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The removal of Pb(II) ions from aqueous solutions by immobilized (*Chlorophyta*) macroalgae: an equilibrium, kinetic, and desorption-regeneration study

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ABSTRACT

This study presents the synthesis of biosorbent by the immobilization of green algae (*Chlorophyta*) into calcium alginate as a supporting composite for the removal of heavy metals. The batch adsorption system was employed to investigate the effectiveness of the algae-alginate synthesized beads (AASB) in lead removal from an aqueous solution. Since pH 5 produced the greatest removal efficiency of Pb(II) ions, it reveals that the pH significantly affects the adsorption of Pb(II) ions using AASB as an adsorbent. Results showed that the ideal working conditions for AASB were: 5 g/L of AASB, 120 min of contact time, pH value of 5, and 200 rpm agitation speed, which achieved roughly 90.98% removal efficiency and a capacity of 9.0492 mg/g. Several analytical methods, such as Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS), were used to evaluate the adsorbent's performance and investigate its adsorption mechanism. FTIR analysis showed the engagement of hydroxyl, amino, and carboxyl functional groups during Pb(II) ions adsorption, At the same time, the metal cations are adsorbed on the surface of the algal biomass, which is demonstrated by SEM to have an amorphous superficial structure, while EDS spectra showed the presence of elements that are favorable for Pb(II) adsorption. The equilibrium isotherm results were well suited to the Freundlich isothermal model, although the adsorption kinetic data is accurately articulated by the pseudo-first-order model. This suggests that heavy metals can be removed from wastewater using AASB which is considered a feasible and effective biosorbent.

Keywords: Adsorption; *Chlorophyta* Algae; Algae-alginate synthesized beads; Pb(II) ions wastewater; Algae characteristics

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