SUPERTEX Project

Sustainable Flame Retardant Technical Textile from Recycled Polyester

ecodesign | eco-innovation | circular economy | Life-Cycle assessment | production process | eco-friendly product | environmental impact

PROJECT DESCRIPTION

The environmental impact of products and processes gains more and more importance as the industry related pollution, amount of waste produced and global warming are increasing. Among the industrial sectors, the **textile manufacturing sector** accounts for 10% of total greenhouse gas emissions globally, ranking eighth in the ranking of production sectors with the highest environmental impact preceded by the food, furniture and cosmetics sectors. Since fibers play a fundamental role in the textile industry, the reduction of the environmental impact of the entire sector cannot but go through the identification of new materials or products with lower environment impact. Considering that Polyester (PET) is the most used fiber (Polyester represents 47% of the entire world production of synthetic fibers), the SUPERTEX project focused on reducing the impact related to the use of this fiber, in two distinct sectors: the automotive sector (production of fabrics for seats) and the contract sector (in particular office furniture), promoting the use of second raw materials.

OBJECTIVES

The objective of the project allowed to use a low quality second raw material, such as the granule from food packaging waste recycling, to create textile products with high added value, that is the minimization of the contamination of raw materials (especially Polyolefins used to ensure the preservation of the food product) that often invalidate the reuse of waste.

PROJECT PHASES

The SUPERTEX project was structured into 7 different work packages and the technical activities were divided on the basis of the different stages of the supply chain involved in the production of technical textiles for the automotive and contract sectors.

- **Characterization of the rheological, thermal and mechanical properties of bottle polyester flakes** (Post Consumer PET) and food packaging polyester flakes (Post Industrial PET).
  Textile products were characterized with respect to products made of virgin material and no differences were evidenced:

Property	Value	Test Method
Weight per square meter	392 ± 2%	
Abrasion Resistance	> 20,000	UNI EN ISO 12947-2:1999
Pilling	5	UNI EN ISO 12945 – 1:2001
Bursting Strength	607.4 ± 15.7 kPa	UNI EN ISO 13938-2:2000
Snagging Resistance	Warp yarn: 3/4 Filling yarn: 4	ASTM D3939:2011
Colour Fastness to Rubbing	Dry rubbing: 5 Wet rubbing: 5	UNI EN ISO 105-X12-2003
Colour Fastness to Alkaline Perspiration	5	UNE EN ISO 105-E04-2013
Colour Fastness to Acid Perspiration	5	UNE EN ISO 105-E04-2013
Colour Fastness to Artificial Light	6	UNE-EN ISO 105-A01/10 UNE EN 20105 A02/98
Flame Retardancy	Not flammable	UNE EN 1021-2 :2006

- **Elaboration of an optimal recipe** of the second raw material (mix of flakes with addition of compatibilizers) with rheological properties able to ensure good application of the second raw material in the spinning process;
- **Optimization of the spinning process of recycled PET** for the production of multifilament yarn (i.e. yarn composed of several, in this specific case of 48, filaments), able to ensure the mechanical resistance necessary for the weaving process;
- **Production of recycled PET fabrics** for the automotive and contract sectors;
- **Optimization of the finishing processes** (dyeing, **flame retardant treatment**) of the textile products with traditional processes;
- **Characterization of the technical performance of the developed fabrics** with respect to the specifications for their use in the target market sectors;
- **Validation of the environmental benefits** according to the LCA (Life Cycle Assessment) methodology;
- **Economic feasibility of the product/ process** evaluated in the frame of a Business Plan.

PROJECT RESULTS

The project activities led to the development of a recycled Polyester (RPET) yarn, based on a mixture of PET bottle flakes and PET from food packaging waste. The 1:1 mixture was found to be optimal, as it allowed to process the material in industrial plants by **modifying only the drying phase of the granule** (recycled PET is more hygroscopic).

In particular, the project achieved the following objectives:

- Definition of the optimal composition of the flakes for the production of recycled PET granules that can be loaded into the spinning unit: the recycled PET (RPET), obtained with a 1:1 mixture of Post Consumer (PC, or Polyester from bottle waste) and Post Industrial (PI, or Polyester coming from the scraps of the food packaging production) polyesters, ensures the rheological properties (i.e. the fluid dynamic behavior of the melted polymer) needed for the spinning process;
- Production of 350 kg of multifilament yarn from PC and PI RPET **without substantial modifications to the spinning machine**. A protocol for the production of yarns from RPET has been defined which provides for a more efficient drying process of the granule (RPET tends to absorb more humidity than virgin PET); reduction of the extrusion temperature by about 2-5 ° C and a greater use of spinning oil.
- Ensuring maintenance of the mechanical properties of the multifilament yarns in PC and PI RPET (167 dtex / 48 threads) for the application of the yarns in the two target markets (automotive and contract sectors): toughness 0,2 N/ tex and elongation 20 %.
- PC and PI RPET-based multifilament yarns in traditional looms: for the automotive sector 220 m2 of knitted fabric and 220 m2 of weft-warp fabric was produced with performance characteristics capable of exceeding the standards imposed by car manufacturers and in particular those envisaged by the FIAT protocol.
  For the contract sector, 340 m2 of knitted fabric was created which did not show any difference in the performance compared to that of analogues fabrics in virgin PET;
- Raising the prestige of the RPET fabrics that can be dyed and finished in the same plants (basket and continuous processes), with the same products and under the same conditions used for Virgin PET;
- The LCA analysis has shown that the production of technical textiles in PC and PI RPET compared to Virgin PET, allows to **reduce: CO2 emissions by 35 - 50%** (from 2.3 - 3.1 to 1.5 kg CO2 eq/ m2 fabric), **fossil material consumption by 50 -70%** (from 1.2-1.3 to 0.6-0.3 Kg oil eq/ m2) and **water consumption by 70%** (from 24 to 6 L/ m2).
- The sales price of the yarn, equal to 4.2-4.6 € / kg in PC and PI RPET, is similar to that of the virgin product (although the latter is subject to even significant fluctuations, depending on the price of oil).

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Acronym
SUPERTEX

Number of reference
ECO/10/277225/SI2.596871

Reference Programme

COMPETITIVENESS AND INNOVATION FRAMEWORK PROGRAMME (CIP) ECOINNOVATION

Beneficiary Coordinator
NTT, Next Technology Tecnotessile Società Nazionale di Ricerca S.r.l.

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EU contribution
728.522,50

Call Year
2010

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2011

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2014

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