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Removal of anionic surfactant sodium dodecyl sulphate from aqueous solution by adsorption onto pine cone biomass of *Pinus Radiate:* equilibrium, thermodynamic, kinetics, mechanism and process design

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ABSTRACT

This study was undertaken to evaluate the adsorption potential of a natural, low-cost agricultural by-product adsorbent, Pine cone (*Pinus Radiate*), to remove sodium dodecylsulfate (SDS) from aqueous solution. It was found that the extent of SDS adsorption by pine cone biomass increased with initial surfactant concentration and contact time but decreased with increasing solution pH, amount of adsorbent, and temperature of the system. These studies also suggested that the electrostatic forces and surfactant self-assembly are dominant mechanisms governing this pH dependent adsorption process. Overall, kinetic studies showed that the surfactant adsorption process followed pseudo-second-order kinetics based on pseudo-first-order and intraparticle diffusion models. The different kinetic parameters including rate constant, half adsorption time, and diffusion coefficient were determined at different physicochemical conditions. Equilibrium data were fitted by both the Langmuir isotherm and Freundlich adsorption isotherm. The maximum monolayer adsorption capacity of pine cone biomass was 95.75 mg g^{-1} at 20°C. The value of separation factor, R_L from Langmuir equation and "*n*" from Freundlich also indicated favourable adsorption. Thermodynamic parameters such as ΔG^0, ΔH^0, and ΔS^0 were calculated. A single-stage batch absorber design for the SDS adsorption onto pine cone biomass also presented based on the Freundlich isotherm model equation.

Keywords: Surfactant; *Pinus radiate*; SDS adsorption; Kinetic model; Isotherm; Process design

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