ReMixT

Separation and Recycling of Mixed Textiles

Background

Recently, the European Commission launched a huge program on the recycling of plastics: The Circular Plastics Alliance, where more than 100 private and public supporters from the whole plastic value chain signed a pledge to increase the amount of recycled plastic by 150 % until 2025.

One of the five priority targets is focusing on investments in research and development, especially on recycling aspects. This alliance is reflecting the importance of a proper recovery of raw materials out of disposed waste for the generation of new products. In textile industry, especially in the apparel industry about 97 % are virgin feedstocks with 55 % being man made polyesters (PES) and 27 % being cotton (CO). The products are mainly blended textiles composed of CO or PES, giving the garment stability, with a certain amount of elastan (EL) for wearing comfort. High performance polymers like aramid or polyamide imid are also processed as blends. 12 % of the feedstocks are lost during production as post-industrial-waste (PIW) in terms of offcuts and most of the disposed post-consumer-waste (PCW) is "thermally recycled" (incinerated) or "mechanically recycled" (transferred into washing cloths etc. of minor quality), leading to a total loss of the used products with no closed-loop recycling that would lead to new feedstocks for textile industry.

Polymer recovery by recycling with green solvents like ionic liquids (IL), deep eutectic solvents (DES) or common biobased solvents (BBS) exhibiting similar properties to IL and DES has the potential to recover the feedstock disposed in PIW or PCW. IL, DES and certain BBS exhibit low vapor pressure, thermal stability and low combustion potential (no necessity of deduction or explosion protection) as well as unique solubilization properties.

Additionally, DES are in general non-toxic, biodegradable and easy to prepare, leading to very low expenditures on raw material. The mentioned solvents are able to dissolve different kinds of polymers at different conditions. A stepwise solubilization of blended textiles enables the separation of the blends and leads to pure polymers either as solids or in different solutions. These can directly be used as new feedstocks for fiber spinning, leading to a closed recycling loop for textile industry. Where harsh conditions at the stepwise solubilization process are necessary finally leading to degraded polymers in a grade too low for direct spinning, these polymers can be extruded and used as raw material in plastic industry, generating an open recycling loop.

By recovering and direct spinning of high performance polymers like aramides, the utilization of toxic or corrosive solvents like the commonly used sulfuric acid can be avoided, generating an economically and ecologically valuable approach.

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Goal

The ReMixT project aims at developing and optimizing a process for polymer recovering and reuse, used as feedstocks in the textile industry, from common PIW and PCW.

We will focus on the treatment and stepwise solubilization and separation of polymers that are typically used (1) as high performance polymers (PIW and PCW collected by factories) and (2) as blended textiles, commonly used in the home textile and apparel and protective clothes industries (PIW as off-cuts and collected PCW) with a subsequent generation of new products by wet- and melt-spinning of new fibers, as well as the reinforcement of polymers into plastics by extrusion.

Pre-experiments already demonstrated the practicability of this approach:

A stepwise solubilization of CO and EL leading to pure polymers in IL and BBS solutions, as well as the solubilization of different high performance polymers has repeatably been accomplished in laboratory scale.

At the end of this research project there will be an economically relevant and ecologically friendly process with low expenditures on raw materials that can easily be established in recycling companies.

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Consortium

The research will be performed in close cooperation between

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