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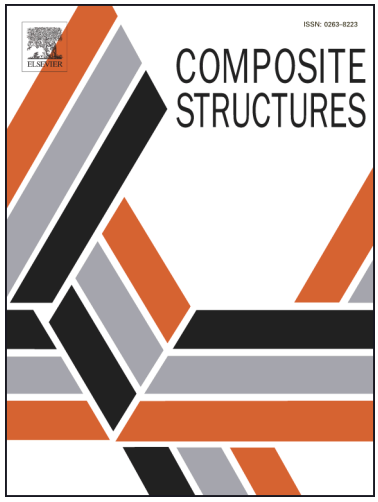

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ACCEPTED MANUSCRIPT

Effects of high-lignin-loading on thermal, mechanical, and morphological properties of bioplastic composites

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Abstract

The present study investigates the effects of high-lignin-loading on properties of lignin/polyethylene-*co*-vinyl acetate **(**EVA) rubber composites. Results from mechanical (quasi-static and cyclic) and rheological investigations revealed a brittle-ductile transition around a lignin volume fraction of $\varphi_L = 0.59$ coinciding with a two-fold increase in steady-shear viscosity. Towards higher lignin contents, a 36 % increase in dynamic stiffness C_{dyn} from $\varphi_L = 0.59$ ($C_{dyn} \approx 350$ N mm^{-1}) to $\varphi_L = 0.71$ ($C_{dyn} \approx 550$ N mm^{-1}) was observed by load increase tests (LIT). In addition, analyses of the ultra-micro-hardness revealed less indentation creep towards high-lignin-loading. At $\varphi_L = 0.59$, a pronounced relaxation endotherm superimposed on the glass transition (T_g) was observed, which was ascribed to molecular confinement to occur at highly loaded composites. At this point, the molecular weight (M_w) of lignin increased considerably. These results were explained by the different role of lignin at high volume fraction, i.e. a change from lignin as mere stiffness-inducing filler to a strength-imparting and fatigue-resistant matrix component which was supported by morphological analysis.

Keywords

Polymer matrix composites (PMC), Lignin composites, Extrusion, Mechanical testing, Fatigue.

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