Effect of cellulose nanofibrils on the properties of Jatropha oil-based waterborne polyurethane nanocomposite film

ABSTRACT

The objective of this work was to study the influence of cellulose nanofibrils (CNF) on the physical, mechanical, and thermal properties of Jatropha oil-based waterborne polyurethane (WBPU) nanocomposite films. The polyol to produce polyurethane was synthesized from crude Jatropha oil through epoxidation and ring-opening method. The chain extender, 1,6-hexanediol, was used to improve film elasticity by 0.1, 0.25, and 0.5 wt.% of CNF loading was incorporated to enhance film performance. Mechanical performance was studied using a universal test machine as specified in ASTM D638-03 Type V and was achieved by 0.18 MPa at 0.5 wt.% of CNF. Thermal gravimetric analysis (TGA) was performed to measure the temperature of degradation and the chemical crosslinking and film morphology were studied using Fourier-transform infrared spectroscopy (FTIR) and field emission scanning electron microscopy (FESEM). The results showed that when the CNF was incorporated, it was found to enhance the nanocomposite film, in particular its mechanical and thermal properties supported by morphology. Nanocomposite film with 0.5 wt.% of CNF showed the highest improvement in terms of tensile strength, Young's modulus, and thermal degradation. Although the contact angle decreases as the CNF content increases, the effect on the water absorption of the film was found to be relatively small (<3.5%). The difference between the neat WPBU and the highest CNF loading film was not more than 1%, even after 5 days of being immersed in water.

Keyword: Nanocellulose; Bio-based polyol; Biopolymer; Bio-based film; Biocomposite