Effect of aminosilane concentrations on the properties of poly(lactic acid)/kenaf-derived cellulose composites

ABSTRACT

To reinforce the use of kenaf-derived cellulose as a compatible plastic filler, the cellulose (C) was thermally grafted with various concentrations (5, 8, and 11 wt.%) of hydrolysed 3-aminopropyltriethoxysilane (APS). The silane-grafted cellulose (SGC) were named as SGC5, SGC8 and SGC11. C (30 wt.%) and all of the SGC were respectively melt-compounded into poly(lactic acid) (PLA) before being hot-pressed into ~0.3 mm sheets, which is the approximate thickness of clamshell packaging. The intermolecular interaction between SGC and PLA, which was absent with C, was confirmed via Fourier Transform Infrared Spectroscopy (FTIR). PLA filled with SGC5 or SGC8 showed significant improvement in thermal, tensile, physical, and barrier properties compared with the PLA/C composite. In contrast, adverse effects were observed with the PLA/SGC11 composite. 8 wt.% of APS was concluded as the critical concentration to be thermally-grafted onto the kenaf-derived cellulose as PLA/SGC8 composite showed optimum reinforcement in tensile strength (52 MPa), crystallizability (16% crystallinity), water resistance (5.3%) and dimensional stability (3.3%), and significantly shifted oxygen barrier from medium-low range to medium range (3.2×10^{-17} m^3 m/m^2 s Pa). Overall, the variation in the properties of these biocomposites may extend PLA's range in food packaging applications.

Keyword: Poly(lactic acid); Kenaf; Cellulose; Composite; Silane coupling agent; Barrier properties