Influence of cellulose II polymorph nanowhiskers on bio-based nanocomposite film from Jatropha oil polyurethane

ABSTRACT

Green polyurethane from plant oil-based such as Jatropha oil has recently received attention due to its environmental friendliness and sustainability. With incorporation of nanocellulose even though at low loadings in polymer matrices has shown a significant improvement. However, limited research has been done on different cellulose nanowhisker (CNW) polymorphs and their impact on composites. A number of studies have shown that the handling of cellulose polymorph also improves the properties of composite products as the cellulose II is more chemically reactive and thermodynamically stable than cellulose I. The aim this study is to investigate the effect ofCNWwith cellulose II polymorph in Jatropha oil-based polyurethane (JOPU). Different weight percent ofCNWII (0.1-1.5 wt%) were incorporated into JOPU films using vacuum rotavap and film casting. The total weight of 6 g was used as a fixed ratio (1:3) matrix of 4.4'-diphenyl-methane diisocyanate (MDI) and Jatropha-oil polyol (JO). The acid hydrolysis process was subjected to mercerised microcrystalline cellulose (MMCC) for the production of CNW-II. X-ray diffraction analyses were carried out to confirm cellulose II lattice of CNW-II. The CNW-II morphology was analysed using the transmission electron microscope. It was found that CNW-II had a granule-like shape with an average size of 74.04 nmin length and 21.36 nmin width. The translucency and colour of the film have also been tested by optical light microscopes. The clarity of the film and colour found affected by the highest CNW-II film loading. Based on the FTIR analysis, the spectra of all films show a typical polyurethane pattern that JOPU spectra found dominant due to very low volume NCW-II content in film. The same trend is observed for thermal degradation tested using a thermogravimetric analyser. Tensile strength and water uptake have been shown to increase in proportion to the CNW-II content.