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Mechanical Properties of Fine Granular Concrete Micro Reinforced with Bazalt Fibers

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ABSTRACT

The article presents the results of an experimental study of the physical and mechanical properties of fine-grained concrete microreinforced with basalt fibers.

Introduction. Reinforcement of reinforced concrete products and structures with dispersed fibers is widely used in order to increase their resistance to cracking, bending and tensile strength. In addition, the fiber-dispersed reinforcement serves to prevent the penetration of cracks into the inner layers of concrete, to increase the strength of cement stone and concrete at the entrance, and also to improve the strength of connections between structural elements. The effective influence of different types of fibrous materials on the properties of concrete depends on the ratio of the modulus of elasticity of the dispersed fiber and concrete. That is, when the ratio of the modulus of dispersed reinforcement to the modulus of concrete is greater than one (E_f /E_b >1), it is possible to obtain concrete that is strong in elongation and crack resistance. Various metallic and non-metallic fibrous materials are used for concrete reinforcement. Basalt fibers, asbestos, polymer, wollastonite and other fibers can be used as metal-free dispersed fiber. We used basalt fiber for such dispersed reinforcement. When basalt fibers are added to fine-grained concrete, the fibers in such concrete do not change their properties in various harmful aggressive environments. As a result, it is possible to increase the durability of the material and the service life.

Materials used for research.

Cement. One of the main components used in the preparation of concrete are binders. We use portland cement as a binder. M400D0 portland cement of "Kyzilkumtsement" JSC was used for the research. GOST 30744-2001 was used to determine the quality of cement.

Chemical composition of Portland cement

Table 1

№	Name of raw materials	Mass amount of oxides, %								
		SiO_2	Fe_2O_3	Al_2O_3	R_2O	CaO	MgO	SO_3	q.m.	total
1	PC 400 D0	21,84	3,75	4,78	1,47	64,79	2,59	0,33	0,30	99,82

Basalt fiber. Fibers are also used in concrete. Basalt fibers were used as fibers. Basalt fiber differs from metal fittings by the following advantages:

- 4-5 times lighter than metal;
- Resistant to aggressive environments;
- Thermal conductivity is zero;
- Bending strength 1200 Mpa;
- Does not lose its strength from -70 ° C to + 100 ° C;
- Lifespan up to 80 years;
- Fiber diameter 10-21 micro m;
- Fiber length 15-20mm.

Water. Drinking water or natural water, which does not contain harmful impurities that interfere with the normal hardening and structure of concrete, is used to prepare the concrete mixture. The hydrogen index of water used should be rN≥4 and the amount of sulfate ions SO_4≤2700 mg/l, and it should not contain harmful impurities (mineral and organic acids, oils, sugar, etc.).

The main part. It is known that concrete is an artificial stone. Since this category belongs to the type of composite materials, it is subject to general laws as well as special laws that apply to different concretes. Calculation of the composition of concrete is based on the integral relationship of the composition and structure of concrete with its properties.

As a result of the use of fillers, mineral and organic binders with different mechanical properties, concretes with different properties can be obtained depending on the preparation method and density (heavy, light, fire-resistant, road concrete, etc.).

Fine-grained concretes are concretes made on the basis of fine aggregates, which belong to the category of high-strength concretes and are mainly used effectively in the preparation of thin shell and reinforced cement structures. In order to increase the strength of such concretes to stretching and bending, crack resistance, fibrous material flakes, that is, metal wires (diameter 0.1...0.5 mm, length 10...50 mm) or non-metallic materials (basalt, kapron, asbestos) are added to the concrete. etc.) are distinguished by the possibility of adding fibers.

In order to analyze and compare the obtained results, to determine the optimal composition of fine-grained concrete with the addition of basalt fiber, to study the effect of basalt fiber on the strength of concrete in different compositions, the strengths of concrete samples with several compositions were determined.

In these studies, we used basalt fiber in the control concrete composition in relation to cement mass of 1.5; 3; 4; 5; 6% was added.

The analysis of the gold results, the implementation of changes in the strength of fine-grained concrete with the addition of basalt to the strength of ordinary concrete depends on the community. With this in mind, the joint strength of ordinary concrete composition in concrete samples built on the foundation is determined in parallel with the above experiments, in parallel conditions.

The results obtained are presented in the following tables

Table 2.

Strength of samples, MP			
№	Contents	When hot processed	
		Rben.str.	Rcom.str.
1	Control composition	7,1	39,4
2	Basalt fiber composition (BF-1,5)	7,7	41
3	Basalt fiber content (BF -3)	7,8	41,4
4	Basalt fiber composition (BF -4)	7,85	42
5	Basalt fiber composition (BF -5)	8,2	44
6	Basalt fiber composition (BF -6)	7,9	42.5

Note: Rben.str. - bending strength. Rcom.str. - compressive strength

BF - basalt fiber.

Conclusion. The following conclusions are drawn from the conducted experimental studies:

1. Compared to the control composition, the bending strength of samples with 1.5% basalt fiber increased by 8.4%, and the compressive strength by 4%.
2. Compared to the control composition, the bending strength of samples with 3% basalt fiber increased by 9.9%, and the compressive strength by 5%.
3. Compared to the control composition, the bending strength of the samples with 4% basalt fiber increased by 10.1%, and the compressive strength by 6.6%.
4. Compared to the control composition, the bending strength of the samples with 5% basalt fiber increased by 15.5%, and the compressive strength by 11.7%.
5. Compared to the control composition, the bending strength of the samples with 6% basalt fiber increased by 11.2%, and the compressive strength by 7.9%.

When 5% basalt fiber was added to the composition of fine-grained concrete, the flexural and compressive strengths of the samples reached the highest values.

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