

Influence of multi-walled carbon nanotubes on thermal behaviour and mechanical properties of pineapple leaf fibre-based natural rubber composites

Abstract

Replacing synthetic fibres with natural fibres as reinforcement fillers in natural rubber (NR) tends to yield eco-friendly bio-composites. This study investigated the tensile and hardness properties, and the thermal behaviour of pineapple leaf fibre (PALF)-reinforced NR composites with and without the addition of multi-walled carbon nanotubes (MWCNT). The fibre content was varied at 0, 10, 20, and 30 parts per hundred rubber (phr) and the MWCNT content was fixed at 10 phr. The surface morphology of the tensile-fractured specimens was examined using scanning electron microscopy (SEM) to identify the rubber-matrix adhesion and tear mechanisms of the fibres in the NR matrix. The results revealed that including the PALF and MWCNT allowed the NR composites to exhibit excellent stretching stress at low elongations. Additionally, the composites displayed enhanced stiffness, further increasing the hardness of the composite, ranging from 46.8 to 62.8 Shore A. However, PALF reduces the thermal stability of the composite, where the initial degradation temperature increases. From the thermogravimetric analysis, the residues remaining in the NR composites ranged from 6 to 13% at various fibre loadings. Therefore, this study provides valuable insights into the tensile and hardness properties and the thermal behaviour of PALF-reinforced NR composites to improve end-use properties.

Keywords

Hardness; Multi-walled carbon nanotube; Natural rubber; Pineapple leaf fibre; Scanning electron microscope; Tensile; Thermal