Adsorption study of Pb(II) by chemically modified cattail stem

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ABSTRACT

A series of new chemically modified cattail stem adsorbents were prepared and the feasibility of adsorbents to remove Pb(II) ion from aqueous solution was examined. Structural and textural modifications of cattail stem powder which occurred during the synthesis of adsorbents were confirmed by infrared spectroscopy (IR), scanning electron microscopy (SEM), X-ray diffraction (XRD), and thermogravimetry (TG). The effectiveness of the adsorbents in Pb (II) removal from aqueous solutions at different initial concentrations, pH, and temperature of the solutions was studied. Higher pH favors higher Pb(II) removal in acid solution. Increase in temperature results in a larger Pb(II) loading per unit weight of the adsorbents. The equilibrium adsorption data were analyzed using two widely applied isotherms: Langmuir and Freundlich. The isothermal data for CC and MC (cattail stem powder modified by 1.0 M citric acid and malic acid, respectively) were fairly well fitted with Langmuir equations. The maximum adsorption capacities obtained from Langmuir model were 352.2 and 299.2 mg/g by using CC and MC. The thermodynamic parameters of the cattail adsorbents, \( \Delta H \), \( \Delta S \), and \( \Delta G \), were calculated. The negative \( \Delta G \) values of Pb(II) at various temperatures confirmed the adsorption processes were spontaneous.

Keywords: Modified cattail stem adsorbent; Lead ion; Adsorption; Kinetics; Isotherm