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Adsorption of Fluoride onto activated carbon synthesized from *Manihot esculenta* biomass - equilibrium, kinetic and thermodynamic studies

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Abstract

Removal of fluoride using cheap, effective activated carbon derived from biomass of *Manihot esculenta* has been investigated. To understand the properties of activated carbon, characterization using SEM, BET, total pore volume, zero point charge etc. have been studied. The effect of adsorbent dose, contact time, initial concentration and pH on adsorption has been experimentally studied using batch mode of adsorption. Freundlich model of adsorption is found to be best fitted as compared to Langmuir and Temkin model. Kinetic studies indicate that adsorption follows a pseudo-second order kinetic model. Thermodynamic process on adsorption of fluoride onto activated carbon was found to be endothermic and spontaneous. Presence of co-ions on fluoride removal follows the order of $CO_3^{2-}>SO_4^{2-}> NO_3^-\approx Cl^-\approx Br^-$. Regeneration of *Manihot esculenta* activated carbon with NaOH was successfully achieved with NaOH solution upto 98.7% could be regenerated.

Key words: adsorption, fluoride, *Manihot esculenta,* regeneration.

1. Introduction

Fluoride is a double edged sword-like element as its presence in drinking water can be either beneficial or detrimental to human health[1].Fluoride is beneficial as it promotes the growth and maintenance of bones and teeth if taken at the right permissible level[2,3].Though fluoride is universally found in earth crust and rocks, we usually come in contact with fluoride through water, food, drug, cosmetics, air and other commercial sources [4]. According to World Health Organization(WHO), fluoride is considered as one of the drinking water contaminants in addition to arsenic and nitrate which cause large-scale health problems through drinking water exposure [5].Fluoride levels in water in many countries is notably found to be beyond permissible limits (1.5mg/L according to WHO) especially in Sri Lanka, China, the Rift Valley countries in East Africa, Turkey, and parts of South Africa and India[5,6]. Long term consumption of fluoride contaminated water could lead to various health effects because it is