

Insulation material “Fibrol”

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Abstract - Described in article new insulation material could be produced from recycled materials so very cheap raw materials. So, it is promising for use also in countries with limited income level and readily available components. Mixture of fiber and foamed materials need not to apply certain binders or adhesives what make production costs even lower. Large amount of natural and artificial types of fibers and almost the same number of natural and artificial foam materials allows to combine the raw materials and create numerous types of final materials for broad range of applications, demanding specific material properties. Different combinations of raw material provide possibility to create moisture resistant or materials withstanding high temperatures. Mixing different components, it is possible to create insulation plates with different density, having broad range of mechanical properties and shapes. In loose form this material is useful to fill cavities in walls or insulate surfaces by simple pouring. Superior thermal performance makes it among best insulation materials. Low cost of material provides the possibility to use it in energy efficient or even passive houses. Described insulation material due to broad range of raw materials has to be engineered to certain demands of certain application and every case is individual with its own properties, so only those types, available for wholesale market are with determined thermal property values. Other important feature of this material is “breathing” – one of few materials applicable for wooden house insulation from inside, according to demands for historical houses. This article is dedicated to general description of this novel insulation material and its properties. All theoretical descriptions and mathematical model is available in article, mentioned in references.

Keywords: new insulation material, foam and fiber mixture, recycled raw materials.

I. INTRODUCTION

Energy efficiency measures in the national economy and in the private sector, for example the measures taken on saving the heating, electricity and fuel; more widespread use of public transport and cycling parallel to informative campaigns for the society and its involvement, are tasks of governmental importance. The most important criteria of energy efficiency success is reduced consumption of heating, electricity and efficient consumption of energy resources both, in the private and the governmental sector. Taking into consideration the previously mentioned issues, the applicant of this project intends to expand the development and research of the thermal insulation material “Fibrol” and commercialize the obtained technology. During the manufacturing process of this product no binding agents are used, characteristic to manufacturing of thermal insulation

materials. The innovative insulation material consists of homogenous mixture of fiber material and thermal insulation material which is hold together by the mentioned fiber material. Any organic or non-organic origin fiber can be used as the source of the fiber material, for example, cellulose fibers (shredded waste paper), tow, and granulated herb bundles; hey, cotton, cloth fibers, glass, basalt or rock wool or any other suitable material. Any organic or non-organic material which possesses good thermal insulation properties, can be used as the source of the insulation material, for example, foam polystyrene (both, extruded and granulated), foam polyurethane, cork, dry bark, dry pieces of hemp straw, or any other suitable material. The insulation material is obtained by soaking the source of the fiber material in water, stirring and chopping, thus processing it into pulp. The obtained pulp of the fiber material is mixed together with the chopped insulation material until a homogenous mixture is formed. Binding agents can be added to change the attributes of the insulation material. To make the material fireproof, fire retardant is added, for example, ammonium sulfate. The obtained mixture is poured into molds and pressed to separate water and give the insulation material the necessary shape. The obtain mass can be used to fill up the empty gaps in a building construction or building material, thus obtaining an insulation segment for the mentioned materials or constructions. In such cases pressing is not obligatory. After the water has been extracted the obtained insulation material is dried until it is dry as air. An advantage of this material is that when chopping the fiber material in water, the energy needed for the chopping reduces, which consequently lets us obtain a more homogenous liquid mass which improves the quality of the ready-made product. Another advantage of this product is that it is possible to use only secondary raw materials, for example, shredded waste paper and foam polystyrene waste. Another advantage of this discovery is its suitability for insulation of wooden houses, because this insulation material provides the necessary function for wooden constructions of “breathing”. Owing to the interlayer of the fiber material, the water vapor can migrate within the insulation material, however in limited depth. To improve the ability of the fibers of the shredded waste paper to bind with the particles of the foam polystyrene, the mass can be treated with vapor or hot air during the process of pressing.

Such type of manufacturing technologies is in line with the National Economy Transformation Direction defined by RIS3: “No. 3 Industries with significant horizontal impact and investment into national economy”. Alike, it is in line with the growth priority No. 3 “Increase of energy efficiency which includes creation of new materials, optimization of manufacturing processes, implementation of technological

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innovations, usage of alternative sources of energy and other solutions”. Even more, considering the process of “Fibrol” technology of manufacturing and the used raw materials, it can be concluded that the corresponding area of the smart specialization is “No. 1 Knowledge-intensive Bio-economy”.

At this moment the stage of technology readiness is TRL 4 - Technology validation in laboratory environment, i.e., the integration of the key technological components has been performed to test their co-operation in laboratory environment. Under laboratory circumstances, several types of the new thermal insulation material samples have been acquired by the help of the new technology. Analysis of these sample is being done and laboratory research is ongoing. Which means that there has already been fundamental research done and industrial research needs to be undertaken. It is necessary to start validating the technology in an artificially created environment: technological components must be integrated with real support elements to check the technology under such circumstances. The system model needs to be tested in the laboratory (artificial environment). Then it is necessary to do the experimental production with a following system prototype demonstration in a real operating environment: a system prototype that corresponds to the planned system or has only a tiny deviation from it. This means that the prototype of the technological system has been tested in the real-world environment and technology readiness level TRL 7 has been achieved. This is what is necessary to be able to successfully perform the intended commercialization. The experimental production of the technology under development is intended to be done in co-operation with a waste polygon which is run by Ltd “Liepajas RAS”, based on a mutually signed contract. Such decision has been made owing to Ltd “Liepajas RAS” ability to provide the prototype of the experimental production with the needed raw materials.

II. NOVELTY OF TECHNOLOGY

Differently from the manufacturing process of the traditional eco-construction wool, “Fibrol” is obtained by soaking the source of the fiber material in water, stirring and chopping, thus processing it into pulp. The obtained pulp of the fiber material is mixed together with the chopped insulation material until a homogenous mixture is formed. Binding agents can be added to change the attributes of the insulation material. Compared to the manufacturing costs of other insulation materials, “Fibrol” prime cost and consequently also its price is on average 33, 33% to 50% cheaper. Information on this material has been published in the Patent Catalogue (patent No. LV15123). The information has been published by the Head of the project under development, Armands Grickus. There have been publications related to this technology-to-be-commercialized [1], which is a scientific article approved for publication.

There are no binding agents used for making insulation materials during manufacturing of this product. The innovative insulation material is a homogeneous mixture that consists of a fiber material and a thermal insulation material which are held together by the mentioned fiber material. This is in principle a new concept for manufacturing of such thermal insulation materials. Plus, the manufacturing process

itself happens by processing soaked materials which allows to save on energy and cost of equipment. This is how in the course of this project the intended approach will offer significant advantages versus other thermal insulation materials present in the sector.

III. ADVANTAGES OF TECHNOLOGY

“Fibrol” is:

- ecologically clean, natural and anti-allergic – it is being made of recycled materials, without pollution to the surrounding environment and without an impact on human health;
- it secures “breathing” of the building and humidity regulation;
- it has high thermal insulation capability - eliminates convective heat loss;
- it contributes to effective sound insulation – owing to its structure because cellulose fibers is a very effective sound-drowning material;
- this material is pests and rodents unfriendly – it is the contained fire retardant that provides protection against pests and rodents;
- fireproof and flame retardant – during manufacturing it has been treated with fire retardant; exposed to open flame “Fibrol” will only burn off and will be able to protect the bearing structures against fire for much longer.

The main advantage of “Fibrol” as opposed to the traditional thermal insulation materials is the decreased coefficient of heat loss. For example, the data acquired during the course of feasibility study, let us conclude that the potential thermal conductivity coefficient λ – 0,033 W/(m²K), which is less if compared to competing material, for example, “Werro Wool” cellulose wadding, out-of-sack glass wool and rock wool. Therefore, the following can be concluded:

The thermal conductivity coefficient of “Werro Wool” cellulose wadding (λ) is 0,0409 W/(mK);

The thermal conductivity coefficient of out-of-sack glass wool (λ) is 0,042 W/(mK);

The thermal conductivity coefficient of out-of-sack rock wool (λ) is 0,045 W/(mK);

The thermal conductivity coefficient of “Fibrol” loose material (λ) is 0,033 W/(mK);

Consequently the thermal conductivity coefficient of “Fibrol” is 26,66% better than the coefficient of the out-of-sack rock wool; it is 21,43% better than the one of the out-of-sack glass wool and 19,32% better than the coefficient of “Werro Wool” cellulose wadding.

The lower is the thermal conductivity coefficient, the better are the insulation attributes of the material. Due to his unique qualities “Fibrol” creates a uniform, seamless thermal insulation layer which allows to achieve greater heat resistance. This is one of the cheapest thermal insulation materials as it is made of recycled paper and its manufacturing does not require a huge energy consumption as compared to the manufacturing costs of other insulation materials.

It is estimated that “Fibrol” prime cost and consequently also its price is on average 33, 33% to 50% cheaper than for similar thermal insulation materials such as eco-construction wool. And 50% cheaper than another analogue – Izoprok. Moreover, one should take into consideration the fact that the thermal conductivity coefficient of eco-construction wool (λ) is 0,039 W/(mK), the same as Izoprok. All the above-mentioned advantages of “Fibrol” are owing to the new technology it is made of.

made by the Latvian company Ltd “Thermeko”. Nevertheless, this product is manufactured in the conventional style, without using fiber material as binding agent, as well as without treating the soaked material, which contributes to the higher prime cost of the mentioned product and makes “Fibrol” a much more attractive alternative for the potential customers.

REFERENCES

1. Armands Grickus, Sharif E. Guseynov (2015). On one Mathematical Model for Dynamics of Propagation and Retention of Heat over New Fibre Insulation Coating. – Proceedings of the 10th International Scientific and Practical Conference "Environment. Technology. Resources", June 18-20, 2015, Rezekne, Latvia, ISSN: 1691-5402, Vol. 3, p. 82-86. DOI: <http://dx.doi.org/10.17770/etr2015vol3.504> SCOPUS

IV. TARGET MARKET & THEORETICAL RESULT

The most common problem that the construction companies are faced with, is the very high requirements for the thermal insulation materials which subsequently increases their price. Another issue is the potential presence of allergens in products that are not ecologically clean. The thermal insulation material “Fibrol”, made after the new technology, can solve this dilemma when one should make a choice between a cheaper lower quality product or a much more expensive better quality one. Carrying out a little feasibility study in the potential markets (Germany, Great Britain, Scandinavia and Baltic countries), the Applicant of the project has learnt that energy efficient houses (consequently also the thermal insulation material) are becoming more and more popular and on demand. This is also owing to the lately growing demand for ecologically clean and natural construction materials, therefore, also contributing to the growing demand for such type of houses. Considering the advantages of the technology used in “Fibrol”, different from other similar materials it also provides the necessary humidity regulation and ecological tidiness which is very important in so dynamically growing sector as passive (also ecological material built of) house construction. The main task of the contemporary construction sector is to create as ecological as possible living space for a human which consequently also has a great impact on the ecological condition of the Planet Earth in general. By building houses of ecological wood and with ecological thermal insulation materials, which moreover also stand out for their better specific conductivity of heat coefficient, the micro climate is healthier and gives sense of comfort. This is exactly the market the new technology-made thermal insulation material “Fibrol” is intended for. The potential target market for “Fibrol” most definitely is Scandinavia which has a high demand for such type of projects. It is well-known that every degree of “cold” is about three times more costly than the degree of heat. It means that this insulation material is promising for use in countries with hot climate, too.

During the course of commercialization, it is necessary to speak up to manufacturers of construction materials who pay a lot of attention to the use of green technologies and energy efficiency because the needed raw materials for the production of “Fibrol” can be entirely secondary use. For now the capacity of the potential outlet market has not been fully measured. But one is for sure already now, the new material can be used not only in the construction of passive or ecological houses, but also in the construction of block houses and renovation, which greatly expands the volume of the potential market. Speaking of competition, it is essential to mention the eco-construction wool “Izoprok” which is