Characterization of structural and physical properties of dichloromethane- and methanol-fractionated Kraft lignin and its adsorption capacity of Cu (II) and Ni (II) ions

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ABSTRACT

This work investigates the effect of the molecular weight and polydispersity of Kraft lignin (KL) on its capacity to remove copper and nickel ions from aqueous solutions. KL and its fractions were characterized by gel permeation chromatography, 1H NMR, 31P NMR and attenuated total reflectance—Fourier transform infrared spectroscopy, elemental and ash analyses. Moreover, the glass transition temperature of lignin samples was determined by dynamic mechanical analysis. The fractionated lignin exhibited lower molecular weight and narrower polydispersity than the original KL. Accordingly, the successive solvent extraction herein applied would appear to be a convenient way to extract low molecular fractions admixed with sulphur from KL. A pseudo-second-order rate model was utilized to describe the sorption kinetics of metal ions. The KL fractionated with dichloromethane and methanol possessed a greater capacity for copper and nickel sorption than the original KL. Maximum uptake was 5.94 mg of copper and 7.95 mg of nickel per gram of the fractionated KL. The results obtained demonstrate that molecular weight characteristics can influence the metal scavenging efficiency of the KL.

Keywords: Adsorption capacity; Lignin; Metal ions; Molecular weight distribution; Water treatment