World Bulletin of Social Sciences (WBSS)
Available Online at: https://www.scholarexpress.net
Vol. 7, February,2022
ISSN: 2749-361X

OPTIMIZATION OF THE CONTENT OF CEMENT COMPOSITIONS WITH NEW GENERATION SUPERPLASTIFICATORS

Samariddin Rashidovich Majidov
majidovsamariddin2020@gmail.com
Feruza Baxtiyor qizi Mukhammadiyeva
muxammadiyevaferuza95@gmail.com
Tashkent Institute of Architecture and Construction

Article history:

Received: December 8th 2021
Accepted: January 8th 2021
Published: February 13th 2022

Abstract:

The article presents the results of the study of physical and mechanical properties of mixtures by incorporating a new generation of synthesized superplasticizer into cement compositions

Keywords: Cement Stone, Binders And Fillers, Superplasticizer Additives, Physical And Mechanical Properties

The inclusion of superplasticizers in building mixes and concrete mixes significantly changes their properties. Superplasticizer increases the mobility of building mix and concrete mix, improves convenient placement properties, reduces water demand, and so on.

The introduction of superplasticizer reduces the ratio of water and cement, the reduction of water consumption leads to an increase in the strength characteristics of concrete, all of which opens up the possibility of obtaining high-strength concrete. Such aspects have a positive effect on the longevity of concrete, ie its longevity.

To study the effect of the amount of superplasticizer SDj-1 on the physical and mechanical properties of concrete, Portland cement PTs400 D0 and PTs400 D20 of JSC "Ahangarontsement" was used. The concrete composition prepared by Binokor Beton Servis JV LLC at the factory, concrete class V30, the mobility of the mixture is characterized by a 4-5 cm conical subsidence.

The results of the study conducted by TAQI Laboratory "Building Materials" and the State Laboratory of Standardization and Certification under "Davlatarkhitekstroy" to determine the composition of concrete with superplasticizer additives showed that the additive SDj-1 has the best operational properties.

INNOVATIVE PRODUCTION TECHNOLOGY

In order to approbate the results, to study the effect of the chemical additive SDj-1 on the physical and mechanical properties of concrete, experimental studies were conducted on the basis of the laboratory TAQI "Building Materials". All researches Interstate standard GOST 30459-2008 "Additions for concrete and construction solutions. Determination and evaluation of efficiency "was performed in accordance with the requirements [1; 8800-8807-b.].

Based on the results of the analysis of experimental studies on the rheological properties of cement mix and concrete mix, the following was established: observed in a mixture containing a quantity of additive.

On the basis of experiments to study the physical and mechanical properties of concrete, the optimal amount of SDj-1 was accepted at 0.8% by weight of cement [2; 180-185-p.].

Once prepared, they were placed in a normal freezing chamber to solidify the samples. Samples were tested on days 1, 3, 7, 14, 28 of normal hardening. The second series of concrete samples were tested for mass density and water absorption. The results of the tests are shown in Tables 1 and 2 and Figures 1 and 2, respectively. Tables 1 and 2 show that the addition of the appropriate amount of SDj-1 superplasticizer to the concrete composition leads to an increase in the density and strength of the concrete..

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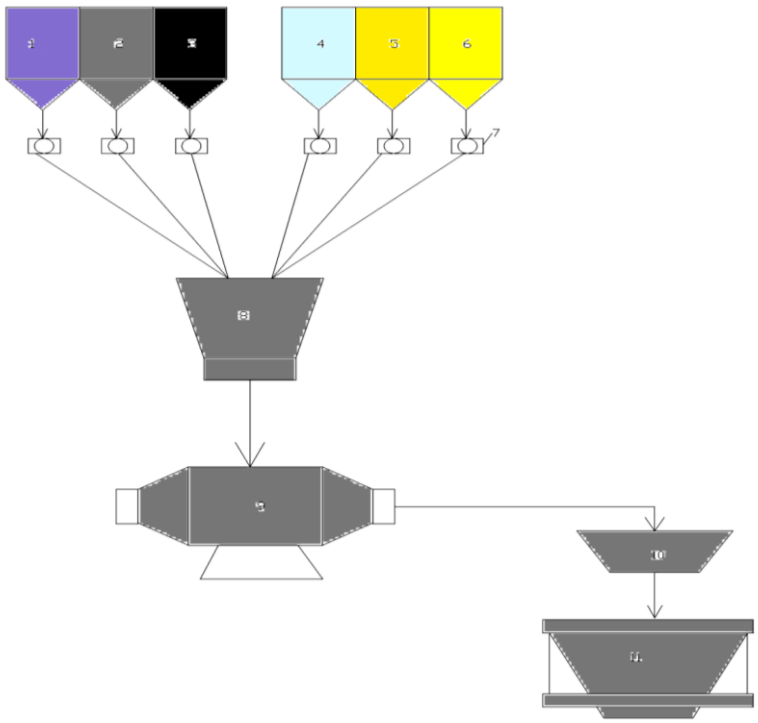

1-cement, 2-sand, 3-crushed stone, 4-water, 5-superplasticizer, 6-water solution, 7-boiler, 8-mixer, 9-ready mix, 10-molding.

The analysis of the studies showed that the strength of concrete increased by 25-30% compared to the control components, and the water absorption decreased by 12-15%. It was found that the properties of 0.8% SDj-1 admixtures are higher than those of 0.4, 0.6, 1.0% SDj-1 admixtures. Accordingly, the SDj-1 superplasticizer increases the strength of concrete throughout the hardening period. However, the largest increase in resilience was observed in the first three days. The highest strength is provided by the addition of 0.8% SDj-1. Within 7 days, the compressive strength reaches 76% of the design strength of the concrete.

Table 1.
Compositions of V30 class concrete mixes on the example of Binokor reinforced concrete service plant.

т/р	Name of materials	Composition of concrete mix, kg		
		1 m3	Control mixtures corresponding to 7 liters of mixture	SDj-1 additives equivalent to 7 liters of mixture
1	Cement, kg	350,0	2,450	2,450
2	sand, kg	750,0	5,250	5,250
3	Pebbles, kg	1050,0	7,350	7,350
4	Water,l	220,0	1,540	*1,530-1,480
5	SDj-1 relative to cement mass, 0.2%	0,7	-	0,049

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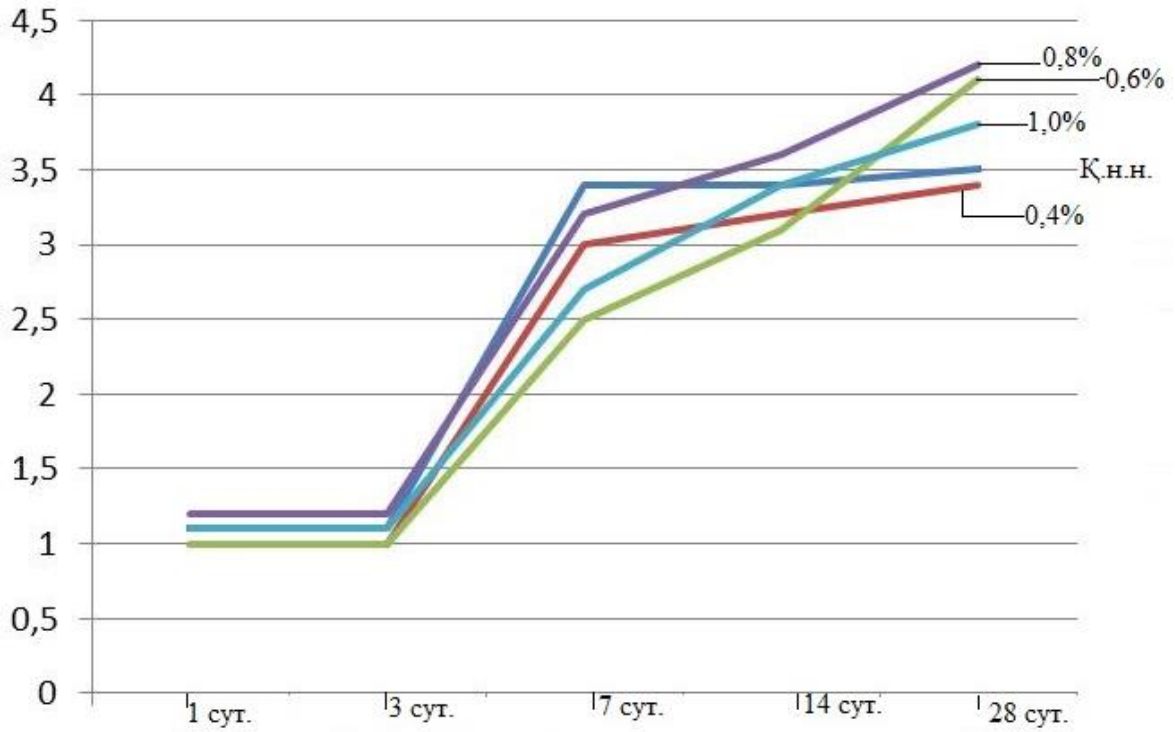
6	SDj-1 relative to cement mass, 0,4%	1,4	-	0,098
7	SDj-1 relative to cement mass, 0,6%	2,1	-	0,147
8	SDj-1 relative to cement mass, 0,8%	2,8	-	0,196
9	SDj-1 relative to cement mass, 1,0%	3,5	-	0,245

* the amount of water may vary depending on the amount of superplasticizer.

2 – Table.

Dependence of the bending strength of a mixture with a fine-grained uniform cone deposition on the amount of SDj-1 superplasticizer

т/р	SDj-1 relative to cement mass, %да	Bending strength (MPa) of the mixture in days				
		1	3	7	14	28
1	Additional control sample	1,1	1,1	3,4	3,4	3,5
2	0,4	1,0	1,0	3,0	3,2	3,4
3	0,6	1,0	1,0	2,5	3,1	4,1
4	0,8	1,2	1,2	3,2	3,6	4,2
5	1,0	1,1	1,1	2,7	3,4	3,8



Time, days

Figure 1. The bending strength of a fine-grained mixture depends on the amount of SDj-1 superplasticizer. Bending strength of concrete without additives 1; 2- 0.4% SDj-1; 3- 0.6% SDj-1; 4 –0.8% SDj-1; 5 is the bending strength of the SDj-1 additive mixture added in an amount of 1.0% relative to the cement mass.

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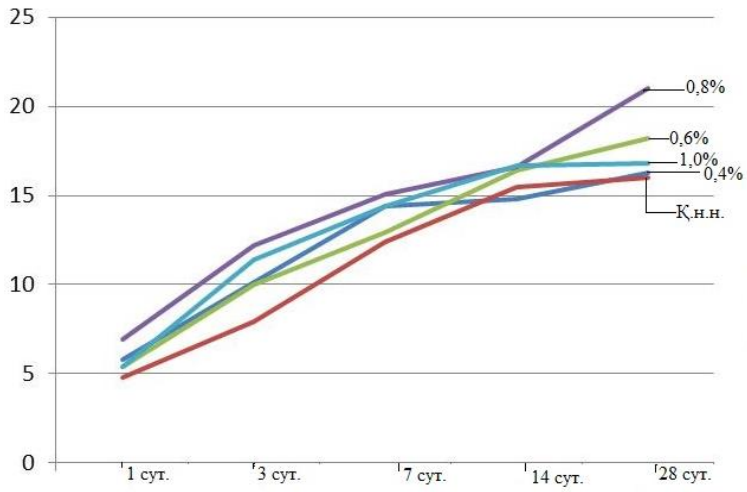
3 – Table.
Dependence of the compressive strength of a mixture with a fine-grained conical sediment on the amount of SDp-1 superplasticizer

т/р	SDj-1 relative to cement mass, %да	Compressive strength (MPa) of the mixture in days				
		1	3	7	14	28
1	Additional control sample	5,8	10,1	14,4	14,8	16,3
2	0,4	4,8	7,9	12,4	15,5	16,0
3	0,6	5,4	10,0	12,9	16,4	18,2
4	0,8	6,9	12,2	15,1	16,6	21,0
5	1,0	5,4	11,4	14,4	16,7	16,8

The inclusion of SDj-1 superplasticizer in the concrete mix allows to reduce its water demand by 15-20% by weight. This increases the compressive and flexural strength of concrete by around 25-30%, as can be seen in Figures 1 and 2. It was found that the bending strength of the concrete with the addition of SDj-1 for 3 and 7 days was much higher than that of the control samples. The bending strength of SDj-1 admixture is 30% higher than that of control samples [3; 225-229-b.].

Studies to determine the effect of SDj-1 superplasticizer on the physical, mechanical, chemical and operational properties of concrete, as well as the multifunctional effect (plasticization, initial hardening intensity, increased density) have shown a higher effect than traditional superplasticator.



Time, days
Figure 2. Compressive strength of fine-grained mixture
Dependence of SDj-1 on the amount of superplasticizer. Compressive strength of concrete without additives 1; 2-0.4% SDj-1; 3- 0.6% SDj-1; 4 –0.8% SDj-1; 5 is the compressive strength of the SDj-1 additive mixture added in an amount of 1.0% relative to the cement mass.

CONCLUSION.

Based on the results of the study, it was shown that SDj-1 achieved the highest efficiency when incorporated into the cement composition. At the same time, the mobility of concrete increases by 3-4 times compared to the control components (KCh - 18-20 cm). The same moving properties of concrete with added control SDj-1 will have 20 and 30% strength, respectively, in compression and bending. Due to the formation of the desired micro and macrostructure, the density increases, the water absorption decreases, which in turn allows to improve the quality of cement compositions.

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