Adsorption behavior of diclofenac sodium from aqueous solution using natural volcanic ash

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ABSTRACT

Chinese natural volcanic ash (NVA), with smooth surface and layered structure, was used for a typical pharmaceuticals and personal care products-diclofenac sodium (DCF)-removal from water. The main crystal compositions of NVA were dolomite, quartz and ankerite. To investigate the adsorption performance of NVA, batch experiments were conducted under different initial pHs (2–10), contact time (0–480 min), initial concentration of DCF (0.5–50 mg/L), temperature (298.15, 308.15, and 318.15 K), and co-existing ions (NO₃⁻ and SO₄²⁻). Results showed the removal efficiency increased by 20% at optimal pH of 2 comparing to neutral solution. The kinetics evaluated in different initial DCF concentration revealed that the $R^2$ was higher at 5 mg/L initial DCF concentration, moreover, the data fitted pseudo-second-order model well. Results of isotherms investigated at different temperature showed that DCF adsorption on NVA was an exothermic process, and the data fitted Freudlich model very well with the value of $R^2$ followed 308.15 K > 298.15 K > 318.15 K. Adsorption selectivity for DCF was evaluated through analyzing the distribution coefficient ($K_d$). The similar $K_d$ in the presence of NO₃⁻ and SO₄²⁻ (50–5,000 mg/L) showed high selectivity of NVA for DCF. This study suggested that NVA has good potential as a cost-effective adsorbent for DCF removal and its application can be expected after modification.

Keywords: Volcanic ash; Diclofenac sodium; Adsorption; Isotherms; Selectivity

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