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Hierarchically Porous Zeolite X Composites for Manganese Ion-exchange and Solidification:
Equilibrium Isotherms, Kinetic and Thermodynamic Studies

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Abstract

This paper deals with the kinetic and isotherm studies of manganese ion removal by zeolite X and its hierarchically porous composites as ion-exchange materials. A hydrothermal treatment was applied to grow a layer of zeolite X over diatomite and carbon surfaces. The hierarchically porous composites used for Mn^{2+} ion removal showed higher ion-exchange capacity when compared to pure zeolite X under same conditions. A thermodynamic study of the rate of ion-exchange revealed that the intra-particle diffusion rate constant of zeolite X/carbon and zeolite X/diatomite was higher than that of pure zeolite X indicating that the intra-particle diffusion was enhanced when zeolite was prepared in form of hierarchically porous composites. The study showed that the thickness of boundary film of zeolite X/carbon and zeolite X/diatomite was less than that of pure zeolite X indicating ion diffusion resistance to the active sites was reduced when the composites were utilised. The experimental data showed good agreement with Freundlich model. The calculated thermodynamic parameters such as ΔG° , ΔH° and ΔS° indicated the ion-exchange process of Mn^{2+} ion by zeolite X and its composites was spontaneous, endothermic and the randomness increased at the liquid/solid interface under the conditions studied. The results of kinetic study showed that the ion-exchange of Mn^{2+} ion by zeolite X and its composites followed a pseudo second order

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