STI07-BAS-007

Efficacy of Quaternary Ammonium Functionalized Waste Paper Bio-Coagulant for Removal of Fluoride Ions from Aqueous Solution

Kithinji Adams Mawira[a]*, Esther Wanja Nthiga[b], Gerald K. Muthakia[c]

[a,b,c]Chemistry Department, Dedan Kimathi University of Technology, Private Bag, 10143 – Dedan Kimathi, Nyeri-Kenya

*Presenting author: kithinji.adams@yahoo.com

Abstract

Fluorides are one of the many pollutants found in water. At low concentration, fluorides are essential for improving the density and hardness of bones and teeth enamel

during their growth. A concentration greater than 1.5 mg/L in drinking water has several detrimental effects on human health, including dental and skeletal fluorosis. There are several methods employed to rid water of fluorides. These include, reverse osmosis, adsorption, ion exchange, coagulation and flocculation. This study focuses on removal of fluorides from aqueous solutions by coagulation using quaternary ammonium functionalized waste paper bio-coagulant. Quaternary ammonium compounds were synthesized from waste paper by first nitrating cellulose present in waste paper. The attached nitro groups, were reduced to amine groups and quaternization was done using methyl iodide. The prepared bio-coagulant was characterized using FTIR and TGA. The coagulant was used to remove fluorides from model solutions and real water samples from Gilgil area in Nakuru County, Kenya. A fluoride ion selective electrode was used to determine fluoride ion concentration in each model solution and in the real water samples. Optimized parameters included pH, initial fluoride ion concentration, contact time and bio-coagulant dosage. Characterization data confirmed successful quaternization was achieved. Thermal stability of the material was up to a temperature of 563.15 K. The optimum pH value was 4.0 while the contact time was 15 minutes. Fluoride removal increased with increase in initial concentration up to an optimum 20 mg/L. Fluoride removal was also observed to increase with increase in coagulant dosage. Obtained data fitted well on Langmuir adsorption isotherm with R2 value of 0.9707, confirming chemisorption as the predominant intermediate process. An adsorption capacity of 3.6311 mg/g was obtained. Fluoride ion removal percentage in the model solution was 81% and 66.25% in the real water sample. It is evident from this study that used waste paper can be modified and used to treat water containing fluorides.

Keywords— Coagulation, Bio-coagulation, Fluoride, Quaternary ammonium, Water, Adsorption