Effects of multi-walled carbon nanotubes (MWCNTs) on the degradation behavior of plasticized PLA nanocomposites

H. Norazlina[a]; A. A. Hadi[a]; A. U. Qurni[a]; M. Amri[a]; S. Mashelmie[a]; Y. Kamal[b]

[a] Faculty of Chemical Engineering TechnologyTATI University College (TATIUC)KemamanMalaysia

[b].Faculty of Chemical and Natural Resources EngineeringUniversity of Malaysia PahangGambangMalaysia

ABSTRACT

Polymer blend nanocomposites based on polylactic acid (PLA) were prepared via simple melt blending and investigated for its biodegradation behavior. The CNTs were surface-modified using acid treatment, and characterizations of composites were done using FTIR. FTIR spectra confirmed the surface modification of CNTs. The water uptake and weight loss behavior in hydrolytic analysis of CNT and m-CNT nanocomposites at different temperatures (25 and 45 °C) were studied. It was found that the water absorption and weight loss of nanocomposites increase by incorporation of CNTs and m-CNTs up to 2% for all samples, with and without PEG loading. In sample PLA/CNTs, 2% CNTs loading shows 1.18% water uptake at 25 °C and increases to 1.95% at 45 °C water immersion, whereas, in PLA/m-CNT nanocomposites, the water uptake reduces at 1.16% at 25 °C and 1.50% at 45 °C of analysis. In the meanwhile, the weight loss of 2% CNTs loading in PLA shows 2.88% at 25 °C and 6.28% at 45 °C, and for m-CNTs loading, the weight loss exhibits 2.09% at 25 °C and 5.29% at 45 °C. This proved the modified CNTs be able to retard the ability of nanocomposites degradation. The effect of plasticizer addition in nanocomposites was studied by loading 5 and 10% PEG. As expected, the inclusion of PEG enhanced the rate of degradation in both hydrolytic and soil burial studies. For the same amount of 2% CNTs inclusions and 10% PEG, at 45 C, the water uptake shows 5.56% as compared with 5% PEG loading, only 3.1% water uptake is shown. In soil burial test, the weight loss also increases with the addition of nanofiller. PLA/m-CNTs show lower weight loss which is only 4.50% and around 7.02% for PLA/CNTs nanocomposite. In the other hand, 10% PEG loading shows an increase in the weight loss in both CNT and m-CNT nanocomposites. Results from this study demonstrate that the inclusion of CNTs and m-CNTs into polymer matrix could increase the environmental persistence of polymers in lakes, landfills and surface waters.

KEYWORDS:

Polylactic acid; Poly(ethylene glycol); Carbon nanotubes; Degradation