Effect of glutaraldehyde cross-linking degree of chitosan/sporopollenin microcapsules on removal of copper(II) from aqueous solution

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ABSTRACT

Bio-based sorbents, especially cross-linked chitosan, have been widely used in heavy metal removal. Type of cross-linking agent and degree of cross-linking largely affect metal sorption behaviour of chitosan-based sorbents. This study describes the preparation of chitosan/sporopollenin (CS) microcapsules cross-linked with different amount of glutaraldehyde (GA)/chitosan ratios. The microcapsules were modified by the incorporation of 0.3, 0.9 and 1.5 mL of GA solution (in water 25% v:v) for 1.50 g of chitosan. A protected cross-linking method was used for the preparation of the CS/GA microcapsules by the reaction of the microcapsules with Cu(II) as the protector. Scanning electron microscopy, Fourier transform infrared spectroscopy and thermogravimetric analysis were employed for the microcapsules characterization. The adsorption performance of the microcapsules was studied for the removal of Cu(II) at different concentration, contact time, amount of adsorbent, temperature and pH. The maximum Cu(II) removal values were 88.9, 100.4 and 80.7 mg g\(^{-1}\) by 0.3, 0.9 and 1.5 mL of GA impregnated CS microcapsules, respectively. The equilibrium adsorption isotherm data of the microcapsules exhibited a better fit to the Freundlich isotherm model. Affinity of the CS microcapsules for Zn(II), Cd(II), Ni(II) and Cr(III) in presence of Cu(II) was also investigated. GA/chitosan ratio affected the metal sorption performance and physicochemical properties of the microcapsules. The results revealed that CS microcapsules that were cross-linked with 0.9 mL of GA solution had better Cu(II) ion sorption capacity and can be cost-effective sorbents in water treatment.

Keywords: Adsorption; Chitosan; Sporopollenin; Microcapsule

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