Abstract

Composites of Styrene-Butadiene Block Copolymer Reinforced with Waste Printed Circuit Boards (WPCB) †

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The organic part of the waste printed circuit board (WPCB) contains mainly epoxy resin, fiberglass and brominated flame retardants, a composition that makes it quite difficult to reuse [1,2]. Therefore, WPCB has no economic value, becoming the final waste deposited in a waste storage space and a secondary pollutant of the environment. The mechanical recovery of the waste affects the ecosystem. The research aimed to reuse the WPCB powder as a reinforcing agent for styrene-butadiene block-copolymers, composites that can be used as masterbatch for the production of shoe soles that are injected directly onto the footwear. The reinforcing study was achieved using a star styrene-butadiene block-copolymer with 32% polystyrene, a molecular mass of 190000 g/mole and WPCB ground to less than 1 mm in size after the metal (Cu) was removed. The composites were obtained by adding 5–30% WPCB into the styrene-butadiene block-copolymer solution in THF, followed by centrifugal casting desolvation. To improve the processability by injection, the melting viscosity was reduced by extending the composites with 25% naphthenic-paraffin oil. The composites were characterized by mechanical (tensile) testing, and thermal (DSC, TGA) and dynamo-mechanical analysis. WPCB was found to be distributed in the continuous polybutadiene phase of SBS, acting as a non-reactive filler (continuous decrease in tensile strength and elongation at break with increasing WPCB dosage was observed). The increase in storage modulus and mechanical losses proportional to the ratio of WPCB confirms its reinforcing effect. The study established that WPCB can be recycled as SBS composites expanded with 25% naphthenic-paraffinic oil in a maximum proportion of 30% with mechanical properties suitable for obtaining shoe soles materials injected directly onto the footwear.

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References


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