Reviving mixed plastic waste through chemoenzymatic recycling

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Poor waste management worldwide leads to constantly increasing environmental pollution; if current production and waste management trends continue, roughly 12bn tonnes of plastic waste will end up in landfills or the natural environment by 2050 [1]. Even though recycling plastic packaging waste is the most sustainable solution for the circular plastics economy, a minor part of packaging waste is recycled; 8% of plastic waste was recycled from 1950 to 2019 [2]. The main obstacle to viable mechanical recycling is the presence of different polymer types in end products (mixed-plastic waste), hampering the recycling process and reducing the recyclates quality. The **EnZyReMix** project aims to develop innovative methodologies to separate complex packaging waste streams, i.e., mixed plastics, and valorise the depolymerized oligomers from post-consumer materials *via* upcycling approaches. Specifically, we will focus on mixtures of PLA/PET since PLA is a new source of polymeric contamination for rPET, and their separation is not easily feasible due to their similar appearance and densities. Commercially available grades will be identified through mapping of the polymer market focusing on bottle-grade PLA and PET, characterized, and processed *via* cryogenic milling into mixtures of different ratios based on the estimated PLA occurrence in the bottle household waste. The initial materials will be submitted to hydrolysis to prepare oligomers of controlled characteristics for the screening, identification, and structural characterization of degrading enzymes. In parallel, PLA and PET films will be prepared *via* compression molding and submitted to accelerated laboratory weathering to simulate improper waste disposal in soil and sea. Ageing kinetics will be studied at different temperatures, and the aged single-type materials/mixtures will serve as a model waste to be subjected to selective enzymatic degradation. Overall, different polymeric substrates will be prepared to be tested on a real case study of an upcoming type of waste, i.e., PLA/PET bottles.

References

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[2] Ding Q. and Zhu H. The key to solving plastic packaging wastes: Design for recycling and recycling technology. Polymers. 2023. 15: 1485

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