

Thesis Title	Effect of Cellulose Nanowhiskers' pH on Properties of Starch-Based Bionanocomposite Films
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ABSTRACT

Bacterial cellulose nanowhiskers (BCNWs) were prepared by acid hydrolysis of bacterial cellulose (BC) using 50% (w/v) sulfuric acid at 50 °C. The effect of sulfuric acid hydrolysis time and pH adjustment on properties of the obtained nanowhiskers was investigated. Yield (%) of BCNWs decreased when increasing hydrolysis time. It was found that the 48 hours acid hydrolyzed BCNWs possessed the highest perfection of the crystal lattice or crystallinity. Transmission electron microscope (TEM) revealed that the continuous BC fiber network transformed into the isolated rod-like nanocrystals of the BCNWs with a diameter and length of averaged 28.18 ± 2.0 nm and 637.61 ± 147.10 nm, respectively. The sulfuric acid treatment leads to decreasing in the thermal stability of BCNWs confirmed by thermogravimetric analysis (TGA). This is due to the induced sulfate groups onto the BCNWs after acid hydrolysis. Additional pH adjustment by NaOH can significantly improve the thermal stability of the BCNWs. The pH of BCNWs was adjusted to 3, 5, 7 and they were used to reinforce in the starch matrix to prepare the bionanocomposites (with varied contents of 1, 5, 10 wt%) by film casting technique. With increasing BCNWs content, the bionanocomposites revealed a significant improvement in their crystallinity (confirmed by XRD), thermal stability (a increment

of 20-30 °C, confirmed by TGA) and water resistance. The highest water resistance was observed in the bionanocomposite films reinforced with 10 wt% BCNWs of pH 7. The mechanical properties of the films reinforced with BCNWs of pH 3 and BCNWs of pH 7 were not improved because of a poor interaction between BCNWs of pH3 and starch matrix and formation of large aggregates of BCNWs of pH 7 in the bionanocomposites structure. Finally, the films reinforced with BCNWs of pH 5 showed improved the mechanical properties possibly due to the optimum dispersion of BCNWs and sufficient interaction between BCNWs and the starch matrix in this system.

Keywords: Cellulose Nanowhiskers/Starch/Bionanocomposites/pH

