

EXTRACTION OF CELLULOSE NANOCRYSTALS FROM TEXTILE WASTE AND THEIR INCORPORATION INTO POLYLACTIC ACID COMPOSITES

Andrea López González¹, Rosa Gabriela López Gonzaleznúñez², Erick Omar Cisneros López³, Emma Rebeca Macias Balleza²

¹Universidad de Guadalajara, Ingeniería de Proyectos, Mexico. ²Universidad de Guadalajara, Ingeniería Química, Mexico. ³Universidad de Guadalajara, Física, Mexico.

This research presents the extraction and characterization of cellulose nanocrystals (CNCs) from textile waste, specifically post-consumer denim jeans, and their use as reinforcement in a polylactic acid (PLA) matrix. CNCs were obtained via acid hydrolysis under different conditions of acid concentration, temperature, and reaction time, based on a three-level experimental design. The nanocrystals were characterized using dynamic light scattering (DLS), attenuated total reflection Fourier-transform infrared spectroscopy (ATR-FTIR), scanning electron microscopy (SEM), atomic force microscopy (AFM), and X-ray diffraction (XRD). The resulting CNCs exhibited lengths ranging from 160 to 460 nm, an ellipsoidal shape, and a crystallinity index (CI) of up to 90%. The study confirmed that hydrolysis parameters influence both the hydrodynamic diameter and CI of the CNCs, with acid concentration identified as the most significant factor. The CNCs were then dried in an ultra-vacuum oven and incorporated into a PLA matrix at 5 wt%, using nanocrystals of different sizes. Mechanical performance was evaluated through flexural strength and Charpy impact tests. Results showed that the reinforcing effect of CNCs correlates with their crystallinity: the higher the crystallinity, the greater the mechanical strength. The PLA/CNC composite reinforced with CNCs measuring 216.8 ± 14.86 nm and exhibiting the highest crystallinity index demonstrated the best mechanical performance, with a 100% increase in Young's modulus and a 52% improvement in impact resistance

Keywords: Cellulose Nanocrystal, Biocomposite, Textile waste

Acknowledgment:

First author, Andrea López González thanks the Secretaría de Ciencia, Humanidades, Tecnología e Innovación for the scholarship granted for her Master's studies.

Presenting author's email: andrea.lopez4107@alumnos.udg.mx