Mixture of illite-kaolinite for efficient water purification: 
Removal of As(III) from aqueous solutions

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ABSTRACT

Adsorption technology is one of the most promising technologies to remove heavy metals from water. This paper aims to remove arsenite As(III) from contaminated water using a less costly, easier to handle and efficient absorbent. Purified natural clay was characterized and tested as an adsorbent. Mineralogical and textural analysis showed that this adsorbent is a non-swelling clay mineral (illite + kaolinite) and a mesoporous material with specific surface area \( S_{\text{BET}} = 128 \text{ m}^2\cdot\text{g}^{-1} \). A series of batch tests were performed as a function of contact time (10–180 min), temperature (25–55°C), initial As(III) concentration (20–100 mg·L⁻¹) and solid/liquid ratio (5–25 g·L⁻¹). The adsorption equilibrium studies revealed that Freundlich isotherm was followed with a better correlation than the Langmuir isotherm, moreover, it was intra particle diffusion controlled. The adsorption of As(III) onto the mixture illite-kaolinite was significant in the pH range 9–10.8 with a maximum adsorption capacity \( q_{\text{max}} = 233.1 \text{ mg·g}^{-1} \). At 298 K, the thermodynamic investigation indicates that the adsorption processes is spontaneous \( \Delta G^{\circ}_{\text{ads}} = -9.3 \text{ kJ·mol}^{-1} \) and exothermic \( \Delta H^{\circ}_{\text{ads}} = -4.58 \text{ kJ·mol}^{-1} \). The \( \Delta S^{\circ}_{\text{ads}} \) parameter was found to be +15.8 J·mol⁻¹·K⁻¹ meaning an increase in the randomness of the processes at the surface of clay particles.

Keywords: Illite/kaolinite clay minerals; Arsenite adsorption; Freundlich and Langmuir models; Intra particle diffusion; Thermodynamics

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