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Performance Evaluation and Research of Alternative Thermal Insulation Based on Waste Polyester Fibers

Rostislav Drochytka[a], Michaela Dvorakova[a]*, Jana Hodna[a]

[a]*Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 602 00, Brno, Czech Republic66*

Abstract

In the production of building materials the emphasis is put on the utilization of waste materials generated in various industrial processes. The production of secondary raw material increases annually with the increase in production volume that is highly dependent on increasing demand. Based on material properties of harmless raw material the utilization in civil engineering is being search. This paper deals with laboratory examination of fundamental material characteristics such as composition, size, shape and thermal and acoustical properties. This paper is subsequently dedicated to the complexity of making a thermal insulation from polyester fibers and bi-component fibers. The research aims to eliminate the amount of waste going to landfills and expand manufacturing industry of producer. The tests results show that the thermal insulation from waste polyester fibers has comparable characteristic with mineral/rock wool.

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Keywords: thermal insulation, waste material, polyester fibres, bi-component fibers

* Michaela Dvorakova. Tel.: +420 541 147 501; fax: +420 541 147 502.
E-mail address: dvorakova.m@fce.vutbr.cz

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1. Introduction

Annually approximately 250 tons of waste polyester fibers with residues of polyvinylchloride (PVC-P) granulate are produced. Produced waste material is partly returned to production as recycled and about 200 tons of waste is landfilled. Charges for landfilling represent an annual cost of around €8,000. The planned doubling of the production capacity of waterproofing membranes leads to doubling production of waste and thus the cost of landfill.

Fibrous material tested in this study is generated within production of multi-layer synthetic membrane for roof waterproofing membrane. It is based on premium-quality plasticized polyvinyl chloride (PVC-P) and reinforcing polyester mesh. A high-tech method of co-extrusion is used to produce this membrane, which consists of two layers, holding reinforcing polyester mesh in the middle (Fig. 1. (a)). The upper layer of light grey color provides very high resistance to weather and UV rays, while the underlying dark grey layer is punching resist [1].

After cooling down the final membrane the jagged edges of wide 50 - 100 mm are cut off and transport to the recycling line. Primary the cut and cutting are chopped, then spun and finally separated in separating line on polyvinylchloride granulate and polyester fibers.

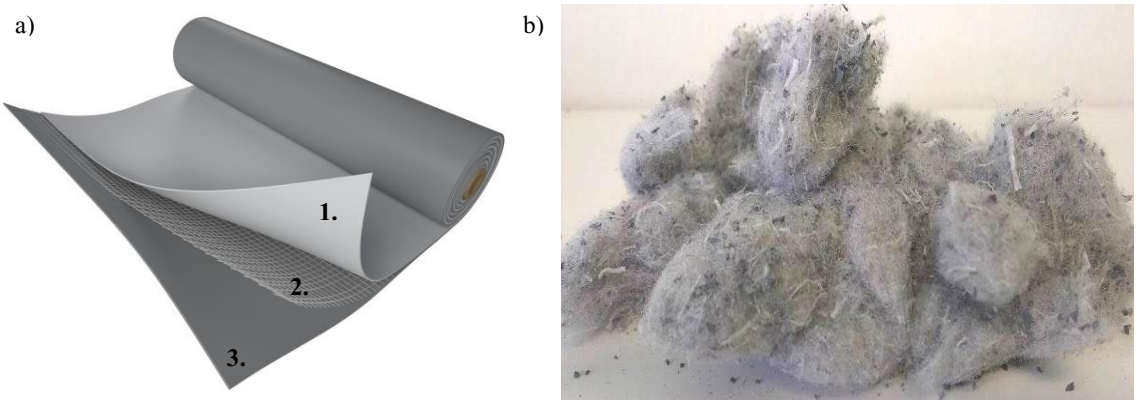

Fig. 1. (a) Synthetic multi-layer waterproof membrane for roof consist of three layers:1. upper PVC-P layer, 2. reinforcing polyester net, 3. bottom PVC-P layer. [1]; b) Photo of polyester fibers with residues of polyvinylchloride matrix.

The current Czech legislation is very weak from the perspective of further use and utilization of produced waste materials. A fundamental document in the field of waste management in Czech Republic is Government Regulation No. 197/2003 Coll., The Waste Management Plan which establishes basic principles and measures for all relevant aspects of this branch. Based on this, companies and producer cooperate with universities and research centers to test and develop product based on waste material and apply it in building practice.

Based on the preliminary laboratory testing the waste fibrous material has potential for thermal and acoustic insulation used in building industry. In recent years, the field of thermal protection in buildings is focused more upon ecological properties. Environmental awareness is not only focused on energy savings and utilization of ecologically friendly materials [2-5], but also on utilization of harmless waste material instead of landfilling. Development in the field of thermal and acoustical insulators has undergone great progress in recent years. Besides traditionally used thermal and acoustical insulation based on polystyrene, mineral and glass wool there is a wide range of commercially available insulators from sheep wool, jute, recycled cotton, cellulose, technical hemp, straw and etc. [2-6]. Approximately 5.8 mil. tons of textile waste fibers are produced per annum within EU and only approx. 25 % are recycled and reused [7-8].

The main idea of this study was to obtain sustainable, environmentally friendly and cost effective insulation material with potential use in construction practice. The goal of this contribution was to determine the basic physical characteristic values for thermal and acoustic product based on polyester fibers.