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Title : Modification and Characterization of Chitosan for Removal of Heavy Metal Ions from Wastewater

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ABSTRACT

The adequate quality of water that we use is under question and drawing considerable interest in recent years as these contaminants have harmful effects both to the environment and human health. Biopolymers have attracted great research interests in their use as adsorbents in recent years. Chitosan; a biopolymer; obtained by the deacetylation process of chitin, has intrinsic properties that make it an effective bioadsorbent for removing the heavy metal ions from wastewater. A method for the preparation of thiosemicarbazide-chitosan(TSCS) exploring the evaluation of enhanced adsorption of heavy metal ions and antibacterial activities via derivatization was proposed and experimented. The experimental equilibrium data was evaluated by the Langmuir, the Freundlich and the Dubinin-Radushkevich isotherm models. The applicability of the fit of model to experimental values was accessed on the basis of error analyses. The Langmuir adsorption model was best fitted with experimental value, suggests the existence of monolayer coverage of adsorbed molecules with a maxima of 142.85mg g^{-1}.

Macroporous thiocarbohydrazide cross-linked chitosan-polyvinyl alcohol framework (TCPF), prepared via the condensation reaction of thiocarbohydrazide and the oxidized chitosan(OCS) and polyvinyl alcohol(OPVA) with selective and efficient adsorption for Cu(II), Pb(II) and Hg(II). The adsorption of Cu(II), Pb(II) and Hg(II) onto TCPF were studied through batch adsorption experiments and the adsorption data were analyzed by using various models. The

Langmuir model best fits with the experimental values which yields adsorption capacities of 47.16mg g^{-1}, 47.39mg g^{-1} and 52.63mg g^{-1} for Cu(II), Pb(II) and Hg(II) respectively. The calculated thermodynamic parameters ΔG^{o}, ΔS^{o} and ΔH^{o} suggest that the adsorption of Cu(II), Pb(II) and Hg(II) is thermodynamically favorable and thus a spontaneous process which follows pseudo-second-order kinetics. The plot of q_t versus $t^{1/2}$ suggests that intraparticle diffusion is not only the rate-controlling step, but the positive value of the intercept in Pb(II) and Hg(II) plots. Finally, the complete soil degradability which can be attained in approximately 90 days makes the whole process environmentally friendly and economically feasible.

Thiosemicarbazide modified carboxymethyl cellulose-chitosan adsorbent(TCMCC) was synthesized by oxidation reaction of carboxymethyl cellulose and chitosan with sodium periodate followed by a condensation reaction with thiosemicarbazide and stabilised with sodium borohydride. TCMCC was characterised by field emission scanning electron microscopy(FESEM), X-ray diffraction(XRD), thermogravimetric analyser(TGA), X-ray photoelectron spectroscopy(XPS) and Fourier-transform infrared spectroscopy(FTIR). The kinetics of adsorption and error analysis suggests that the Pseudo second order model fits better than the other models. The maximum adsorption capacity of Cu(II) ion, obtained by the Langmuir model is 144.92(mg g^{-1}) which is higher than the other adsorbents. Furthermore, TCMCC also exhibited a higher regeneration, Cu(II) recovery and can be used without marked loss of adsorption capacity after a number of adsorption/desorption cycles.p

The recent benefits of biomaterials with adsorption properties are being examined and employed efficiently and chitosan in its various forms has demonstrated efficacy as reported in this thesis.