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Mechanism of Fluoride Mobilization in an Alluvial Aquifer: a Kinetic Approach

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Abstract: The present research work is executed in order to evaluate the sorption potential of F⁻ contaminated alluvial aquifer sediments of Birbhum district, West Bengal. The sediment samples are collected from one of the endemic areas of Birbhum district, West Bengal, at a drilled depth of 28 - 32m. Mineralogical studies reveal the presence of quartz, Na-feldspar, K-feldspar and zeolite. Bulk sediment analysis (wt%) indicates the dominance of SiO₂ and Al₂O₃ followed by MgO, CaO, Fe₂O₃, K₂O, Na₂O, TiO₂ and P₂O₅. Batch studies are performed to determine the effects different variables *viz.* pH, sediment dose, interaction time, initial concentration and temperature on sorption-desorption potential of sediment samples. The adsorption isotherm is studied at different temperatures and isotherm profiles offer an excellent fit with Freundlich isotherm with a high R² value of 0.977. With respect to different kinetic models the studied sediment samples are more compatible to pseudo second-order kinetics (R² 0.992). Free energy (ΔG°) suggests an exothermic nature of adsorption. Thermodynamic study reveals that the aquifer sediments have moderate adsorption potential of F⁻ but have higher desorption potential at neutral to alkaline pH level.

Keywords: Fluoride; aquifer sediment; batch study; Kinetic study.

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