Reinforcing mechanical, water absorption and barrier properties of poly(lactic acid) composites with kenaf-derived cellulose of thermally-grafted aminosilane

ABSTRACT

The effects of filling poly(lactic acid) (PLA) composites with cellulose thermally-grafted with hydrolysed 3-aminopropyltriethoxysilane (APS) were investigated. Composites containing 30 wt% of kenaf-derived cellulose (C) and silane-grafted cellulose (SGC) were melt-blended into a PLA matrix before being hot-pressed into 0.3 mm sheets. The tensile strength of neat PLA was 47 MPa. With addition of C and SGC, the tensile strength was improved by 13% and 23%, respectively. The tensile modulus was approximately doubled for both of the composites. PLA/C and PLA/SGC composites remained brittle with marginally lowered elongation at break. The addition of C and SGC significantly increased the oxygen barrier of PLA with the reduction of oxygen transmission rate (OTR) of PLA at 76.6 cc/m2 /day to 42.2 cc/m2 /day and 40.3 cc/m2 /day, respectively. This was due to the tortuous path created and crystallites induced by the fillers. The water vapour transmission rate (WVTR) for PLA, PLA/C and PLA/SGC was in the range of 21-23 g/m2 / day. From the water absorption test, PLA/SGC reported slightly better water resistance as compared to PLA/C. The reinforcing results from these bio-based materials may suggest contribution towards packaging oxygen and moisture sensitive food.

Keyword: Cellulose; Kenaf; Mechanical barrier; Poly(lactic acid); Silane coupling agent; Water absorption