



Investigations on the effectiveness of the Saba banana peel for the treatment of fluoride contaminated water

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ABSTRACT

This study aims to evaluate the effectiveness of Saba banana peel powder, an agro-based adsorbent for the removal of excess fluoride from water. A series of batch adsorption experiments were carried out to determine the influence of adsorbent dose, pH, agitation speed, contact time, initial fluoride concentration and the effect of co-existing ions (F^-/Cl^- and F^-/SO_4^{2-}). The adsorbent–fluoride interactions were more pronounced at neutral pH, and equilibrium was attained within 160 min, where 82% removal efficiency was recorded for 10 mg/L fluoride solution. FTIR results showed the presence of various functional groups ($-OH$, $-NH_2$, $-COOH$), which played a major role in fluoride removal. The fluoride removal rate decreased at a higher concentration of sulfate ions, but was independent of the presence of chloride ions. The experimental data followed pseudo-second-order kinetics and fitted well with both Langmuir and Freundlich isotherms. This implied the predominance of chemisorption process on the heterogeneous surface of adsorbent. The linear relationships with high R^2 values (>0.99) for both isotherms proved that the experimental data were statistically significant. Despite having low surface area ($1.87 \text{ m}^2/\text{g}$), this abundantly available horticultural waste showed remarkable fluoride adsorption capacity of 5.9 mg/g , and the residual fluoride concentration also met the WHO regulated standard.

Keywords: Fluoride; Saba banana peel; Batch adsorption; Isotherms; Kinetics

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