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Studies on the remediation of chromium(VI) from simulated wastewater using novel biomass of *Pinus kesiya* cone

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ABSTRACT

Hexavalent chromium pollution in water puts forward a huge threat to environment and human health. Conventional methods of heavy metal removal from water generate toxic by-products, which mandate the use of efficient and alternative biosorbent-based strategies. In this study, a novel biosorbent *Pinus kesiya* cone biomass has been investigated for the hexavalent chromium removal from aqueous solutions. The biosorbent characteristics have been analyzed using Brunauer–Emmett–Teller, Fourier transform infrared spectrometry, field emission scanning electron microscopy–energy dispersive X-ray spectrometry, thermogravimetric analysis, X-ray diffraction and electron spin resonance analyses. Parameters influencing the biosorption process were optimized as pH 2.0, temperature 303 K, initial Cr(VI) concentration 500 mg/L, biosorbent dose 0.5 g/L, biosorbent size of <300 μm and contact time 210 min. Langmuir isotherm fitted experimental data better than the Freundlich and Dubinin–Radushkevitch isotherm showed that the biosorption followed monolayer adsorption. Maximum biosorption capacity calculated by Langmuir adsorption isotherm was found to be 73.96 mg/g. Pseudo-second-order kinetics was found to have a better fit than the other kinetic models analyzed. Thermodynamic studies revealed that the biosorption process occurs in spontaneous, stable and exothermic manner. Desorption and regeneration studies showed that the biosorbent is reusable and an ecofriendly option for Cr(VI) removal from aqueous solutions. Breakthrough experiment on Cr(VI) biosorption by *P. kesiya* cone biomass was carried out in continuous packed bed column. These interesting findings on Cr(VI) biosorption by *P. kesiya* cone biomass vouches for its potential application as an alternative biosorbent for Cr(VI) removal.

Keywords: *Pinus kesiya* cone biomass; Isotherm; Kinetics; Desorption; Chromium; ESR; Langmuir; Freundlich; Pseudo-first order; Pseudo-second order

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