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Influence of vitrimers on the dynamics and crystallization process of degraded semi-crystalline polyolefins

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A major recent advance, which can serve as a very promising solution to the problem of mechanical degradation of plastic waste, is the development of associative dynamic covalent networks called “vitrimers” [1]. As the exchange reactions can occur between different positions along the polymer chains, macroscopic flow is achieved at long times without compromising the network coherence. Since these exchange reactions are thermally activated, the exchange dynamics are slow at lower temperatures, imparting strength to the material akin to thermosets [2]. At higher temperatures used for processing, the exchange reactions are fast, allowing the material to flow. Consequently, vitrimers can be reshaped and reprocessed at wish, while maintaining the desired chemical and mechanical resistance of crosslinked polymers, which is of prime interest for developing recyclable elastomers [3]. Vitrimers have a huge potential as agents to improve the mechanical properties of recycled polymers and can serve as critical ingredients for novel materials. However, despite the large progress in developing new vitrimers, these materials are not yet used, today, to improve commodity plastic recycling.[4] This requires, first, to understand how the addition of vitrimers in a degraded polymer will affect its properties. Within this direction, we selected some different grades of High-Density Poly(Ethylene) (HDPE) and studied the evolution of their composition and properties after several cycles of processing. In this way we determined the degradation of the polymer chains based on their linear viscoelastic and thermal properties and on their molar mass distribution, using experimental techniques like Rheology, GPC, NMR, DSC and flash DSC. After this procedure we will investigate the influence of the addition of different amounts of HDPE vitrimers on the dynamics, creep resistance, crystallization and structure of the degraded samples.

References:
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