Optimizing the Acid Hydrolysis Process for the Isolation of Microcrystalline Cellulose from Oil Palm Empty Fruit Bunches Using Response Surface Methods

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Keywords:

Microcrystalline cellulose; Oil palm empty fruit bunch; Thermochemical characteristics; Response surface methods

Abstract

Purpose

The objective of the study was the optimization of the acid hydrolysis process parameters for the isolation of microcrystalline cellulose from oil palm empty fruit bunches (OP-EFB-MCC). The experiments were conducted following the central composite design of experiments, to determine the influences of reaction time, temperature, and acid concentration on the OP-EFB-MCC yield, thermal stability, and crystallinity index. The response surface methodology was employed to evaluate the influence of the variables and their interactions for obtaining maximum yield, thermal stability, and crystalline index. The results showed a good fitting of the experimental data to a second-order-polynomial model equation. The optimal experimental conditions of the acid hydrolysis process were determined to be 20 min reaction time, 106 °C, and 2.5 N acid concentration. Several analytical methods were employed to determine the thermochemical properties of the OP-EFB-MCC and the results were compared with those from the raw OP-EFB and commercial microcrystalline cellulose (C-MCC). The findings of this study revealed that the OP-EFB-MCC, isolated under the optimum experimental conditions, had thermochemical characteristics compatible with those of C-MCC. Thus, it has the potential to be used as an alternative for C-MCC in the synthesis of green composites, as a bio-reinforcement material or bio-filler.