

Manufacturing special fabrics from local basalt threads

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Abstract: This scientific article presents a comprehensive investigation into the technological production of fire-resistant textile materials based on basalt filaments, specifically engineered for advanced thermal and flame protection applications. The study systematically examines the manufacturing processes of basalt-derived fabrics utilizing optimized weaving technologies and locally sourced basalt raw materials. Furthermore, an in-depth experimental analysis of the physical-mechanical characteristics - including tensile strength, structural integrity, thermal stability, and resistance to high-temperature exposure - has been conducted. The obtained results substantiate the significant potential of basalt fiber-based textile structures as high-performance refractory materials for industrial and protective applications.

Keywords: basalt fiber, basalt textile structures, refractory composites, thermal resistance, indigenous basalt raw materials, advanced weaving technology, basalt yarn engineering

Basalt rock is considered a raw material and is widely used in various industries around the world for the production of fire-resistant and heat-resistant materials, metal substitutes, electrical insulators with various potentials, acid-resistant products, composites, Portland cement, and other materials.

Uzbekistan has very large reserves of basalt raw materials, mainly located in Navoi, Jizzakh, Tashkent, and Namangan regions, and their quantitative indicator exceeds 150 million m³. The development of these deposits will allow increasing the production capacity of basalt processing enterprises, creating a new industrial sector and additional jobs for the production of environmentally friendly products for various purposes.

It is known that basalt processing enterprises in the Republic produce a limited range of products, mainly reinforcement for civil and industrial construction, basalt mesh, and non-woven materials. To date, the country's industry has been experiencing a severe shortage of environmentally friendly and cost-effective products made from local basalt raw materials for various purposes. Little attention is being paid to the comprehensive utilization of the raw material potential of the Republic's basalt deposits (Jizzakh, Gavasay, Asmansay, and Aydarkul basalt deposits). The reason for this is the lack of scientifically based methods for

processing basalt fiber yarns obtained from basalt stone, including their composition and physical-mechanical properties, as well as the absence of an effective technological base and methods for producing various textile products.

Addressing these issues is an urgent task, which is of great importance not only for meeting the demand for basalt products in domestic and international markets but also for the production of import-substituting and currency-saving products. To achieve new successes in this area, it is necessary to solve the following issues:

- comprehensive study of the chemical, physical, and mechanical properties of basalt fibers and yarns;
- development of technology for preparing basalt yarns for the production of various textile products;
- creation of technology and technological factors for the production of special fabrics from basalt yarns;
- creation of fire-resistant technical and household special fabrics from basalt fibers intended for various functional purposes.

Basalt fabrics are replacing asbestos, glass, silicon, and other fabrics depending on their function. Basalt fabrics have high-quality insulating, strengthening, and filtering properties. Compared to glass fabrics, basalt fabric has advantages in sound insulation, higher dielectric properties, and superior mechanical characteristics.

The production of textile products for various industries from raw materials - basalt fiber and yarn produced in the Republic's basalt deposits, and the comprehensive utilization of the raw material potential of the Republic's basalt deposits is an urgent task.

At the Department of TMT of TITLI, research is being conducted on creating a range of fire-resistant fabrics for fire-retardant coverings based on basalt fibers and improving production technology.

It is known that the main requirement for fire-retardant covering fabrics is fire resistance, as well as characteristics such as high strength, specified structural dimensions, and resistance to breaking and tensile forces. Basalt threads were used as raw materials in the production of basalt fabric. The fabric sample was produced on the ATPR-100 loom using a plain weave.

Table 1

The following table shows the technological fabric preparation parameters.

Technological parameters of basalt fabric preparation

No	Parameters	Unit of measurement	Value
1.	Linear density of warp yarn	tex	175
2.	Linear density of weft yarn	tex	175
3.	Fabric density along the warp	threads/10cm	60
4.	Fabric density along the weft	threads/10cm	60
5.	Reed number	dents/10cm	60

6.	Number of threads per dent	thread	1
7.	Number of installed heddles	heddle	2

The weave pattern and setup program for the produced basalt fabric sample are shown in the figure. The fabric sample was produced using a plain weave. For the production of the sample, 2 heddles and a pneumatic reciprocating selvedge formation mechanism were used on the loom.

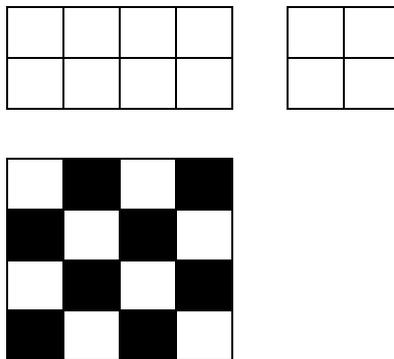


Figure 1. Weave pattern and setup program for basalt fabric

The physical and mechanical properties of the fabric sample were determined through testing at the “CENTEXUZ” laboratory of TTYSI. The breaking strength of the fabric along the warp was 1225 (125) N (kgf) , and along the weft - 784 (80) N (kgf) , with a thickness of 0.375 mm. The surface density of 1 m² of fabric was 252 g/cm². In the production process of the basalt fabric sample with plain weave, the number of breaks in the warp yarns was found to be 0.8 breaks/m, and in the weft - 0.4 breaks/m. It was established that the developed basalt fabric, produced from local basalt threads, meets the required specifications in terms of strength and breaking load. It was determined that this fabric can be technologically manufactured on shuttleless weaving looms.

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