Impact of Graphene Nanoplatelets and MWCNT on the Recyclability and Properties of Polyamide 6 Nancomposites

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Abstract

The process of recycling polymers, including polyamide 6 (PA6), presents difficulties due to the typical deterioration of properties across multiple recycling cycles. A promising strategy to address this issue involves the incorporation of graphene nanoplatelets (GNPs) and MWCNT, which may help counteract these degradative effects and improve the longevity of recycled PA6. This approach has the potential to extend the functional lifespan of polymer-based materials in environmentally sustainable applications. The materials underwent compounding in a twin-screw extruder, followed by a three-cycle recycling process involving injection molding and grinding. X-ray diffraction analysis (XRD) revealed alterations in the crystal structure of both PA6, PA6/GNP PA6/MWCNT after reprocessing. Fourier-transform infrared spectroscopy (FT-IR) showed no notable changes in chemical composition across multiple reprocessing cycles. Dynamic mechanical analysis (DMA) indicated a decrease in the glass transition temperature (Tg) with reprocessing. Scanning electron microscopy (SEM) images showed enhanced GNP dispersion at low concentrations, while high loadings (10 wt.%) exhibited persistent agglomeration despite reprocessing. For the MWCNT, SEM images showed there is no signicant change in the morphology during the reprocessing. Differential scanning calorimetry (DSC) results demonstrated an increase in crystallinity for both PA6, PA6/GNP, and PA6/MWCNT. During the reprocessing, the Higher GNP loadings led to improved Young's modulus in the composites, although maximum stress remained relatively constant. However, strain at break decreased with increasing GNP content in both virgin and reprocessed PA6/GNP composites.