

## GREEN BIOSORPTION APPROACH FOR HEXAVALENT CHROMIUM REMOVAL USING WATER HYACINTH POWDER: KINETICS AND ISOTHERMS

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Hexavalent chromium [Cr(VI)] contamination in water sources poses a significant threat to environment and human health, necessitating efficient and sustainable remediation strategies. Among available methods, adsorption is widely recognised for its simplicity and efficacy, with biosorbents offering a promising eco-friendly and cost-effective alternative to synthetic materials. This study investigated the potential of powdered *Eichhornia crassipes* (water hyacinth), a highly invasive aquatic plant, as a natural biosorbent for the removal of Cr(VI) from synthetic aqueous solutions. The biosorbent was prepared by drying the entire plant at 60 °C and grinding it to a particle size of 300–500 µm, which was identified as optimal for effective adsorption. Key operational parameters, namely, biosorbent dosage, contact time and solution pH, were systematically optimized. The maximum removal efficiency of > 95% and the highest adsorption capacity of 12.40 mg g<sup>-1</sup> were achieved for 10 mg L<sup>-1</sup> Cr(VI) solution at 1.50 g dosage, 90 min shaking time and 30 min settling time. The process remains effective at solution pH values above 5.5, eliminating the need for pH adjustment and thus enhancing field applicability. Adsorption kinetics follows the pseudo-first-order model, indicating predominantly physisorption, accompanied by specific interactions with dichromate ions. Fourier-transform infrared spectroscopy reveals the involvement of –OH, C–O–C, and C=O functional groups in Cr(VI) binding, supported by characteristic spectral shifts. X-ray fluorescence spectroscopy confirms Cr uptake, while scanning electron microscopy indicates significant surface morphological changes after adsorption of Cr. Isotherm modeling shows the best fit with the Sips model, suggesting heterogeneous adsorption behavior encompassing both monolayer and multilayer characteristics. These results demonstrate that *E. crassipes* powder is a highly efficient, low-cost, and environmentally sustainable biosorbent for Cr(VI) remediation, offering strong potential for practical application in wastewater treatment systems.

**Keywords:** Adsorption, Chromium, *Eichhornia crassipes*, Remediation