Equilibrium isotherm and mechanism studies of Pb(II) and Cd(II) ions onto hydrogel composite based on vermiculite

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ABSTRACT

In the present work, the abilities of chitosan-g-poly(acrylic acid)/ vermiculite (CTS-g-PAA/VMT) hydrogel composites to remove Pb(II) and Cd(II) ions from aqueous solutions were compared. Batch adsorption studies were carried out to examine the influence of various parameters such as the VMT content, the initial pH value, the contact time, the initial metal ion concentration on adsorption capacities. Adsorption of Pb(II) and Cd(II) ions on the composite showed a pH-dependent profile. The maximum adsorption capacity for both metal ions was found to lie between 5.5 and 6.00. The adsorption processes were all relatively fast. Over 90% of the total adsorption was reached in around 3 min for both Pb(II) and Cd(II) adsorption at 303 K, and the equilibrium was reached after about 15 min of contact time. The adsorption data for the composite fitted well not only the Langmuir model but also the Freundlich model. The maximum Pb(II) adsorption capacity (3.0774 mol/g) of the composite is only a little more than that of Cd(II) (2.9817 mmol/g) at 303 K, however, the desorption efficiency of Pb(II) loaded sample (63.27%) is much lower than that of Cd(II) loaded sample (86.26%) when 0.1 mol/L HNO3 solution was used as the eluent. The adsorption of Pb(II) and Cd(II) ions by the composite seemed to involve ion exchange, chelation, electrostatic attraction or adsorption. –NH2, –COOH and –OH groups are all involved in the adsorption processes. Moreover, there are only few of –NH2 groups participating in the reaction with Pb(II) ions.

Keywords: Chitosan; Vermiculite; Hydrogel composite; Pb(II); Cd(II); Adsorption mechanism

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