Sustainable Development of Eco-Friendly Bio-Nanocomposites: Utilizing Nanocellulose Extracted from Saccharum Officinarum for Advanced Applications

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Abstract:

This study presents the development of eco-friendly bio-nanocomposites using poly(lactic acid) (PLA), poly(caprolactone) (PCL), and their blends with nanocellulose extracted from *Saccharum Officinarum*. The extracted nanocellulose was optimized through chemical treatment and hydrolysis processes, yielding a sustainable and renewable resource for enhancing polymer properties. Bio-nanocomposites of PLA/nanocellulose, PCL/nanocellulose, and PLA/PCL/nanocellulose with varying nanocellulose contents (1, 3, and 5 wt%) were prepared via melt-blending and characterized using Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), X-ray diffraction (XRD), dynamic mechanical analysis (DMA) and tensile testing. The results show significant improvements in the thermal and mechanical properties of the polymeric matrices upon the addition of nanocellulose, demonstrating the potential of these bio-nanocomposites for advanced applications. These developments are promising for obtaining bio-nanocomposites from local bio-sources, leading to more sustainable and eco-friendly alternatives to traditional materials.

Keywords:

Bio-nanocomposites, Polycaprolactone, Poly(lactic Acid), Nanocellulose and *Saccharum Officinarum.*