Influence of Alkali Treatment on the Mechanical, Thermal, Water Absorption, and Biodegradation Properties of Cymbopogan citratus Fiber-Reinforced, Thermoplastic Cassava Starch–Palm Wax Composites

ABSTRACT

In this study, thermoplastic cassava starch–palm wax blends, reinforced with the treated Cymbopogan citratus fiber (TPCS/ PW/ CCF) were successfully developed. The TPCS were priorly modified with palm wax to enhance the properties of the matrix. The aim of this study was to investigate the influence of alkali treatments on the TPCS/PW/CCF biocomposite. The fiber was treated with different sodium hydroxide (NaOH) concentrations (3%, 6%, and 9%) prior to the composite preparation via hot pressing. The obtained results revealed improved mechanical characteristics in the treated composites. The composites that underwent consecutive alkali treatments at 6% NaOH prior to the composite preparation had higher mechanical strengths, compared to the untreated fibers. A differential scanning calorimetry (DSC) and a thermogravimetric analysis (TGA) indicated that adding treated fibers into the TPCS matrix improved the thermal stability of the samples. The scanning electron microscopy (SEM) demonstrated an improved fiber–matrix adhesion due to the surface modification. An increment in the glass transition temperature (Tg) of the composites after undergoing NaOH treatment denoted an improved interfacial interaction in the treated samples. The Fourier transform infrared spectroscopy (FTIR) showed the elimination of hemicellulose at wavelength 1717 cm−1, for the composites treated with 6% NaOH. The water absorption, solubility, and thickness swelling revealed a higher water resistance of the composites following the alkali treatment of the fiber. These findings validated that the alkaline treatment of CCF is able to improve the functionality of the Cymbopogan citratus fiber-reinforced composites.