



Sorption of Zn(II) ion onto the surface of activated carbon derived from eucalyptus bark saw dust from industrial wastewater: isotherm, kinetics, mechanistic modeling, and thermodynamics

Vishal Mishra*, Chandrajit B. Majumder, Vijay K. Agarwal

*Department of Chemical Engineering, Indian Institute of Technology, Roorkee 247667, India
Tel. +91 9415962309; email: vishal.biochemical@gmail.com*

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ABSTRACT

The activated carbon was derived from base (0.2 M NaOH)-mediated activation of biomass followed by thermal treatment at 1,123 K. The utmost metal ion uptake capacity and sorption percentage of activated carbon derived from eucalyptus biomass were 1.42 mmol g^{-1} and 93.42%, respectively. Freundlich isotherm model proved to be superior with higher linear correlation coefficient $R^2 = 0.96\text{--}0.98$. Similarly, it was observed that pseudo-second-order reaction model with lower χ^2 (0.002703–0.009351) and sum of square errors (0.0001–0.0144) value together with higher R^2 (0.98–0.99) ruled in all the possibilities of sorption of Zn(II) ion on activated carbon surface as chemisorption. Bangham's model ($R^2 = 0.93\text{--}0.95$) applicability in the present investigation demarcated the fact that the main rate-controlling step in the sorption of Zn(II) ions on activated carbon surface was film diffusion rather than intraparticle diffusion. The results of diffusivity coefficients ($D_f = 7.16 \times 10^{-6} \text{ cm}^2 \text{ s}^{-1}$) reproduced the analogous viewpoint that film diffusion is quite a dominant step in the biosorption of Zn(II). ΔG , ΔH , and ΔS values obtained through the thermodynamic study of Zn(II) biosorption system were $-9798 \text{ kJ mol}^{-1}$, $-34.74 \text{ kJ mol}^{-1}$, and $-107.63 \text{ kJ mol}^{-1} \text{ K}^{-1}$, respectively.

Keywords: Biosorption; Zn(II) ion; Pseudo-second-order model; Film diffusion; Diffusivity coefficient

*Corresponding author.