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ABSTRACT

On the Use of Recycled PET: Formability and Strain-Induced Crystallization

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In Europe, PET waste amounted to over 4 million tons in 2019, and the EU aims to collect 90% of plastic bottles by 2029, with 25% recycled PET in bottles by 2025 [1]. Despite PET's high recycling potential, many bottles are not collected or recycled effectively. Mechanical recycling, while environmentally friendly, results in lower-quality material, often requiring further steps like melt filtration and post-condensation polymerization to remove contaminants and restore polymer properties. Recycled PET (rPET) must retain sufficient mechanical properties and avoid hazardous substances, especially if used in food contact applications.

This study examines the impact of mechanical recycling on rPET's stretchability, particularly in Injection Stretch Blow Moulding (ISBM) or thermoforming processes. Using different types of rPET issuing from different mechanical recycling loops, results show that recycled materials behave similarly to virgin PET at lower deformations but differ in strain-hardening and crystallization rates at higher deformations. Using recycled PET has an influence on cold crystallization in quiescent conditions, and also on strain-induced crystallization kinetics in the forming rage. Optimization of process conditions, such as adjusting temperatures or strain rates, is necessary to improve the stretchability of recycled PET.

[1] Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on "the reduction of the impact of certain plastic products on the environment", (Text with EEA relevance) PE/11/2019/REV/1, OJ L 155, 12.6.2019: 1–19, Juin 2019