Subsurface mechanical properties and subsurface creep behaviour of modified nanoclay-based wood–plastic composites studied by nanoindentation

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ABSTRACT

Wood–plastic composites (WPCs) were prepared by polypropylene, wood flour, maleic anhydride-grafted polypropylene and pristine (Na^+ montmorillonite)/TMI-modified nanoclay using extruder followed by injection moulding technique. The surface mechanical properties of the nanoclay-based WPC were investigated by means of nanoindentation technique. The results show that the hardness, elastic modulus and creep resistant of the WPC dramatically enhanced with the incorporation of nanoclay. This enhancement was dependent on the nanoclay content as well as the dispersion of nanoclay in the polymer matrix. At 1 wt% nanoclay content, the hardness, elastic modulus and creep resistant of pristine nanoclay-reinforced WPC (WPC/MMT) improved by approximately 35%, 30% and 15%, respectively, compared to WPC without nanoclay. For the TMI-modified nanoclay-based WPC (WPC/MMT Cu), the improvements in these properties were about 1.2, 1.5 and 1.5 times higher than the WPC/MMT. Viscoelastic model was applied to examine the effect of nanoclay loadings on the creep performance of the WPC. Results exhibited that the model was in good agreement with the experimental data. Incorporation of nanoclay leads to an increase in elastic deformation, especially in WPC/MMT Cu, and induces a higher initial displacement at the early stage of creep.

KEYWORDS

Wood–plastic composites; Nanoclay; Nanoindentation; Subsurface mechanical properties; Subsurface creep behaviour

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