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MIXED CEMENTS BASED ON SULPHOALUMINATE-BELITE CLINKERS

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Annotation:
It can be noted that mixed cements containing sulfoaluminate-belite clinkers are characterized by an intensive set of strength in the first day, which continuously increases.

Keyword: mixed cements, clinker, sulfoaluminate-belite clinker, calcium sulfate, clinker with mineralogical composition.

To obtain mixed cements, the synthesized sulfoaluminate-belite clinkers of various mineralogical compositions were preliminarily crushed. Portland cement clinker grade 500 to "Akhangarancement" was taken as the basis for the manufacture of mixed cements.
Mixed cements were prepared by mixing the crushed components, containing 10 ... 60% sulfoaluminate-belite clinkers.
The use of sulfoaluminate-belite clinkers of various mineralogical composition made it possible to reveal the dependence of a number of properties both on the ratio of the components of mixed cements and on the content of basic minerals in the synthesized clinkers.
Physical and mechanical properties of mixed cements
To determine the compressive strength of the obtained mixed cements, cubes were molded with Volsky sand of a fraction of 0.2 ... 0.4 mm at a ratio of 1:3. Samples were stored for 24 hours in humid air conditions and then in water. When the specified hardening time was reached, the samples were tested.
The strength of mixed cements significantly exceeds the strength of the original Portland cement stone.
It has been established that the brand of mixed cements depends not only on the amount of sulfoaluminate-belite clinker, but also on its composition and synthesis temperature. So, with an increase in the content of sulfo-aluminate-belite clinkers in mixed cements, the strength increases, but to certain limits, depending on the composition of these clinkers. Important in this case is the amount of sulfoaluminate and excess calcium sulfate, which contribute to an increase in strength.

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However, with a significant content of the latter, mixed cements with small amounts of synthesized clinkers are characterized by the best results.

Mixed cements are characterized by an intensive set of strength in the first day, which continuously increases with the course of the hardening process. By the age of three months, it exceeds by 1.5 ... 2 times the strength at 28 days of age. The increase in strength occurs within about two years and by three years of hardening it falls, approaching the brand. Tests of samples from mixed cements after six years of hardening indicate an increase in strength by an average of 30 MPa compared with three-year results (Table 1).

With an increase in the content of sulfoaluminate-belite clinkers in mixed cements, the grade changes as follows. With a 10% content of sulfoaluminate-belite clinkers in mixed cements, the grade is in the range of 600 ... 1000. Subsequently, with an increase in the content of sulfoaluminate-belite clinkers, the upper tensile strength decreases, which is associated with the mineralogical composition of the clinkers. So, low strength (20…30 MPa) is observed when there is 30…60% clinker in mixed cement, where the content of calcium sulfoalminate is 10%, there is no anhydrite, and 90% is dicalcium silicate. Compressive strength of samples from mixed cements containing 10% sulfoluminate-belite clinkers synthesized at 1573 K, MPa

Table 1

No. of cement	Clinker composition, %			Curing time							
	Calcium sulfoalminate	Dvuhkal-calcium silicate	Excess calcium sulfate	day			months		years		
				1	3	28	3	6	1	3	6
1	10	90	-	18	29	61	69	75	82	85	87
2	10	90	10	22	37	76	86	88	91	94	96
3	10	90	20	22	31	85	97	99	110	103	104
4	10	90	30	25	34	68	76	84	90	92	98
5	30	70	-	18	34	73	78	83	83	84	86
6	30	70	10	15	30	83	84	84	87	89	91
7	30	70	20	15	36	68	80	84	86	91	94
8	30	70	30	13	29	51	58	61	63	67	71
9	50	50	-	18	21	47	53	58	62	64	67
10	50	50	10	20	25	42	55	54	63	68	66
11	50	50	20	25	27	46	48	42	47	50	48
12	50	50	30	21	25	41	43	48	51	44	46

The highest strength is typical for mixed cements with a content of 10 ... 30% sulfo-aluminate-belite clinkers, consisting of 20 and 30% calcium sulfoaluminate and 30% excess calcium sulfate.

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An increase in the content of these keclinkers to 40...60% leads to a decrease in the strength of portland dam to 20...30 MPa at 28 days of age. This is explained by the fact that at a content of 10...30% of these clinkers, ettringite is a structure-forming element of high strength. With an increase in the content of these clinkers in mixed cements, internal deformations occur in the cement stone, due to the abundant formation of ettringite crystals, resulting in a decrease in strength.

Comparing mixed cements containing 10% sulfoaluminate-belite clinkers synthesized at temperatures of 1573, 1623, 1673 K, we conclude that with increasing temperature, the strength increases in the first day, and the grade does not change significantly.

Thus, it can be noted that mixed cements containing sulfoaluminate-belite clinkers are characterized by an intensive set of strength in the first day, which continuously increases.

The dependence of the strength of mixed cements on the firing temperature of sulfo-aluminate-belite clinkers is as follows: with an increase in the firing temperature from 1523 to 1673 K, the strength increases only in the first day of hardening, while the grade does not change significantly. This makes it possible to roast sulfoaluminate-belite clinkers at lower temperatures of 1523–1573 K.

With an increase in the content of sulfoaluminate in the above clinkers in the absence of excess calcium sulfate, the strength decreases. An excess of calcium sulfate leads to an increase in the strength of mixed cements. The main part of the obtained cements can be classified as high-strength. The content of clinkers in mixed cements with 10 ... 50% presence of calcium sulfoaluminate in the presence of an excess of calcium sulfate consistently provides high strength.

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