Defluoridation of ground water using mixed Mukondeni clay soils.

*Ngulube, T¹, Mugera W Gitari¹ and Hlanganani Tutu²

¹Department of Ecology and Resources Management, University of Venda, Private bag X5050, Thohoyandou, 0950, South Africa, Tel: +27159628572, Email: tholisongulube@gmail.com mugera.gitari@univen.ac.za.

²Department of Chemistry, University of Witwatersrand, P/Bag X4, WITS, 2050, South Africa, Tel: +27117176771, Email: hlanganani.tutu@wits.ac.za

ABSTRACT

The potential of mixed Mukondeni clay soils as an adsorbent for the removal of fluoride from aqueous solution was investigated. The purpose of this study was to evaluate the feasible application of mixed Mukondeni clay soils as a convenient and cheap technology for the removal of excess fluoride from underground water. Characterization was done by XRF, XRD, SEM, BET and FTIR. CEC and PZC were determined using standard methods. Parameters optimized included: contact time, adsorbent dosage, initial concentration, pH and temperature. Optimization experiments were done in batch procedures. The results showed that the optimum conditions for the defluoridation of water using mixed Mukondeni clay soils are 30 min, 5g, 15mg/L, 5:100 S/L ratios a pH of 2 and a temperature of 25°C. The equilibrium isotherm regression parameter (R²) showed that the Langmuir isotherm (0.9809) gave a better fit than the Freundlich isotherm (0.8664), and the Dubinin-Radushkevich isotherm (0.9668) was even better than the Freundlich. The value of the Activation energy (58.8554 kJ/mol) obtained from the Arrhenius Equation indicates chemisorption. Chemical sorption was also validated by pseudo second order kinetics which gave an R² value of 1. The parameters obtained from the Langmuir and Freundlich isotherm showed that the sorption of fluoride ions onto mixed Mukondeni clay soils is a more of monolayer adsorption. This comparative study indicated that mixed Mukondeni clay soils are fairly good in the defluoridation of groundwater but if they are chemically modified to enhance their adsorption capacity they can be a better adsorbent for the removal of fluoride from underground water.

Key words: Fluoride removal, adsorption, mixed Mukondeni clay soils, groundwater and adsorption mechanisms.