


Sequestration of Aqueous Lead(II) Using Modified and Unmodified Red Onion Skin

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Abstract

The efficacy of onion skins, both unmodified and chemically modified with thioglycolic acid, was investigated as alternative low-cost adsorbents for the sequestration of aqueous lead(II) ions from aqueous solution. The adsorbents were characterised using Fourier transform infrared spectroscopy and scanning electron microscopy – energy dispersive X-ray spectroscopy. Adsorption experiments were performed using batch sorption processes. The effects of contact time, pH, initial Pb(II) concentration, adsorbent dose, and temperature were investigated. Optimum sorption conditions were found at pH 4 and a 150 min equilibrium time for the modified onion skin and unmodified onion skin. The Langmuir, Freundlich, Dubinin-Radushkevich and Temkin models were used to characterize the equilibrium experimental results. The equilibrium process was best described by the Freundlich isotherm. The maximum adsorption capacities of 4.878 and 6.173 mg/g were obtained for modified and unmodified adsorbents, respectively, using the Langmuir model. Kinetic studies indicated that the sorption of Pb(II) ions followed a pseudo-second-order model. Thermodynamic parameters such as standard enthalpy change (ΔH°), entropy change (ΔS°), and free energy change (ΔG°) were evaluated from the sorption experimental measurements. The results showed that the sorption process of Pb(II) ions on unmodified and modified onion skins was feasible and exothermic under the conditions used in this study. The sorption process followed the mechanism of physisorption.

KEYWORDS: Biosorption; Fourier transform infrared spectroscopy (FTIR); isotherms; onion skins; scanning electron microscopy–energy dispersive X-ray spectroscopy (SEM-EDX)

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