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Editorial corner – a personal view

Challenges and opportunities of polymer recycling in the changing landscape of European legislation

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The European Union is committed to achieving sustainable growth and climate neutrality by 2050 through the European Green Deal, with the new circular economy action plan adopted in 2020 as a key component. The transition to a circular economy is proposed by closing the loop of product life cycles through increased recycling and reuse, providing both environmental and economic benefits. The role of polymeric materials is essential in achieving these goals as ecodesign and recirculation of plastic products can substantially decrease waste generation and demand for raw materials and energy. Adopting the circular economy approach to polymers does not only mean reducing the negative impact on the environment but also fundamentally and comprehensively changing the way we design polymers. The circularity of the polymers is rooted in their tailored chemical structure and the design of polymeric systems enabling recycling. The material recycling of thermoplastic polymers is already an industrially viable method by simple mechanical recycling by melting and reprocessing. Therefore, the main challenges of this field involve developing inherently recyclable thermoset polymers (https://doi.org/10.3144/expresspolymlett.2021.89) and the design of easily recyclable thermoplastic polymer systems that allow the use of long-fibre reinforcement for structural applications (https://doi.org/10.1016/j.polymdegradstab.2021.109797). As most current applications of thermoplastics assume a very short lifetime, in their case, the focus should be on recycling rather than increasing the lifetime. Therefore, enhancing the lifespan can be a relevant strategy, primarily in the case of thermosetting composites (https://doi.org/10.3144/expresspolymlett.2022.81) and can be achieved by a variety of approaches, e.g. structural health monitoring (https://doi.org/10.1016/j.compscitech.2020.108317, https://doi.org/10.3390/polym11030523) (including non-destructive testing) and repair during operation.

Although it is estimated that product design determines up to 80% of the environmental footprint of a product during its lifecycle, sustainable strategies are often not exploited to their full potential at the design stage. This is particularly true for polymer waste, where downcycling is the most common way of recycling, leading to quality degradation and a shorter lifetime. The additional functionalities introduced by upcycling can be key to increasing the industrial acceptance and uptake of recyclates. The high thermal stability and good fire resistance (https://doi.org/10.3144/expresspolymlett.2018.17) of polymers are crucial when replacing metals in structural applications to reduce weight. As the 'Proposal for a Regulation on circularity requirements for vehicle design and on management of end-of-life vehicles' of the European Union aims to set a mandatory recycled content target for plastics in newly type-approved vehicles of 25% by 2030, upcycling of secondary polymers will be a fundamental aspect in the future.

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