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## Polyester apparel cutting waste as insulation material

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### ABSTRACT

Polyester waste is the dominant component of the clothing industry waste stream, yet its recycling in this industry is rarely addressed. This paper proposes using polyester cutting waste as an insulation blanket for roofing and buildings' internal walls in order to reduce environmental pollution. The designed textile structures used waste cuttings from different polyester fabrics without opening the fabric to fibre. Thermal insulation, acoustic insulation, fire resistance and biodegradation of the new insulation structure were investigated and compared to commercial insulation materials. Standard investigation methods were modified to fit the samples voluminous nature. The coefficient of thermal conductivity ranged between 0.0520 and 0.0603 W/mK. The achieved sound absorption with *NRC* ranging from 54.71 to 74.77%, surpassing standard commercially used insulators. The insulating structure did not conduct flame, the radius of impaired place was 1.60–2 cm while the depth was 0.4–1.3 cm, and showed lack of biodegradability, with loss of mass ranging from 0 to 0.3%.

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### 1. Introduction

In 2014, the production of man-made fibres amounted to 55 million tons, accounting for over 70% of the total world fibre production. Polyester production accounts for nearly 60% of man-made fibres and is projected to double in the next 20 years (Carmichael, 2015). The end use of polyester has diversified, yet clothing and household textiles are predominant. According to (Jorgensen & Jensen, 2012), 55% of world production of textiles and apparel are based on synthetic fibres, mainly polyester. Manufacture of these fibres is based on oil, which has become increasingly scarce. Moreover, these fibres are not biodegradable, hence their recycling should be given priority. Therefore, the study of technically and economically feasible alternatives for recovery and recycling are necessary.

One of the dominant environmental problems for the clothing industry is the production of waste during the cutting processes. Although all contemporary waste management systems consider landfilling as the worst waste removal option, it remains the preferred manner of textile waste removal (Sakthivel et al., 2012). In the EU, consumers throw away about 5.8 million tons of textiles, of which about 4.3 million tons are disposed of in landfills and incinerated, while only 1.5 million tons (25%) recycled (European Commission, 2012). The recycling of textile waste can be done by chemical or mechanical processes. At present, mechanical rather than chemical recycling methods are preferred due to their cost-efficiency. The recycled waste finds end use mostly in construction, as insulation material.

Insulation materials represent a major tool for constructing energy-efficient buildings. Inorganic fibrous materials – stone and glass wool and organic foamy materials-expanded and extruded polystyrene are dominant on the European market. The performance of insulation materials is a multi-criteria problem, which has to be carried out with respect to: physical properties, health and environmental protection, applicability as building elements and their cost (Papadopoulos, 2005). Good thermal and sound insulation are the primary requests posed on insulating materials. Most traditional insulating materials are characterised with coefficient of thermal conductivity of 0.030–0.045 W/mK and noise reduction coefficient of 0.5–0.9 (Srivastava, Dhabal, Suman, Saini, & Panchal, 2006).

Recycled textile waste can be used as a raw material for insulation structures. Theoretically, 97% of textile waste can be recycled. Recycling textile waste has ecological, as well as economic benefits, making it more popular in the past decades (Jordeva, Tomovska, Trajkovic, & Zafirova, 2015). In the countries of the European Union, the production of ecological products with reduced harmful effects on the environment has become a priority. Ecological labelling of the products in the EU started with the application of EEC num. 880/92 EU Council in 1992, with the purpose of motivating the business sector to develop products that would fit in the scheme of ecological products. This has led to efforts toward the production of ecological insulation materials from recycled textile. Commercialised products of this kind in Europe are Inno-Therm and Le Relais, obtained by mechanical recycling of post-consumer cotton.