



EFFECTIVENESS OF BASALT FIBER CONCRETES IN INCREASING THE FIRE RESISTANCE OF REINFORCED CONCRETE STRUCTURES

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ABSTRACT

The article analyzes the problems of increasing the fire resistance of reinforced concrete structures. Factors such as changes in the physical and mechanical properties of concrete and reinforcement under the influence of high temperatures, and a decrease in the load-bearing capacity of structures are considered. In particular, the fire resistance properties of fiber-reinforced concrete reinforced with basalt fibers are studied. The results of studies conducted by various scientists were analyzed and it was found that basalt fibers limit the formation of cracks in concrete, maintain strength under the influence of high temperatures, and reduce the risk of explosion. It is concluded that the use of basalt fiber-reinforced concrete in reinforced concrete structures is one of the promising directions for increasing the level of fire resistance.

Introduction. Today, reinforced concrete structures are widely used in high-rise buildings, industrial facilities and transport infrastructure facilities. In the event of a fire, as a result of high temperature, changes in the internal structure of concrete occur, the cement stone is dehydrated, and concrete strength decreases. The heating of the armature deteriorates its mechanical properties. Therefore, increasing the fire resistance of reinforced concrete structures is one of the most urgent scientific and practical issues in the field of construction.

In recent years, dispersed reinforced concretes, including fiber concretes, have attracted great interest as high-temperature resistant building materials. Basalt fibers have high strength, corrosion resistance, and stability at high temperatures, making their use in concrete compositions of great importance.

Various methods for increasing the fire resistance of concrete are presented in the scientific literature. In particular, it was noted that the resistance of concrete to high temperatures can be increased by using silica additives, polypropylene fibers, metal fibers and basalt fibers.

Main part. One of the modern and promising methods of increasing the fire resistance of structures is the dispersed reinforcement of concrete structures, that is, the use of fiber

concrete. In particular, basalt fibers, which are obtained from natural rock and have high thermal stability, have great potential for increasing the fire resistance of concrete.

Basalt fibers are obtained by melting natural volcanic rocks. They have the following advantages:

- high tensile strength;
- good chemical stability;
- corrosion resistance;
- stability to high temperatures;
- environmental safety.

The melting temperature of basalt fibers is around 1050–1450 °C, which is significantly higher than that of many polymer fibers.

Basalt fibers form a three-dimensional reinforcing framework in the concrete structure. This reduces internal stresses caused by high temperatures and limits the propagation of cracks. As a result, the probability of concrete bursting decreases and the load-bearing capacity of the structure is maintained longer.

A. Bentur and S. Mindess [1] studied the structure and strength properties of fiber-reinforced concrete and showed that the fibers limit the development of microcracks in concrete. Sim and co-authors analyzed the mechanical and thermal properties of basalt fibers and found that they are relatively stable even at temperatures of 600–800 °C. Pliya and other researchers studied the residual strength of basalt fiber concrete under high temperature.

In studies conducted by J. Sim et al. [2], basalt fiber concrete samples were heated to 600 °C. As a result, the residual compressive strength remained 15–20% higher than that of ordinary concrete.

P. Pliya et al. [3] compared different fiber concretes under high temperature. In basalt fiber samples, structural integrity was maintained even after 800 °C and there was little evidence of explosive fragmentation.

Studies led by M. Branston [4] found that when 0.5–1.5% basalt fiber was added to the concrete composition, the residual flexural strength after fire exposure was 18–25% higher, it was noted that the rate of decrease of the modulus of elasticity at high temperatures is slowed down due to the fact that basalt fibers limit the expansion of microcracks.

In experiments conducted by H. Zhang et al. [5], it was found that basalt fiber reinforced concrete elements retained 70–80% of their load-bearing capacity after fire, compared to 55–65% for ordinary reinforced concrete.

V. Kodur in his work [6] studied the fire deformation of high-strength concrete and showed the importance of polymer fibers in reducing internal pore pressure. However, since polypropylene fibers melt at 160–170 °C, they only serve to open microchannels, but do not contribute to strength at high temperatures.

The analyzed studies show that basalt fibers play an important role in improving the fire resistance properties of concrete. The fibers' high temperature resistance, limiting microcracks, and reducing internal stresses contribute to the preservation of the concrete structure. At the same time, the optimal amount of basalt fibers is usually recommended to be in the range of 0.5–1.5% of the concrete volume.

Conclusions:

1. Increasing the fire resistance of reinforced concrete structures is one of the important conditions for ensuring construction safety.
2. Fibroconcretes with basalt fibers maintain better mechanical properties when exposed to high temperatures than ordinary concretes.
3. Basalt fibers limit the development of microcracks in concrete, reducing the risk of explosive fragmentation.
4. According to the results of scientific studies, the residual strength of basalt fiber concrete can be 15-25% higher after fire.

The use of basalt fiber concrete in reinforced concrete structures increases fire safety and extends the service life of structures.

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