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Examining the Adsorption of Flouride Ions in Flouride-Bearing Groundwater using Suspended Particles of Thermally Activated Laterite Soil

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Abstract

The present study used thermally activated laterite soil as a novel adsorbent to remove fluoride from the selected groundwater. The main objective of this study is to examine thermally activated laterite soil to remove fluoride by the suspension. The optimum temperature for heating the raw laterite soil was determined using a temperature series from 100° C to 400° C for 4 hours in a muffle furnace. Based on the results, 350° C treated laterite soil was used as the optimum temperature (TALS350). The physicochemical characteristics of laterite soil were investigated by X-ray Diffraction (XRD) analysis, X-ray Fluorescence (XRF) analysis, Fourier Transfer Infra-Red spectroscopy (FT-IR), Scanning Electron Microscope (SEM), and Brunauer-Emmett-Teller (BET). The effect of active parameters such as pH of the groundwater sample, adsorbent dosage, and contact time was examined on fluoride adsorption by TALS350 using batch experiments. The batch experiments used a groundwater sample with an initial 2.5 mg/L fluoride concentration. The results showed that the maximum fluoride efficiency attained by TALS350 was at an initial pH of 5 after 50 minutes of contact time and with an adsorbent dose of 7.5 g. Experimental kinetic adsorption data fitted better with the pseudo-second-order kinetic model with the maximum adsorption capacity of 0.014 mg/g. The FT-IR spectrum confirmed fluoride adsorption onto the TALS350 after fluoride adsorption of TALS350. Forty groundwater samples were collected from three villages in Nikaweratiya to analyse fluoride removal efficiency on TALS350. In addition, physical and chemical parameters were examined to determine the quality of the groundwater. The groundwater was identified as sodium (Na^+) and chloride (Cl^-) type based on the results of Piper classification. The results concluded that the selected groundwater shows 98% maximum fluoride removal efficiency. Therefore, this study revealed that thermally activated laterite can act as an efficient adsorbent to remove fluoride ions from the selected groundwater under suspension.

Keywords: Batch-experiment, Suspension, Kinetic, Physicochemical