Influence of solution chemistry on heavy metals removal by bioadsorbent tea waste modified by poly (vinyl alcohol)

Yun Zhang\textsuperscript{a,*}, Xiaoli Li\textsuperscript{b}, Yanfeng Li\textsuperscript{a}

\textsuperscript{a}College of Chemistry and Chemical Engineering, Institute of Biochemical Engineering & Environmental Technology, Lanzhou University, Lanzhou 730000, P.R. China

\textsuperscript{b}College of Resources and Environment, Lanzhou University, Lanzhou 730000, P.R. China

Received 22 August 2013; Accepted 29 October 2013

\textbf{ABSTRACT}

In this study, the macroporous spherical composite biomaterials, Poly(vinyl alcohol)/teawaste (PVA/TW), were prepared and investigated for their potential to remove Pb\textsuperscript{2+}, Hg\textsuperscript{2+}, and Cu\textsuperscript{2+} from aqueous solution. Investigations showed that adsorption capacity of Hg\textsuperscript{2+} by PVA/TW bead was much higher than that of Pb\textsuperscript{2+} and Cu\textsuperscript{2+}, while adsorption rate of Pb\textsuperscript{2+} was fastest. The experimental data obtained for Pb\textsuperscript{2+}-PVA/TW, Hg\textsuperscript{2+}-PVA/TW, and Cu\textsuperscript{2+}-PVA/TW at different solution temperatures indicate a monolayer type biosorption, which explains why the Langmuir isotherm accurately represents the experimental data obtained in this study. The Langmuir maximum biosorption capacities of Pb\textsuperscript{2+}, Hg\textsuperscript{2+}, and Cu\textsuperscript{2+} onto PVA/TW were 81.56, 175.68, and 49.08 mg/g at 298 K, respectively, which is comparatively superior to most other low-cost biomaterials. Fourier transform infrared spectroscopic analysis of the metal-loaded biosorbents confirmed the participation of \textsuperscript{\textendash}COOH, \textsuperscript{\textendash}NH\textsubscript{2}, and O-CH\textsubscript{3} groups in the complexation of Pb\textsuperscript{2+}, Hg\textsuperscript{2+}, and Cu\textsuperscript{2+}. Thermodynamic parameters demonstrated that the biosorption of Pb\textsuperscript{2+} onto PVA/TW was endothermic, spontaneous, and feasible at 288–318 K. The results evidently indicated that PVA/TW would be suitable biosorbents for Pb\textsuperscript{2+}, Hg\textsuperscript{2+}, and Cu\textsuperscript{2+} in wastewater under certain conditions.

\textbf{Keywords:} Tea waste; Polymer PVA; Adsorption mechanism; Heavy metals

\textsuperscript{*Corresponding author.

1944-3994/1944-3986 © 2013 Balaban Desalination Publications. All rights reserved.