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Extraction and Application of Cellulose Nanocrystals in Epoxy Composites

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Highlights

- Extraction of cellulose nanocrystals from cotton fibers
- Drying step strongly affects CNC yield
- FTIR reveal structural differences

Abstract

The search for sustainable and high-performance materials has driven the application of cellulose nanocrystals (CNC) due to their mechanical properties, high surface area, and renewable character. The objective of this study was to extract CNC from cotton fibers by two distinct methods, to compare their yields, to characterize the obtained samples, and to prepare epoxy nanocomposites reinforced with different CNC sources to evaluate its effect on microhardness.

The conventional extraction technique yielded 70% of CNC (±0.00375), while the variation that excluded the drying phase during pulping (CNC-ND) yielded only 30% (±0.00135), indicating the significance effect of this steps (Fig. 1). Possibly the heat provided during drying contributes to the removal of lignin. The FTIR spectrum revealed a shift at 1024 cm^{-1}, attributed to C-O-C stretching (Fig. 2), present in cellulose and ligning chemical structure. Epoxy composite containing 0.5% of CNC or commercial CNC presented similar microhardness (18.0 to 18.5 Vickers microhardness, n=7), suggesting similar effect in this property. The results indicated that it was possible to extract CNC from cotton fibers and that the drying steps during alkaline pulping contributed to higher yield.

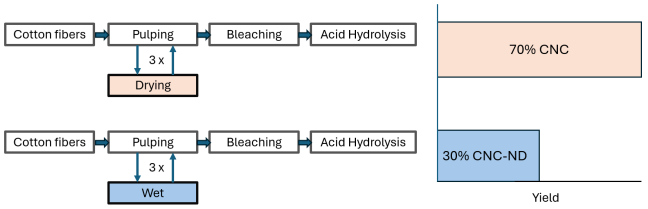

Figure 1. Yield of CNC by traditional method and without drying during pulping steps (n =3).

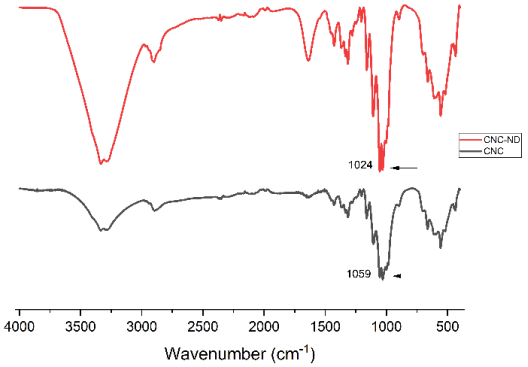

Figure 2. FTIR spectra of CNC samples obtained by two different extraction methods.

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