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ION-EXCHANGE MECHANISM IN BIOSORPTION OF Pb^{2+} IONS FROM CONTAMINATED WATER BY BANANA STALK WASTE

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Abstract

Banana stalk (BS) waste is used to remove Pb^{2+} from aqueous solution. Equilibrium data were analyzed with Langmuir and Freundlich adsorption models, which fit better in the former equation. The q_{max} (maximum metal uptake capacity) for Pb^{2+} adsorption was 105.14 mg/g of BS at pH 5.0, which followed pseudo-second order kinetics model. IR spectra confirmed the participation of hydroxyl, amino, and acidic functional moieties in the removal of Pb^{2+}. The major mechanism involved in the biosorption of Pb^{2+} was ion-exchange as conformed by m_{eq} (milliequivalent) ratios of Pb^{2+} adsorbed and the amount of alkali (Na^+, K^+) and alkaline earth (Ca^{2+} and Mg^{2+}) metals released. BS was used in five repeated adsorption-desorption cycles, recovering +99% of adsorbed Pb^{2+} with 0.5 M HCl as desorbent. The optimized batch experimental parameters were applied to treat large volumes of Pb^{2+}-contaminated wastewater to obtain breakthrough curves in fixed bed columns. The effective removal of Pb^{2+} by BS, a low-cost and efficient biosorbent to sequester Pb^{2+}, meets the criteria of internationally acceptable maximum discharge limits in wastewaters.

Key words: breakthrough curve, column bioreactor, desorption, ion-exchange, lead

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