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Processing of basalt fiber production waste

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Abstract. The production of mineral rock wool forms a large proportion of off-test waste products. In addition to the cost of their production, there are costs for processing and utilization, such as transportation, disposal and preservation. Besides, wastes have harmful effect on the environment. This necessitates research aimed to study the stress-related characteristics of materials, their recyclability and use in the production of heat-saving products.

1. Introduction
One of the important directions of resource-saving is the provision of thermal insulation of industrial and residential buildings due to the constant cost increase of their heating. As a result, the demand for environmentally friendly insulation increases significantly, in the manufacture of which different insulation materials are used, including basalt fiber [1].

The waste in the production of basalt fiber by the existing methods can be up to 15%, which is often just utilized. This, of course, has a detrimental effect on the environment.

The aim of this research is to identify possible ways of using waste in the production of basalt fiber, the study of its stress-related characteristics and determining its optimum fractional makeup for the use in the end products. This research sets a goal also to create a device and method for desagglomeration of fibre by-products [2, 3].

2. Materials and methods
Basalt fiber is produced from a melt of basalt in the melting furnaces by its free flow through the spun plates, made of heat-resistant metals. Due to the fact that raw material for production of stone wool is rock formation, thermal insulation products meet the requirements of fire safety and can be used as fire insulation and fire protection. The limit of sintering temperature of basalt fibers is 1000 degrees Celsius, resulting in a high maximum operating temperature [4].

The process of making rock wool, excluding the cutting waste (6÷8 %), gives off-test products and freak stock (5÷8 % of the total volume of output). Thus, from 5 to 15 % of total output is not suitable for use and sale because of its low quality. In many cases it is impossible to reprocess the cutting waste and the residues have to be utilized as waste.

Defect products and cutting waste are taken to special landfills for utilization. This, of course, has a detrimental effect on the environment. In addition to this, the particles of the material obtained in the processing of basalt fibers can get into human lungs and cause unwanted effects. For this reason the structure of basalt fiber is enriched by some elements, which help to create a relatively secure main product for the use in the manufacture of heat-shield materials. But artificial building materials can contain trace components that have a damaging effect on the human body.

At the same time, the question of what kind of harmful effects can be caused by certain components of protective materials used in a particular construction, containing these materials, is very difficult. It is also known that natural materials can evolve contaminants, such as when heating plug.

However, the environmental pressure of the whole complex of technological processes for obtaining and operating basalt fibers is incommensurably lower than in the production and use of similar glass or mineral materials.

Basalt fiber, in addition to the mentioned above, is an effective microarray additive in concrete and other solutions based on cement or gypsum (Figure 1) [8].

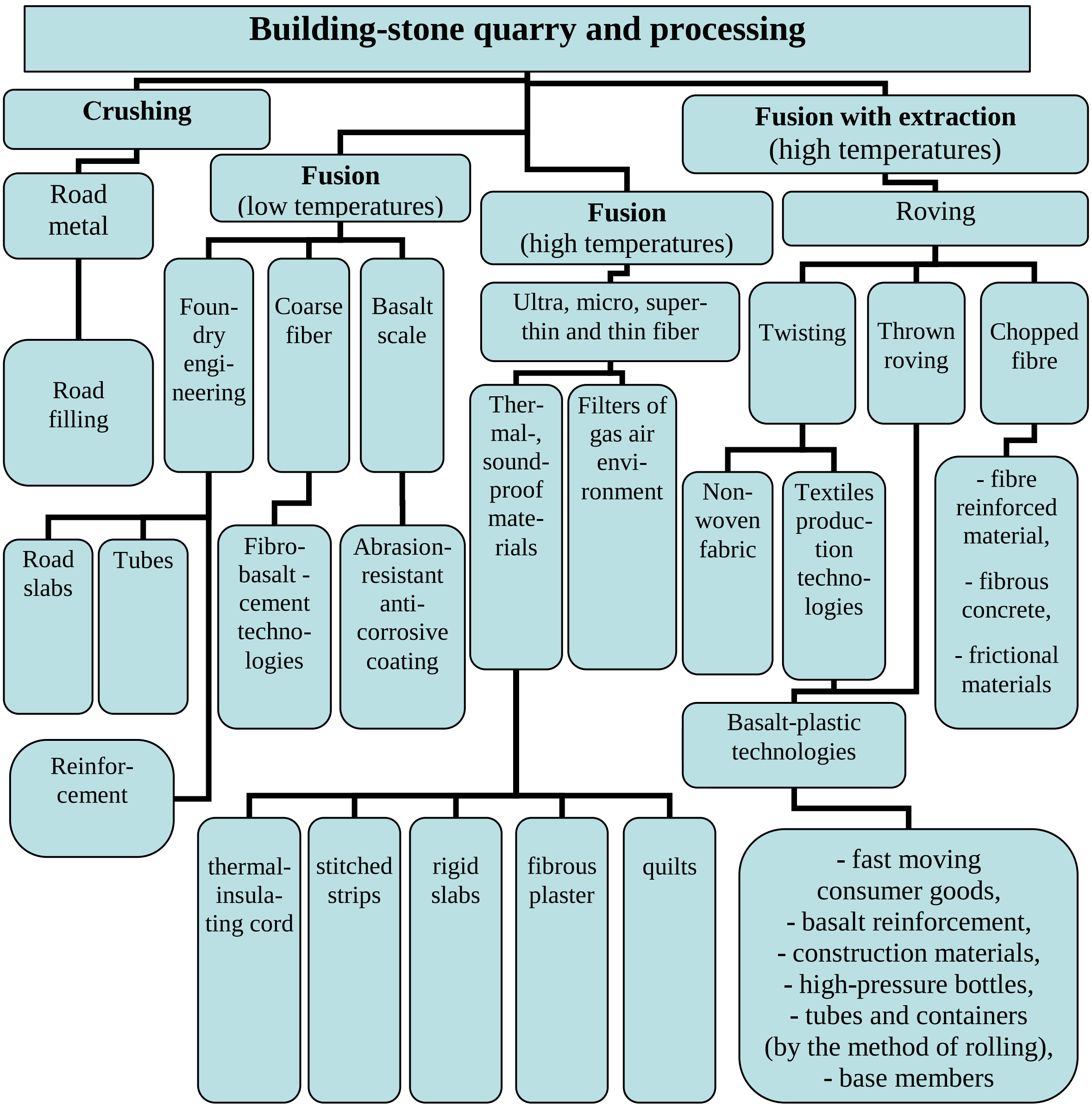

Figure 1. Scheme products based on basalt fiber translation

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It increases the resistance of concrete to the strain at the initial stage. When concrete begins to shrink (at a later stage), basalt fibres prevent cracking of the concrete, thereby reducing the risk of fracture. In the manufacture of ornamental products of cement or gypsum, basalt fiber reduces the amount of product failure by 90÷100%.

The use of basalt fiber in concrete solutions reduces the formation of shrinkage cracks at an early stage by 90% (wire-mesh reinforcement reduces this figure by just 6%). But, in cast-in-place construction, basalt fiber still cannot be used as a replacement for steel reinforcement. It is possible to use reinforcement made of basalt-plastic.

The use of basalt fiber can make the hydration process of concrete slower, thus reducing the internal stresses under temperature variations. Basalt fiber is resistant to physical damage during mixing , to all chemical substances, contained in the composition of concrete, and to the alkalis, used in the production processes. Basalt fiber is heat-resistant, noncorrosive (which is typical for steel fibers),easily distributed without forming clusters, long-lasting, compatible with any additives and concrete additives, including plasticizers, antifreeze additives, accelerators and retarders of setting and hardening [5, 9-12].

The given above analysis of the fields of basalt fibre use, arises not only the problem of providing the necessary technological conditions for industrial materials processing, but also of receiving from industrial materials microfiber fillers with desired physical and mechanical characteristics: size, shape, dispersiveness, etc.

3. The proposed solution

To solve the problem of utilization of basalt fiber waste, it is proposed to be used for dispersed reinforcement of concrete. The patent research has been conducted, with the aim of finding technical solutions for desagglomeration of waste production of basalt fiber [6-7].

The technical proposal is shown in Figure 2.

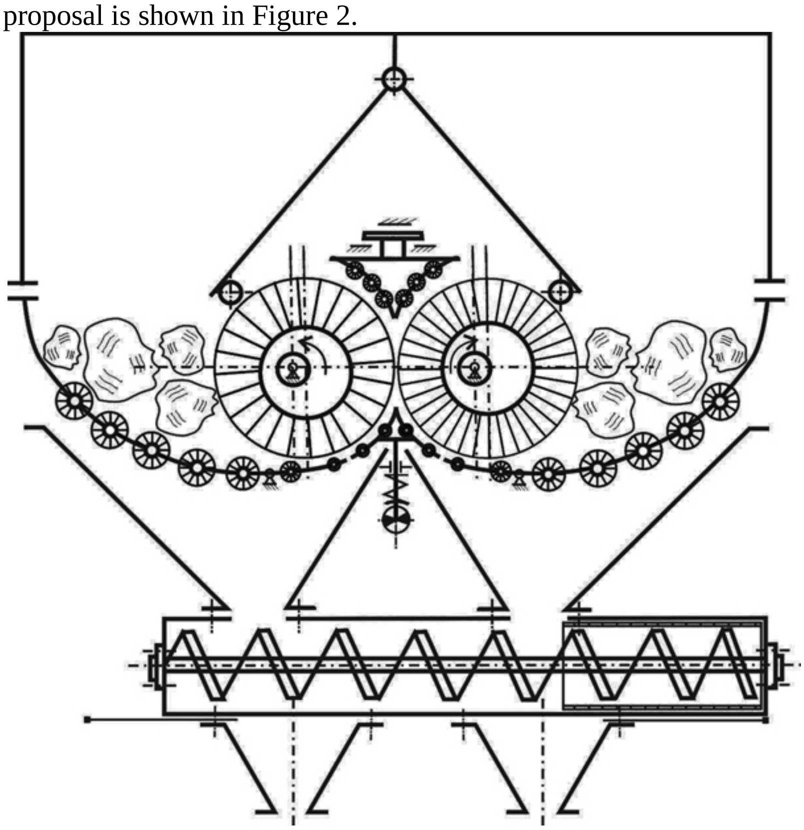

Figure 2. Device for desagglomeration

Method of desagglomeration of fibre by-products implies the repeated exposure of needle-milling working elements mounted on the rolls. Rolls having different circumferential speeds, provide tensile force and effect on the compressed fibrous material. The device allows one to filter out fine-grained materials, and by vibroseis stimulation eliminates the seal material between the rotating towards each other of the needle-milling rolls and contributes to spatial orientation of fluff fibers in the direction of flow. The method also includes the selection of desagglomeration material for the individual fractions.

4. Conclusion

Thus, the proposed method and design of the device will effectively separate the fibrous materials and also make selection of desagglomeration material required for the individual fractions. The resulting basalt fiber can be used as an effective microarray additive in concrete and other solutions.

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References

[1] Ural'skiy V I, Sinitsa E V, Ural'skiy A V, Sazhneva E A 2017 *Bulletin of BSTU named after V.G. Shoukhov* **10** 144–148
[2] Sevostyanov M V 2016 *Bulletin of BSTU named after V.G. Shukhov* **4** 140–145
[3] Sevostyanov V S 2006 *Monograph* 436
[4] http://www. basaltech.org/ forum/forum73/topic481/messages
[5] http://budmat.kiev.ua/stattjy/statjy/bazaltovayafibra.html
[6] Shatalov A V, Dubinin N N, Shevlyakov V I 2014 *International conference* 363–366
[7] Dubinin N N, Evtushenko E I, Nemets I I, Nosov O A, Osokin A V 2014 *Research Journal of Pharmaceutical, Biological and Chemical Sciences* 1710–1718
[8] http://www.2013.arko24.ru/project/bazaltovoevolokno
[9] Wei B, Cao H, Song S 2010 *Materials Science and Engineering* **18-19** 4708–4715
[10] Rybin V A, Utkin A V, Baklanova N I 2013 *C'em. Concr. Res.* 1–3
[11] Park S H, Kim D J, Ryu G S, Koh K T 2012 *Cement and Concrete Composites* **2** 172–184
[12] Rybin V A, Utkin A V, Baklanova N I 2016 *Corros. Sci.* 503–509