High added value rubber composites and thermoplastic elastomers as strategies to recycle wastes rubber

N. Candau[1]*, N. León Albiter [1], MLl. Maspoch[1]

[1]*Centre Català del Plàstic – Universitat Politècnica de Catalunya, Departament de Ciència i Enginyeria de Materials, Universitat Politècnica de Catalunya. BARCELONATECH. Avda. Eduard Maristany 16, 08019 Barcelona, Spain*

*nicolas.candau@upc.edu

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ABSTRACT

Reducing the environmental impact of the polymers production using bio-based plastics and rubber wastes valorization, are two essential ways of reversing the negative impact of the polymer industry on the environment [1]. The design of rubber composites and/or bio-based thermoplastics elastomers using wastes rubber can be proposed [2] but providing high values materials still requires investigation to deliver industrially suitable products. To this aim, we prepared rubber composites and thermoplastic elastomers using natural rubber (NR), wastes rubber (GTR) and Polylactic acid (PLA). First, we prepared vulcanized NR/GTR blends, where the GTR shows a nucleation ability on strain induced crystallization (SIC) in the NR, associated with a large strain reinforcement [3]. The latent heat due to crystallization/melting during cyclic tests performed in adiabatic conditions generates heating/cooling that was found superior in the NR/GTR blends as compared to neat NR [4]. Second, we aimed to improve the toughness of the biobased Polylactic acid (PLA) and take advantage of properties of the previously prepared NR/GTR blends. To do so, PLA/NR/GTR blends were dynamically vulcanized. The elastic modulus, the impact strength and the shape recovery in PLA/NR/GTR were maintained as compared to the PLA/NR blends that do not use wastes, that we attributed to the encapsulation of the GTR particles into the NR matrix forming a co-continuous PLA/rubber morphology. Moreover, PLA/NR/GTR blends exhibit a ten-fold increase of the impact strength as compared to the neat PLA. The NR/GTR and PLA/NR/GTR materials are promising candidates for applications such as heating/cooling technology or high impact pieces.

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