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Surface modification of cellulose fibers from oil palm empty fruit bunches for heavy metal ion sorption and diesel desulphurization

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ABSTRACT

In this study, purely-extracted cellulose from Oil Palm Empty Fruit Bunches (OPEFB) were successfully surface-engineered with acetate (mono-carboxylic), oxalate (di-carboxylic) and ethylene diamine tetra acetic acid (tetracarboxlic group) with different degree of substitution, due to the presence of carboxylic group on the an hydro glucose unit of cellulose. The changes from smooth to rough surface can be attributed to the effects of sodium hydroxide treatment and distribution of carboxylic group. All Fourier transform infrared spectroscopy spectra showed similar peaks suggesting the stability of purely-extracted cellulose structure after treatment. The only difference was the 1730 cm^{-1} peak for carboxlic group (C=O) observed in all substituted spectra, but not in the original purely-extracted cellulose. The ultrasonic and autoclave treatments of cellulosic fibers modified (M) with the carboxylic groups showed the highest Pb(II) adsorption from EDTA modified (232.9 and 236.7 mg g^{-1}) sorbents. The low Pb (II) ion uptake at pH 4 was attributable to the competition for the active sites with higher concentration of protons, while higher uptake was attained at pH 6 with more abundant hydroxyl ions. The Pb (II) sorption on the surface engineered sorbents followed the pseudo second order kinetics model with R^2 = 0.9771–0.9809, and best fitted to the Temkin adsorption isotherms. The Pb-loaded modified purely-extracted celluloses were tested for desulphurization of diesel and achieved higher sulphur removal (ppm) from the Pb-Oxalate-modified (300) and Pb-EDTA-modified (350) sorbents as compared to without metal-loaded sorbents (80–110).

Keywords: Purely-extracted celluloses; Biosorption; Lead; Adsorption kinetics; Diesel desulphurization

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