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

Kashif Iqbal Sahibzada\textsuperscript{1}, Asma Saeed\textsuperscript{2*}, Imran Kalim\textsuperscript{2}, Muhammad Iqbal\textsuperscript{3}

\textsuperscript{1}Department of Chemistry, F.C. College University, Lahore, Pakistan
\textsuperscript{2}Environment Biotechnology Group, PCSIR Laboratories Complex, Ferozepur Road Lahore, Pakistan
\textsuperscript{3}Centre for Applied Molecular Biology, 87-West Canal Bank Road, Lahore, Pakistan

Abstract

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

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

Received: July 2012; Revised final: June, 2013; Accepted: July, 2013

\textsuperscript{*}Author to whom all correspondence should be addressed: email: asmadr@wol.net.pk; asmadr@brain.net.pk Phone: +92-42-99230688; Fax: +92-42-99230705