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Features of Basalt Fibre Materials

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ABSTRACT: This article discusses ways to reduce energy consumption in basalt smelting and casting processes. Methods for reducing smelting time, increasing furnace productivity, reducing gas consumption and reducing operating costs during basalt processing are also proposed.

KEYWORDS: basalt, composite, electric arc melting, energy carrier, filler, calorific value, lump, pillow.

I. INTRODUCTION

This article is an overview of the main results of the study of basalt fibre characteristics and presents the experience of the production and use of continuous basalt fibre in various industries. The article provides information on the characteristics and main benefits of basalt fibres. Basalt fibre has great potential to become the next generation of material. The global basalt fibre market is projected to grow at an average annual rate of 13.1 per cent over the period 2015-2020, reflecting the successful use and growth of applications in infrastructure projects, the automotive industry and construction.

II. RELATED WORK

Modern scientific advances connected with engineering ideas, supported by economic analysis and forecasting, make it possible to make fuller use of the natural wealth of Uzbekistan. Thus, the Republic owns the solid mountain ranges of Tien Shan and Pamir, which contain millions of cubic cubic metres of basalt, a silicon-based raw material in a mixture with aluminium, magnesium, calcium, boron and other metals and minerals [1]. Geological studies show that basalt is a very common product in nature, particularly in Uzbekistan in the form of a rock of thousands of cubic kilometres. As a product of tectonic movements, basalt incorporated many rare earth metals, including Sio2 silicon. The composition of basalt changes its natural colour depending on the content of the inclusions. Traditionally, the processes of processing natural basalt are considered to be quite complex, costly and require considerable investment. Basalt fibre consists of a single-component melt of raw material (basalt) and exceeds other fibres in terms of thermal stability, heat and sound insulation properties, vibration resistance and durability. Basalt fibres and basalt fibre-based composites have potential advantages for various applications [2]. Basalt fiber is considered an environmentally friendly and non-hazardous material. It is not a new material, but its use cases are sure to be innovative, and its good mechanical, chemical and thermal characteristics have made it possible to use it in a wide range of industries, from construction and energy efficiency to automotive and aircraft construction. Thus, basalt is gaining more and more attention as a reinforcing material, especially when compared to fiberglass.

III. LITERATURE SURVEY

The high resistance of basalt fibers to high temperatures, acids and especially alkalis is well known. This opens up great prospects for the use of basalt fibers in construction as:

- reinforcing material for concrete and asphalt concrete road surfaces;
- corrosion and chemical resistant basalt-plastic reinforcement, profiles, pipes, the strength of which is 2.5 times higher than the strength of alloy steels;
- non-combustible and fire-resistant composite materials for nuclear and thermal power plants, oil refineries and chemical plants, firewalls (fireproofing structures) of high-rise buildings and other critical industrial facilities where the occurrence and spread of fires is unacceptable;
- chemically resistant and wear-resistant coatings, composite materials;
- filters for filtering industrial and domestic wastewater, filters for smoke and dust emissions from industrial enterprises
- materials for the automotive industry [3].

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The technical and economic analysis shows that basalt fibers and materials based on them have the most preferable value for money in comparison with glass fibers. In these industries, the use of basalt fibers has a special perspective.
Based on the listed properties, basalt fibers have an unusually wide perspective for use in various industries and construction. The approximate composition of basalt: SiO2=40÷55%, Al_2O_3=15÷25%, MgO=3÷15%, CaO=10÷19%, B_2O_3=8÷12%, as well as trace elements Li, Na, Fe, Cr, Ca, Al, Ti and others [1].

IV. METHODOLOGY

Basalt according to the structure of the crystal lattice is subdivided into albite and anorite, and anorite, in turn, is divided into oligoclase, andesine, labradorite, bitovite, anorite, pyroxene, olivine. The variety of composition and structure of basalt allows you to obtain products of a wide range of colors. Mankind learned to industrially use (melt) basalt in the 50 years and in the Republic of Uzbekistan in the 90 years of the twentieth century. Lithium basalt has an even lower friction coefficient and the highest wear resistance of 1,600 2,900 units. Compared to corundum alone. However, the use of basalt products has not been widely used (2-3 enterprises have been built producing super thin and short fibre used for insulation of pipelines heat, gas pipelines, roof covers and so on).
The problem of promoting basalt as a finished product is not its properties, but the cost of devices and furnaces forming fibrous mass, for example, one set of the plant costs more than $400,000.

In turn, basalt products are needed by the Republic of Uzbekistan, neighbouring States as well as countries of South-East Asia, Europe and America. They solve many of the problems of the construction automobile, gas, oil, chemical and other industries. Heat-insulating cushions for our republic alone require more than 1000 000 units per year. (one cushion weighs 10 0.5 kg).

Basalt materials replace clay, marble, cement, asbestos, granite, natural fibres, with basalt products serving humans for an order of years and being ecologically clean.

Another use of basalt is the casting of specific products such as bricks, tiles, finishing plates, schiffer, flower pots, decorative utensils, jewellery, etc.

Basalt fibre production is based on four main stages:

- Pre-treatment of basalt gravel (crushing, washing, drying);
- melting basalt crumb in a smelting furnace to produce
- continuous filament in the form of a complex filament;
- continuous fibre forming;
- woven fibre into fabric or other forms of finished product, depending on the scope of further application

Natural basalt (lump) is extracted openly using both mechanical rock destruction devices and explosion. Once the soil has been cleaned, the block is shredded in mills to a size of 3x3x3 cm and fed for smelting. The source of heating is natural gas and electricity. The liquid basalt is fed into a monofibre formation device which is further split into fibres of a thickness of 4 - 5 by a burning gas-air flow microns collected on a condenser in the form of cotton of the specified thickness. The resultant cotton wool is cut along the axis of the condenser drum and packed as a roll into a paper bag called "pillow". The fibre, at the customer's request, can be produced in the form of a "vatin" of a specified length and thickness, providing it with the necessary strength and plasticity or in the form of a belt, yarn, etc.

V. EXPERIMENTAL RESULTS

The basalt product is a sufficiently light, stripped product with a mirror surface, if necessary with a bas-relief drawing, which is moisture-resistant and resistant to high temperatures, It binds well to polymers, so it is a perfect filler for composite materials, has unique heat and soundproofing properties. Products made of basalt will serve the person for hundreds of years [2].

The effect of new technologies is achieved by the modernization of known techniques. Thus, in the production of super-thin fibres, only four to five years ago, devices were used for the preliminary formation of monofilaments and the subsequent splitting thereof. hut later used a slit spill basalt. All of these plants were worth considerable sums due to the inclusion in the alloy of various devices of expensive metals (one filler was used 6250-360 thousand standard units). Nowadays the technology of formation of super thin fibres in vortex "twisted" flow has been created, wherein splitting of basalt is made immediately, and there are no expensive working elements. The device is so reliable in operation that it does not require highly qualified maintenance personnel.

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The developed strategy is aimed at creating small production units producing a limited range of products from basalt, while introducing systems with a limited number of operations. This makes it possible to simplify and shorten the length of the line, save energy and capital.

Therefore, it is necessary to make full use of basalt and for this purpose it is necessary to change the technology of its production by excluding from the processes expensive working organs such as filiera from platinum, create separate processes, where the economic design options have to be justified.

In order to achieve the stated goals and objectives, we have investigated the materials and structures of basalt-spill devices, and the variants of the smelting process and the formation of the finished product from it.

The technology separation strategy makes it possible to minimise the number and design of basalt processing devices, and to apply to technologies low-level mixtures of plasticizers, soaker mixers and other gamers, expanding the scope of the use of basalt products both in the Republic and on the foreign market. Analysis of the comparison of traditional production technology with Small ones using the separate principle of basalt processing has shown a significant reduction in the cost of the finished product. The results of research work on replacement are used in the calculations High-cost working elements in basalt processing, including development of short-term technologies.

In the development of a strategy for the use of small-scale basalt processing plants on the basis of new technologies and the design of end-product production devices, calculations have been made of the efficiency of the production of super-thin fibre and examples of economic justification Replacement of natural fibres with flax, kenaf and jute with basalt with sound-heat insulating pads in the cabins of vehicles manufactured in the Republic of Uzbekistan, replacement of glass-fibre pillows (imported material) for heat insulation of buildings and constructions, economic calculations and justification of basalt as an element of the building industry, on the basis of the production of brick, schiffer, shingles, decorative tiles.

VI. CONCLUSION AND FUTURE WORK

The main properties of basalt fibres, such as high thermal conductivity, fire resistance and rot resistance during operation in various aggressive media, define the following applications:

- heat-insulating materials with and without various binders (blanket mats, canvases, plates, shells, cords, etc.);
- sound-absorbing materials and products (acmigrans and plates thereof);
- construction structures (sandwiches, modular slabs);
- products using fibre as a substitute for asbestos (fabrics, cardboard, friction materials, etc.);
- industrial and household filters for the treatment of gaseous and liquid media;
- composite materials with different plastics, resins and other components to produce materials with specified properties;
- artificial soil for hydroponic cultivation of seedlings and plants.

Advantages of heat-insulating materials from basalt super thin fibre:

- higher application temperature. Mineral products are used up to a temperature of 400°C, heat-sounding materials from basalt super thin fibre have a temperature of long-term use - 750 °C, short-term - up to 900 °C;
- do not break down under the action of heat changers «heating-cooling», at the increase of temperature and at the cyclic action of temperature retain their characteristics and geometric shapes;
- Low thermal conductivity, which requires several times less to achieve the same thermal conductivity of basalt super-thin fibre materials, thus reducing the total cost of insulating materials, The overall size of the insulated product is reduced, and the labour costs of insulating work are reduced;
- Low density, which gives these materials good thermal and sound-proof properties;
- high thermal resistance;
- chemical resistance;
- combustibility, fire safety and explosive safety;
- They have the formula of natural stone - basalt. In contrast to basalt fibre, mineralized products contain 4-5% by mass of organic matter;
- Installation performance;
- durability. The service life of basalt fibre materials is several times higher than that of mineral wool products and reaches 30-40 years;
- not susceptible to fungi and mould;
- are not afraid of ultraviolet light;

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- are not afraid of vibrations, so the products of mineral cotton are destroyed by vibration;
- has good soundproofing properties.

The study examined basalt rock, its properties, composition, texture and application. The initial basalt fibre material, basalt fibre, was further examined, and then the process of basalt fibre production was examined.

In general, it has been proved that the introduction of engineering innovations in the processing and formation of products from basalt is profitable production, which will allow enterprises to enter the world market and to obtain currency on an equal footing, for example, with the cotton company.

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