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Comparative sorption isotherms and removal studies for Pb(II) by physical and thermochemical modification of low-cost agro-wastes from Tanzania

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Abstract

Corn and rice husks, agro-wastes available in large quantities in Tanzania, were used to remove Pb^{2+} from aqueous solution. Husks were used in raw form, pyrolyzed form, and chemically modified form. Material characterization was carried out using the BET method, FTIR spectroscopy, SEM, pH_{PZC} , and cation exchange capacity analysis. Langmuir, Freundlich, Dubinin-Radushkevich (D-R), and Temkin isotherms were used to elucidate Pb^{2+} sorption mechanisms. The surface area and cation exchange capacity (CEC) of untreated and chemically treated biochars were significantly higher than that of raw husks. Sorption data for Pb^{2+} for all biosorbents fit the Freundlich and D-R models well with high R^2 values. Most of the synthesized biosorbents in this study indicated >90% for Pb^{2+} removal, with the $ZnCl_2$ -treated corn husk biochar sorption capacities ranking highest in all modeling results. Surface morphological features (e.g., micropores and fissures) and acidic and unsaturated functional groups may have significantly contributed to the observed Pb^{2+} removal efficiencies.

Keywords

Agro-wastes; Tanzania; Biochar; Lead; Biosorption;