Poly(hydroxamic acid) ligand from palm-based waste materials for removal of heavy metals from electroplating wastewater

ABSTRACT

Heavy metals pollutants are nonbiodegradable and their bioaccumulation results in detrimental environmental consequences. Therefore, it is important to effectively remove toxic heavy metal waste from industrial sewage. Thus, the main goal of this research is to synthesize an ideal cellulose-based adsorbent from palm-based waste materials (agro waste) in order to be utilized in real-life practical applications with low cost as such removing common toxic heavy metals from industrial effluents. A poly(methyl acrylate) grafted palm cellulose was synthesized via a free-radical initiation process, followed by an oximation reaction to yield poly(hydroxamic acid) ligands. The adsorption capacity (q_e) of poly(hydroxamic acid) ligands for metal ions such as copper (Cu^{2+}), iron (Fe^{3+}), and lead (Pb^{2+}) were 325, 220, and 300 mg g^{-1}, respectively at pH 6. In addition, the X-ray photoelectron spectrometry results are to be proved the binding of metal ions, for instance, Cu(II) ions showed typically significant BEs of 932.7 and 952.0 eV corresponding to the Cu2p3/2 and Cu2p1/2 species. The heavy metal ions adsorption followed a pseudo-first-order kinetic model pathway. The adsorption capacity (q_m) is also derived from the Langmuir isotherm linear plot, which does not showed good correction coefficients. However, the results were correlated to the Freundlich isotherm model, where the R^2 value showed significance (>0.98), indicating that multiple layer adsorption occurs on the synthesized ligand. The synthesized polymeric ligand is an excellent adsorbent for the removal of heavy metals from the industrial wastewater. In addition, the metal analysis results showed that about 98% removal of copper and iron ions from electroplating wastewater including lead, nickel, and chromium can be removed up to 85–97%.