Synthesis of immobilized chitosan/humic acid coupling product for removal of Pb(II), Cd(II) and Cr2O7^2- from aqueous solutions

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ABSTRACT

Immobilized coupling product (CP) of chitosan with humic acid was prepared to overcome the solubility limitations in using chitosan and HA as adsorbents for heavy metals ions. Two CPs were prepared: FCP from Fluka humic acid and JCP from Ajloun(Jordan) humic acid. The prepared CPs were found to be insoluble in the pH range from 2 to 12. The CPs were studied by elemental analysis, Ba(OH)2 titration, potentiometric titration, FTIR, solid 13C-NMR, SEM and XRD. The results indicated the formation of covalent amide/ester bonds and electrostatic bonds (~--NH3+...–OOC~~~) between chitosan and humic acid. The uptake of Pb(II) and Cd(II) by CPs was found to increase with increasing pH and ionic strength, while, the reverse was observed in the case of Cr2O7^2- which indicated a unique behavior of CPs compared with free humic acid and chitosan. The adsorption capacities of Pb(II), Cd(II), and Cr(VI) were 33.0, 24.7, and 56.5 mg/g, respectively, in the case of FCP, and 54.9, 20.1, and 54.1 mg/g, respectively, in the case of JCP. The effect of time and temperature on adsorption showed that it is fast, endothermic and entropy driven. The SEM indicated tight surface of CPs due to the strong bonding between chitosan and humic acid. To overcome this problem, CPs were modified by spread over silica gel to produce a high capacity adsorbent (486 mg Pb/g FCP) which has superior removal of low concentrations of Pb < 30 ppm with about 100% efficiency.

Keywords: Adsorption; Cadmium; Chitosan; Dichromate; Humic acid; Lead

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