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Multiple Stage Pretreatment Affecting the Properties of Nanocellulose from Oil Palm Frond

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Abstract. Cellulose extraction is an important step prior to nanocellulose production from lignocellulosic materials. The important view of present study rely on pretreatment method for cellulose extraction by comparing their effect on properties of nanocellulose. Oil palm frond was choose in focusing study as the potential value added product. Two pretreatment method were conduct which are multiple stage pretreatment and compared with single stage pretreatment. Peracetic acid was used as totally chlorine free (TCF) bleaching as it is environmental favorable. Multiple stage is the combination of physical, enzymatic and alkaline treatment while single stage represent for soda pulping process using 14% active alkaline charge in high temperature and pressure (160ºC, 0.6-1.0 MPa). For multiple stage, superheated steam (300ºC, 9 min) used as a prospective in open the fiber structure to allow the subsequent of enzymatic hydrolysis using xylanase. The xylanase was then access to catalyze 1, 4-beta-xylosidase which results in removal of hemicellulose and increase the cellulose content. In addition, xylanase enhanced the delignification process using alkaline treatment of 10% sodium hydroxide. Cellulose nanofibrillation was then conducted using a wet disc mill (WDM). Chemical analysis revealed the cellulose purity from multiple stage and single stage pretreatment with 83.4% and 94.6%. By characterization, the cellulose from multiple stage pretreatment results in high degree of polymerization up to 1,226, higher crystallinity (69.5%) and reach maximum thermal degradation at 326ºC. The characteristics of cellulose eventually affected the nanocelluloses properties and by morphology, the nanocellulose produced from both treatment have the diameter size less than 100 nm.

Keywords: cellulose extraction, superheated steam, enzymatic hydrolysis, alkaline treatment, TCF bleaching, characterization, nanocellulose.