Individualization of microfibrillated celluloses from oil palm empty fruit bunch: comparative studies between acid hydrolysis and ammonium persulfate oxidation

ABSTRACT

In the present study, the feasibility and the practicability of two different approaches to the individualization of microfibrillated celluloses (MFCs) from oil palm empty fruit bunches were evaluated. Some properties of MFCs prepared by ammonium persulfate (APS) oxidation were investigated and compared with those extracted using sulfuric acid hydrolysis. Fourier transform infrared observation demonstrated that almost all the hemicelluloses and lignin were effectively removed after the sulfuric acid hydrolysis, which was substantiated by the disappearance of the characteristic peaks of these two noncellulosic components at 1735 and 1508 cmī 1, respectively. However, a peak at 1735 cmī 1 was observed in the spectrum of APS-oxidized MFCs because the products prepared by this treatment are stabilized by carboxyl groups instead of sulfate half-ester groups, which introduced by sulfuric acid. Furthermore, X-ray diffractograms of MFCs revealed the decrease in crystallinity after sulfuric acid hydrolysis but remained similar after APS oxidation. Thermogravimetric analysis was employed to determine the thermal stability of the treated fibers. In addition, the morphologies and diameters of MFCs were determined by field-emission scanning electron microscopy. MFCs formed by these two different techniques exhibited long and network-like fibrils with widths ranging from 8 to 40 nm. UV-Vis spectroscopy was used to monitor the optical transmittance of the nanocellulose suspensions.

Keyword: Ammonium persulfate oxidation; Carboxyl groups; Microfibrillated celluloses; Oil palm empty fruit bunch; Sulfate half-ester groups; Sulfuric acid hydrolysis