Textile Recycle to Fiber

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Global textile production has been steadily increasing for decades and is expected to increase even more rapidly in the near future. More specifically, the amount of used textiles exported by the EU has tripled from 2000 to 2019, going from just over 550 kton in 2000 to almost 1.7 Mton in 2019. As for the production of textile waste, of interest to us, this sector produces more than 92 million tons every year, which are mainly incinerated, disposed of in the ground or exported to developing countries, exacerbating socio-environmental problems in these regions, such as, for example, marine pollution due to plastic and synthetic material deposits, especially in Asian countries. The aim of the project is therefore to reuse textile waste in order to obtain a secondary raw material, cellulose acetate, with high commercial value capable of having the physical-chemical properties required by the market. Industrially, the acetylation of cellulose is carried out in a heterogeneous phase, using acetic acid as a reaction medium, acetic anhydride as an acetylating agent and sulfuric acid as a catalyst, starting from lignocellulose and cellulose pulp. Starting from textile waste, i.e. mostly cotton, it is necessary to change the type of approach because cotton having a much lower density than cellulose pulp, the volumetric ratios are different and therefore it is impossible to implement the process with the same mass ratios. The diversity of the initial matrix led to the need to change the approach, opting for a homogeneous phase process that involves the solubilization of cellulose in a low-melting ionic solvent, but with high thermal stability, which also plays the role of reaction medium, favouring acetylation without the use of catalysts using acetic anhydride as the acetylating agent. The advantages consist in the possibility of recovering the solvent and reusing it and the possibility of obtaining a different degree of acetate substitution depending on the ratio between cellulose and acetylating agent. This process will then be implemented using an extruder in order to maximize the contact between the solvent and the starting matrices to reduce the solubilization time and accelerate the process allowing, thanks to a subsequent separation by solubilization of the acetate in acetone, the recovery of the polymeric part of the textile fibers.

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