

Synthesis of Cellulose Nanocrystals from Oil Palm Empty Fruit Bunch by Using Phosphotungstic Acid

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Abstract : Oil palm empty fruit bunch (OPEFB), an abundant agro-waste in Indonesia, is being studied as raw material of Cellulose Nanocrystals (CNC) synthesis. Instead of conventional acid mineral, phosphotungstic acid ($H_3PW_{12}O_{40}$, HPW) was used to hydrolyze cellulose due to recycling ability and easy handling. Before hydrolysis process, dried EFB was treated by 4% NaOH solution at 90°C for 2 hours and then bleached using 2% $NaClO_2$ solution at 80°C for 3 hours to remove hemicellulose and lignin. Hydrolysis reaction parameters such as temperature, acid concentration, and reaction time were optimized with fixed solid-liquid ratio of 1:40. Response surface method was used for experimental design to determine the optimum condition of each parameter. HPW was extracted from the mixed solution and recycled with diethyl ether. CNC was separated from the solution by centrifuging and washing with distilled water and ethanol to remove degraded sugars and unreacted celluloses. In this study, pulp from dried EFB produced 44.8% yield of CNC. Dynamic Light Scattering (DLS) analysis showed that most of CNC equivalent diameter was 140 nm. Crystallinity index was observed at 73.3% using X-ray Diffraction (XRD) analysis. Thus, a green established process for the preparation of CNC was achieved.

Keywords : acid hydrolysis, cellulose nanocrystals, oil palm empty fruit bunch, phosphotungstic acid

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