Removal of Fluoride using Quaternized Palm Kernel Shell as Adsorbents: Equilibrium Isotherms and Kinetics Studies

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Abstract

Palm kernel shell (PKS) core fibers, an agricultural waste, were chemically modified using N-(3-chloro-2-hydroxypropyl) trimethylammonium chloride (CHMAC) as a quaternizing agent. The potential of quaternized palm kernel shell (QPKS) as an adsorbent for fluoride in an aqueous solution was then studied. The quaternized palm kernel shell (QPKS) core fibers were characterized using Fourier transform infrared spectroscopy (FTIR) and a scanning electron microscope (SEM). The effect of various factors on the fluoride sequestration was also investigated. The results showed that with an increase in the adsorbent amount and contact time, the efficiency of fluoride removal was improved. The maximum fluoride uptake was obtained at pH 3 and a contact time of 4 h. The adsorption behavior was further investigated using equilibrium isotherms and kinetics studies. The results from these studies fit well into Freundlich, Redlich-Peterson, and Sips isotherm's with a coefficient of determination (R-2) of 0.9716. The maximum fluoride removal was 63%. For kinetics studies, the pseudo-second order was the best fit for fluoride, with an R-2 of 0.999. These results suggest that QPKS has the potential to serve as a low-cost adsorbent for fluoride removal from aqueous solutions.

Keywords

Author Keywords: Fluoride removal; Quartenized palm kernel shells; Adsorption; Isotherms; Kinetics

KeyWords Plus: LOW-COST MATERIALS; AQUEOUS-SOLUTION; DRINKING-WATER; ADSORPTION-KINETICS; PHENOLIC-COMPOUNDS; SORPTION ISOTHERM; REACTIVE DYES; WHEAT-STRAW; METAL-IONS; WASTE

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