Sonosynthesis of microcellulose from kenaf fiber: optimization of process parameters

ABSTRACT

Green composites using cellulose fibers as a reinforcement material provide a sustainable and renewable alternative to petroleum-based polymers. However, controlling the usage of chemicals and processing parameters to extract the cellulose could be sometimes difficult. Therefore, this study aims to optimize the conditions for extracting the microcellulose from kenaf fibers using central composite design (CCD), a statistical tool in design of experiments. Three factors and three levels were chosen for carrying out the analysis. The design was based on sodium hydroxide (NaOH) dosage, Sodium Chlorite ($NaClO_2$) dosage and sonication time as independent variables, while dependent variables were the fiber size and degradation point. Later, size responses were fitted using quadratic polynomial model and degradation responses using 2-factor interaction model (2FI). The R^2 values of 0.89 and 0.83 were obtained for the quadratic and the 2FI model, respectively. Further, surface morphology, thermal analysis, Fourier transform infrared (FTIR) spectroscopy and X-Ray diffraction (XRD) were also used for design validation. Optimal parameters for microcellulose extraction were found to be 0.15 g of NaOH at first stage, 4.6 mL of $NaClO_2$ at second stage, and 10 min of sonication during third stage.

Keyword: Chemical treatment; Extraction,; Microcellulose; Optimization; Sonication; Thermal stability