

As is known, according to the polystructural theory, concretes belong to composite building materials and they are characterized by a macrostructure [4]. The latter is formed when a mixture of binder, modifier, fine and coarse aggregates hardens. The characteristics of the modifying additive, fine and coarse aggregates and the production technology are proposed as structure-forming factors [4].

To obtain a non-segregating high-quality mixture and high-strength concrete, certain requirements are imposed on its components and composition. The size of the fine aggregate should be 0.125 mm (30%) and 0.63 mm (70%). Coarse aggregate is used in two fractions: 5-10 mm and 10-20 mm in a certain ratio, providing the minimum possible voidness [2, 3].

Main part

The study of the possibility of obtaining high-quality concrete mix and high-strength concrete based on PC M400 D0 and D20 with the use of additive KJ-3 was carried out taking into account the above structure-forming and technological factors.

For the construction and reconstruction of railway platforms, the following reinforced concrete products are required: reinforced concrete racks, pile racks, glass-type foundations, foundation blocks, girders, ribbed slabs, flights of stairs or stair steps. For their manufacture, concretes at PC M 400 of classes B22.5, B30 and B40 are widely used. Therefore, we, from the initial materials accepted for the study, first determined the control compositions of these concretes. The calculations were performed on a personal computer using the EXEL program. The concrete compositions obtained by the calculation and experimental method are given in table 1.

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Table 1. Control compositions of concrete at PC M 400 D20

Concrete class	Cone draft, sm	Material consumption per 1 m³ (kg)					
		Cement	Sand	Crushed stone	Water	Water / Cement	Sand / Crushed stone
B 22,5	4-6	370	620	1200	204	0,55	0,52
B 30	4-6	450	645	1175	225	0,5	0,55
B 40	4-6	492	650	1155	235	0,47	0,56

Then, by the same method, the compositions of the concrete mixture with the addition of KJ-3 -1% were determined. The resulting concrete compositions on PC M 400 D0 and D 20 are given in table. 3 and 4.

Table 2.
Control compositions of concrete for Portland cement M 400 Д20

Concrete class	Cone draft см	Consumption of materials for 1 м³ (кг)						
		Cement	Sand	Crushed stone	Water	Water / Cement	Additive,,%	Sand / Crushed stone
B 27,5	12-16	292	780	1170	130	0,445	1,0	0,67
B 30	12-16	320	765	1140	130	0,351	1,0	0,67
B 40	12-16	370	750	1125	130	0,356	1,0	0,63

Data analysis table. 2. shows that due to the plasticizing effect of the action at the consumption of cement for the control compositions with the dosage of the KJ-3 additive 1%, it is possible to obtain concrete mixtures with O.K 12-16 cm and compressive strength of 36, 42 and 56 MPa, corresponding to the classes of concrete B27.5; B30, and B40.

When using PC M 400 D20, it is possible to obtain high-quality concrete mixtures with a diameter of 12-16 cm and compressive strength of 32.48 and 66 MPa, corresponding to concrete classes B25; B35 and B50 (Table 3).

Table 3.
Concrete mixes for Portland cement M 400 D20

Concrete class	Cone draft см	Consumption of materials for 1 м³ (кг)						
		Cement	Sand	Crushed stone	Water	Water / Cement	Additive,,%	Sand / Crushed stone
B 25	12-16	292	780	1170	130	0,445	1,0	0,67
B 35	12-16	320	765	1140	130	0,351	1,0	0,67
B 50	12-16	370	750	1125	130	0,356	1,0	0,63

In the technology of high-strength concrete, an important issue is the method of introducing a chemical additive. For this purpose, we have carried out studies of the influence of the method of introducing a chemical additive into a concrete mixture using the example of class B 30 concrete on PC M 400 D0 and D20 of the following composition: C - 370kg / m3; additive-1%; P / U-0.63 and V / C-0.28 (0.31); O. To concrete mix - 12-16cm.

Two ways of adding the additive have been studied:

- according to the first, the additive in the preparation of the concrete mixture was

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introduced through the mixing water into the dry mixture of aggregates and cement;

- on the second - first, the dry mixture of aggregates and cement was mixed with half of the mixing water, then a chemical additive was added with the remaining water.

First, we studied the effect of the method of introducing a chemical additive on the strength of concrete (concrete composition B50 in accordance with Table 3). Experiments have shown that the second method of introducing a chemical additive is more effective, in which Rc of concrete on PC M 400 D0 and D20 reaches 71 and 61 MPa compared to the first 65 and 52 MPa, or 7.5 and 16% higher (Table 4). When an aqueous solution of a chemical additive is added to a dry mixture of cement and aggregates, the adsorption of molecules on the anhydrous surfaces of cement particles is higher than that moistened with water, and the concentration of the chemical additive in the aqueous solution significantly decreases, which affects the degree of effect of the mechanism of action (dispersion and penetration), as a result of which and are the smaller indicators Rczh of concrete.

In the second method, the adsorption of the molecules of the chemical additive is insignificant and a significant amount of the additive provides plasticization of the concrete mixture, as a result of which there is a greater decrease in W / C and, consequently, an increase in Rc of concrete.

Table 4.

Dependence of the compressive strength of concrete on the method of introducing the chemical additive KJ-3

№ p/p	Type of cement	Cement content, кg/м^3	Supplement content, %	Rсж concrete, MPa	
				first way	second way
1	Портландцемент М400 Д0	370	1,0	65,0	71,0
2	Портландцемент М400 Д20	370	1,0	52,0	61,0

Since only Portland cement M 400 is produced in Uzbekistan, the issue of obtaining high-strength concrete with the addition of local production was of interest. Along with this, the question of the influence of the addition of KJ-3 on the strength of such concrete remains poorly understood.

Therefore, in the process of research, the influence of the following technological factors on the strength of concrete of normal hardening was studied: the dosage of the chemical additive, the type and consumption of cement, the P / W ratio. Concrete compositions of classes B 22.5, B 30 and B 40 with cement consumption of 370, 450 and 492 kg / m^3 were taken as the basic ones; V / C 0.55; 0.5 and 0.47; P / N equal to 0.52; 0.55 and 0.56, respectively, and the mobility of the mixture in O.K is 4-6 cm.

As is known, the mix mobility and concrete strength are determined by the dosage of a chemical additive [1]. Therefore, at first, the effect of the dosage of the chemical additive on the strength of concrete obtained from a mixture with O.K = 12-16 cm on Portland cement M 400 D0 and D20 with W / C = 0.35 and P / W = 0.67 was determined. The dosage of the chemical additive was varied from 0.6 to

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1.2% by weight of the binder. The data shown in Fig. 1 show that the change in the strength of concrete is extreme in nature with a maximum indicator at a dosage of a chemical additive of 1%. Reducing the addition of KJ-3 to 0.6% and obtaining the required mobility leads to an increase in W / C from 0.29 to 0.33 and 0.31 to 0.35 for Portland cement M 400 D0 and D20, which results in a decrease in strength from 71 and 61 MPa to 60 and 51 MPa, or by 13 and 14%, respectively (Fig. 1).

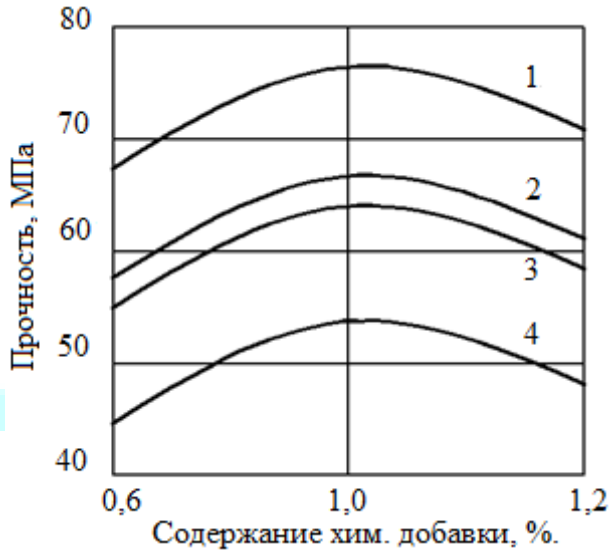
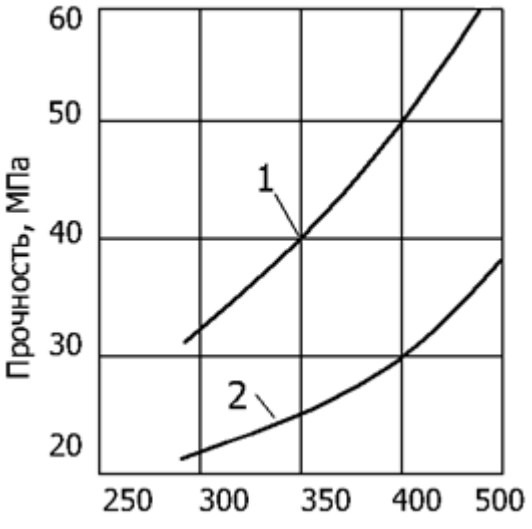


Fig. 1. Influence of KJ-3 dosage on concrete strength

1- concrete at PC M400 DO (second method); 2- concrete at PC M400 DO (first method); 3- concrete at PC M400 D 20 (second method); 4- concrete at PC M400 D 20 (first method).

With an increase in the content of KJ-3 to 1.2%, although the water demand decreases by 1-2 points, the strength of concrete decreases by 7 and 8%, which is probably explained by the thickening of the adsorption films of the aqueous solution of the chemical additive around the grains of the hydrating cement and a slight decrease in strength adhesion between crystalline hydrates of cement stone. The lower values of the compressive strength of concrete on Portland cement M 400 D20 is explained by the increased water demand due to the mineral additive (20% ash) and, accordingly, the lower content of the clinker part of the cement. The absolute values of Rsc of concrete on Portland cement M 400 D0 and Portland cement M 400 D20 are lower by 19 and 25%. This is due to a decrease in the active clinker part of the binder. At the same time, if we compare Rc of base concrete of class B 30 on Portland cement M 400 D0 and Portland cement M 400 D20, which is 41 and 38 MPa, then the addition of 1% KJ-3 increases Rc by 82 and 71%. In other words, the use of the KJ-3 additive makes it possible to obtain high-strength concrete of the B60 class on Portland cement with D0, and with D20 - increased strength B 40.



1- concrete at PC M400 D20 with ext. 1% KJ-3; 2 - the same without additives.

2- **Fig. 2. Influence of cement consumption on the strength of concrete with the addition of KJ-3.**

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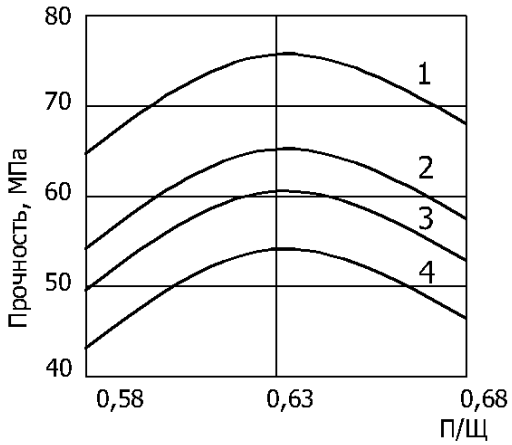
The dependence of the effect of cement consumption on the strength of concrete with the addition of KJ-3 has a curvilinear character (Fig. 2). Rc with a binder content of 292, 320 and 370 kg / m^3 higher than the standard by 51, 62 and 71%, which provides the possibility of obtaining high-strength concrete. In this case, the greatest strength effect is achieved due to the selection of a certain P / U (Fig. 3).

The dependence Rc of concrete with the addition of KJ-3 has an extreme character with a maximum indicator at P / U equal to 0.63. A decrease in the sand content, or an increase in it in the aggregate mixture, increases the voidness, which results in a decrease in the Rc of concrete.



1- concrete for Portland cement M400 DO (second method); 2- concrete for Portland cement M400 DO (first method); 3- concrete for Portland cement M400 D 20 (second method); 4- concrete for Portland cement M400 D 20 (first method).

Fig. 3. Dependence of the strength of concrete on the P / U ratio

Thus, the studies carried out have shown the possibility of obtaining cost-effective cement for concrete mixtures, high-strength concrete of class B 50 and B 60 on Portland cement M 400 D0 and increased strength class B 40 and B 50 on Portland cement M 400 D20 using 1% KJ-3 ...

Conclusion

1. The selection of concrete compositions on PC M 400 D0 and PC M 400 D20 was carried out by calculation - experimental method. It is shown that with the addition of 1 KJ-3, it is possible to obtain concrete mixtures with O.K 12-16 cm, high-strength concretes corresponding to the classes B40, B50 and B60, and increased strength B25, B 30 and B40

2. It has been confirmed that it is more effective to introduce an aqueous solution of the additive into a mixture of cement and aggregates pre-wetted with water. At the same time, the strength of concrete, depending on the type of cement and composition, increases by 6.2 - 14%.

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