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UPCYCLING OF POLYESTER FIBER AND GARMENT-TEXTILE WASTE

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Abstract

This research is part of the project MATE.RIA, aimed at extending the life of post-consumer garment-textiles and identifying a new market for polyethylene terephthalate (PET) waste produced during fiber manufacturing. Here we investigate the possibility of developing innovative products exploiting the thermal insulation capability of textiles for architectural applications. The materials considered in this work are the polyester fiber waste from the production line and the end-of-life garment-textiles, provided by the project partners FranaPolifibre and HUMANA, respectively.

Gel Permeation Chromatography, Differential Scanning Calorimetry, and uniaxial tensile tests were used to preliminarily determine structural, thermal, and mechanical properties. The materials were then used to produce prototype of thermoregulatory panels, which were obtained by applying a layer of PET to one or both fabric surfaces: the fabric acts as a thermal insulator while the PET layer provides rigidity.

Two techniques were used to apply PET layers on a fabric: textile dip coating in PET solution and coupling with cast film. Both processes required the preparation of a PET solution. Hexafluoro isopropanol (HFIP) has been selected as solvent due to its compatibility with the textiles.

A solution of 250 g/L was utilized for dip coating. Textiles varying in percentages of cotton and polyester were dip-coated in a solution on their "Right side", "Wrong side", or on both surfaces. Cast films were obtained by 200 g/L of PET/HFIP. Dried membranes that ranged in thickness from 157 to 190 μm were coupled with the fabrics after wetting the membrane surface with additional HFIP.

The thermal regulation capability of the panel could be modified through Phase Change Materials (PCMs) inclusion. Composites' morphological and porosity characteristics have been examined via optical microscopy analysis. Incorporating PCMs suitable for architectural applications into the composite is under investigation.

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