

Hybrid-filler filled polypropylene/ (natural rubber) composites: effects of natural weathering on mechanical and thermal properties and morphology

Abstract

Comparison was made between the properties of recycled newspaper (RNP)/carbon black (CB) and recycled newspaper (RNP)/silica hybrid filled polypropylene (PP)/natural rubber (NR) composites. The properties studied were mechanical, thermal, and morphological. These composites were also subjected to natural weathering, i.e., the tropical climate in Penang, Malaysia, for 6 months. The incorporation of CB and silica at all weight ratios of RNP/CB and RNP/silica hybrid gave increases in tensile strength, elongation at break (E_B), Young's modulus, melting temperature (T_m), heat of fusion of composites ($\Delta H_{f(\text{com})}$), crystallinity of composites (X_{com}), and the crystallinity of PP (X_{PP}). As expected, the tensile properties (except for Young's modulus), T_m , $\Delta H_{f(\text{com})}$, X_{com} , and X_{PP} of the composites exhibited lower values after weathering than before weathering. The extent of chemical degradation was studied by Fourier transform infrared spectroscopy, and the results showed the formation of several functional groups, i.e., hydroxyl, hydroperoxide, vinyl, carboxylic acid, and ketone. At the same filler weight ratio, the composites filled with RNP/CB hybrid showed higher values of tensile strength and E_B but lower values of Young's modulus, $\Delta H_{f(\text{com})}$, X_{PP} , and X_{PP} , as compared to those with the RNP/silica hybrid under weathering conditions. The good retention in tensile properties indicated that the replacement of RNP by CB and silica improved the weatherability performance of the PP/NR composites.

Keywords —Recycled newspaper (RNP)/ carbon black (CB), recycled newspaper (RNP) silica hybrid, tensile properties, composites.