Fluoride removal from aqueous solution by acid-treated clinoptilolite: isotherm and kinetic study

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ABSTRACT

For removing the fluoride contamination as a serious threat to human health, the adsorption process has shown an appropriate performance among several treatment methods applied in the past. Therefore, the present study investigated the removal of fluoride using the low-cost adsorbent of clinoptilolite treated with acid from aqueous solution. The adsorbent was characterized by various techniques, that is, scanning electron microscopy, X-ray diffraction, XRF and BET. In this lab-scale study, the effect of contact time (1–240 min), pH (3–11), initial concentration (2–8 mg/L) and adsorption dose (1–20 g/L) on the fluoride removal efficiency was evaluated in a batch system. In addition, the isotherm and kinetic studies were applied to describe the data obtained from the adsorption process. The results showed that the highest fluoride removal efficiency (87%) was obtained in the condition of pH = 3 and equilibrium time of 2 h. In addition, it is observed that the pseudo-second-order kinetic model and both the Freundlich and Langmuir isotherm models appropriately describe the obtained data during fluoride adsorption onto the studied adsorbent. Based on the results of this study, acid-treated clinoptilolite indicated an affordable and promising potential for the removal of fluoride from aqueous solution.

Keywords: Fluoride; Clinoptilolite; Adsorption; Isotherm; Kinetics

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