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Effective removal of lanthanum ions from aqueous solution using rice husk: impact of experimental variables

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ABSTRACT

The focus of the present work is to optimize different experimental parameters such as nature of electrolyte, pH, amount of adsorbent, ions concentration, equilibration time, temperature, and operating mode. The effective removal of lanthanum ion (La^{3+}) using biomaterial such as rice husk (RH) was determined by radio-tracer technique. The adsorption phenomenon was verified by FTIR, SEM and EDX techniques. The adsorption data was well fitted to linear and nonlinear forms of Freundlich, Langmuir and Dubinin-Radushkevich isotherm models with characteristic Freundlich constants of $n = 2.087 \pm 0.084$ and $K = 2.81\times10^{-4} \pm 6.387\times10^{-6}$ mol/g and Langmuir constants of $Q_m = (1.046\pm0.105)\times10^{-5}$ mol/g and $K_L = 5347 \pm 995$ dm^3/mol. The sorption free energy was 10.78 ± 0.641 kJ/mol indicating the chemisorption interaction between the La^{3+} ions and the RH with pseudo 2nd order kinetics. Thermodynamic parameters were evaluated using Van't Hoff equation with ΔG values indicating spontaneity of the process. A positive ΔH value of 28.563 kJ/mol suggested an endothermic nature of the adsorption. Freundlich adsorption capacity of La^{3+} ions was 2.81×10^{-4} mol/g for RH indicating that it locally available cheaper material is good alternative for costly commercial adsorbents and may be used for waste management of radionuclide's.

Keywords: Lanthanum; Rice husk; Biosorbent; Isotherms; Kinetic; Thermodynamics

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