

Recycling and valorization of textile waste through vitrimer chemistry

Matheus Nachbar^a, Sébastien Livi^a, Jannick Duchet-Rumeau^a

^a *Université Claude Bernard Lyon 1, INSA Lyon, Université Jean Monnet, CNRS
UMR 5223, Ingénierie des Matériaux Polymères F-69621 Villeurbanne Cedex, France*

* matheus-henrique.nachbar@insa-lyon.fr

Mots-clés : Polyethylene Terephthalate ; Textile ; Recycling ; Vitrimers ; Transesterification ; Ionic Liquids.

Résumé :

Over the past years, textile industry has been pointed as a major contributor to global plastic production, consumption, and consequently environmental plastic pollution. Global fiber production has almost doubled from 58 million tons in 2000 to 113 million tons in 2021. These numbers are still expected to grow up to 149 million tons by 2030. Polyester fibers (polyethylene terephthalate or PET) account for 54% of the market share, being the most used fiber worldwide. However, textile recycling remains a challenge due to the low cost of virgin fibers and clothing collects issues, but also the fact that most of actual clothes are composed by blended fibers. Therefore, 70% of the textile waste is either incinerated either landfilled¹.

The introduction of dynamic bonds to thermoplastics represents a promising approach to valorize textile waste in order to obtain high-value recycled products with enhanced properties. PET-based CANs were elaborated through reactive extrusion by adding bisphenol A diglycidyl ether (DGEBA) as crosslinking agent and the nature of transesterification catalyst was explored. A comparative study between Zn(acac)₂ and zinc-based ionic liquid was conducted, showing the impact of ionic liquid catalyst on the relaxation time, thermal stability and different relaxation modes. Besides the use as catalyst, this work presents the synthesis of innovative and autocatalytic systems using a new generation of epoxidized ionic liquids².

Finally, the elaborated CANs were used as building blocks in the mechanical recycling of PET. Different PET/CAN blend compositions were produced and the rheological and mechanical properties were studied in order to obtain a new generation of polyester fibers.

Références :

1. Textile Exchange, 2022. Preferred Fiber & Materials Market Report.
2. Perli G., Wylie L., Demir B., Gerard J.F., Pádua A. A. H., Costa Gomes M., Duchet-Rumeau J., Baudoux J. and Livi S. ACS Sustainable Chemistry & Engineering 2022 10 (47), 15450-15466.