Effects of $KMnO_4$ Treatment on the Flexural, Impact, and Thermal Properties of Sugar Palm Fiber-Reinforced Thermoplastic Polyurethane Composites

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ABSTRACT

Global warming has had a great impact on environmental changes since the last decade. Eco-friendly industrial products are of great importance to sustain life on earth, including using natural composites. Natural fibers used as fillers are also environmentally valuable because of their biodegradable nature. However, compatibility issues between the fiber and its respective matrix is a major concern. The present work focused on the study of the flexural, impact, and thermal behaviors of environmentally friendly sugar palm fibers (SPF) incorporated into a composite with thermoplastic polyurethane (TPU). Two techniques (extrusion and compression molding) were used to prepare these composites. The fiber size and dosage were kept constant at 250 µm and 30 wt.% SPF, respectively. The effects of potassium permanganate ($KMnO_4$) treatment on the flexural, impact, and thermal behaviors of the treated SPF with 6% NaOH-reinforced TPU composites were investigated. Three different concentrations of $KMnO_4$(0.033%, 0.066%, and 0.125%) were studied for this purpose. The characterization of the flexural and impact properties of the new TPU/SPF composites was studied as per American Society for Testing Materials ASTM standards. Thermogravimetric analysis was employed for thermal behavior analysis of the TPU/SPF composites. The best flexural strength, impact strength, and modulus properties (8.118 MPa, 55.185 kJ/m^2, and 262.102 MPa, respectively) were obtained with a 0.033% $KMnO_4$-treated sample. However, all flexural strength, impact strength, and modulus properties for the $KMnO_4$-treated samples were lower than the sample treated only with 6% NaOH. The highest thermal stability was also shown by the sample treated with 0.033% $KMnO_4$. Therefore, this method enhanced the thermal properties of the TPU/SPF composites with clear deterioration of the flexural and impact properties.

KEYWORDS:

ASTM standards; Bending strength; Compression molding; Extrusion molding