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Mechanical and thermal properties of coconut shell powder filled polylactic acid biocomposites: effects of the filler content and silane coupling agent

Abstract

The effects of the filler content and the coupling agent 3-aminopropyltriethoxysilane (3-APE) on the mechanical properties, thermal properties, and morphologies of polylactic acid (PLA)/coconut shell powder (CSP) biocomposites were investigated. It was found that increasing the CSP content decreased the tensile strengths and elongations at break of the PLA/CSP biocomposites. However, incorporating CSP increased their modulus of elasticity. The tensile strengths and modulus of elasticity of the PLA/CSP biocomposites were enhanced by the presence of 3-APE, which can be attributed to a stronger filler-matrix interaction. The thermal stabilities of the biocomposites increased with the filler content, and they were enhanced by 3-APE treatment. Meanwhile, the presence of CSP increased the glass transition temperatures (T_g) and crystallinities (X_c) of the PLA/CSP biocomposites at a filler content of 30 php. After 3-APE treatment, T_g and X_c of the PLA/CSP biocomposites increased due to enhanced interfacial bonding. The presence of a peak crystallization temperature (T_c) for the PLA/CSP biocomposites indicated that the CSP has a nucleating effect. The melting temperatures (T_m) and the T_c values of the biocomposites were not significantly affected by the fillercontent and 3-APE. PLA/CSP biocomposites that had been treated with 3-APE presented the strongest filler-matrix interaction, as confirmed by SEM.

Keywords — 3-aminopropyltriethoxysilane, biocomposites, coconut shell powder, polylactic acid