Equilibrium Studies of Fluoride Adsorption onto a Ferric Poly−mineral from Kenya

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J. Appl. Sci. Environ. Manage., 2012 Vol. 16 (1) 69

ABSTRACT:

African countries along the Great Rift Valley are among areas of the world where excess fluoride in water sources is a major public health problem. In this work, the removal of fluoride (F) from water solutions using a ferric poly-mineral (FPM) from Kenya was therefore studied using batch adsorption experiments. The effect of change in solution pH, temperature, initial oncentration of F, mass of FPM, contact time and presence of various competing ions on F adsorption onto FPM was evaluated. Adsorption isotherms were then applied to the adsorption data to characterize and establish the adsorption capacity of the mineral. The adsorption of F onto FPM was found to be a fast process and, at 1000 mg/L initial F concentration at pH 3.32 and 293 K and using 0.2 g/mL adsorbent dosage, over 90% F removal from solution could be achieved in 30 min. Based on Giles system of classification of adsorption isotherms, F adsorption isotherm conformed to L4 Langmuir-type isotherms. This indicated that FPM is composed of a heterogeneous surface consisting of sites which, during adsorption, filled-up with F ions in succession. The adsorption data also correlated to Langmuir and Freundlich models indicating that F adsorption onto FPM was a mixed process involving chemisorptions onto surface sites followed by gradual intra-particle penetration of F into mesoporous structure of the mineral. High mean Langmuir adsorption capacity of 10.8 mg/g, indicate that the mineral could be of use as an inexpensive substrate for the removal of F from aqueous streams.

KEYWORDS: Adsorption isotherms; Equilibrium analysis; Ferric poly−mineral; Fluoride adsorption; Water
fluoride