FLUORIDE REMOVAL FROM WATER BY ADSORPTION USING CROP WASTES

(A REVIEW)

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DECLARATION

I, Batesaki Mathias, declare that the information here is my original work to the best of my knowledge and references have been cited were information from other peoples' work was used. The work has never been submitted to any other institution for any award or publication. Signature…… Date…….

Batesaki Mathias

APPROVAL

This work has been supervised and approved by Mr. Egor Moses

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DEDICATION

This review is dedicated to my mother Nabirye Jaliat, my sister Babirye Mariam and my brother Badage Michael for all the efforts and support rendered to me during the research process and make me reach where I am now.

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ABBREVIATION LIST

AcTA - Activated Tea Ash

ARHA - Activated Rice Husk Ash

CAC - Commercial Activated Carbon

CNSC - Cashew nut Shell Carbon

FTIR- Fourier Transform Infrared

ISE - Ion Selective Electrode

LIRHA - Lanthanum Impregnated Rice Husk Ash

MMT- Modified Maize Tassels

NMR - Nuclear Magnetic Resonance

TISAB -Total Ionic Adjustment Buffer

WHO - World Health Organization

WSC - walnut shell carbon

ZICFC - Zirconium Impregnated Coconut Fibre Carbon

ZICNSC - Zirconium impregnated cashew nut shell carbon

Zr-GP - Zirconium loaded garlic peel

ZIWSC - Zirconium impregnated walnut shell carbon

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ABSTRACT

Lack of access to safe drinking water is a major concern due to negative health effects experienced by people in many parts of the world. The quality of such waters is mainly affected by pollutants from natural and anthropogenic sources when they get incorporated in the water sources. These pollutants are either organic or inorganic species. Among the inorganic pollutants are fluorides. Continuous consumption of high concentrations of fluoride ions leads to their accumulation in the body tissues which causes dental fluorosis, skeletal fluorosis and other non-skeletal disorders. These health effects are irreversible and the only way to overcome them is by removing fluoride from water. Several methods for the removal of fluorides in water have been proposed, most of which rely on the use of biomaterials and bone char. In such processes, the adsorbents become loaded with the pre-concentrated pollutants leading to disposal problems. This report reviews on the use of modified or activated crop wastes as adsorbents followed by their subsequent application on the removal of fluoride ions from water. Fluoride occurs naturally in our environment but we consume it in small amounts. Exposure can occur through dietary intake, respiration and fluoride supplements. The most important factor for fluoride presence in alimentation is fluoridated water. When the recommended limit of fluoride by WHO is 1.5 mg/L, in some parts fluoride levels are as high as 35 mg/L. Major problems associated with fluoride remediation are lack of cheap adsorbent to remove fluoride content in water for some communities. Hence, development of community-based defluoridation unit is needed with a technique which is cost-effective, technologically simple in operation while being able to keep the fluoride level in permissible limits. On the basis of extensive investigations, different researchers have developed simple and economical domestic defluoridation processes.

1 INTRODUCTION

1.1 Background of the Study

The chemical structure of water makes it have special properties because of the way its atoms bond together to form the water molecule. This molecular structure gives the water molecule polarity, or a lopsided electrical charge that attracts other atoms. Due to that polarity, water becomes a universal solvent for polar substances as they are easily dispersed uniformly within the water molecules. This dissolving power of water is very important for life as it enables it to harbor dissolved nutrients that support living things.

The ability of water to split ionic compounds has contributed to 97% of the world's water being salt (Soteris, 2005). Most of these salt ions occur naturally in the soil, sedimentary and igneous rocks in many places of the earth's crust. They are leached into water out of land by rainwater and accumulated into ground water sources and other water bodies (Renault et al., 2009). This renders this vital commodity polluted with dissolved materials of both organic and inorganic origin. Among these pollutants, of serious concern is the fluoride ion (Suman & Anubha, 2014). The reported tolerance limit of fluoride concentration in drinking water is 1.5 mg/L ((WHO), 1993). However, continuous consumption of high concentrations of fluorides in excess of 0.5-1.0 mg/L leads to accumulation in body tissues capable of causing dental and skeletal fluorosis (Edmunds & Smedley, 1996).

Consumption of fluoridated water has emotional problems as well. This is because persons with stained teeth are hesitant to provide a gleaming smile and in many occasions appear withdrawn.

Preliminary studies by (Choi et al., 2012) have also shown a strong connection between exposure to fluoride in drinking water and decreased IQ scores in children. To overcome the negative health effects of fluoride in water, it should be removed from water for the safety of consumers. This has previously been achieved by the use of methods such as ion exchange, reverse osmosis and chemical precipitation (Cha, 1997).

These conventional removal methods have not been effective when the concentrations are in low levels. They are also expensive thus not affordable to majority of the affected consumers. The use of phyto-biomass materials such as agricultural products and waste by-products in removal of pollutants has been reported (Waheed et al., 2009). Phyto-biomass materials have been found to be effective in removal of pollutants even at trace levels (Bhatnagar & Sameer, 2006). These materials are available in large quantities and may have a potential to be applied as low-cost water remedial materials that are environmentally friendly (Deans & Dixon, 1992) reported removal of fluoride ion from water using neem leaf as adsorbent. The material had removal efficiency of 86% in a solution containing fluoride of 10 mg/L. However, the material could not be regenerated. Similar cases were reported by (Jadhav, 2014; Lavanya et al., 2017) while investigating the removal of fluoride using maize cobs and maize husk fly ash. The materials had removal capacity of 86% and 59.6%, respectively.

1.2 Objectives of the Study

To review on the removal fluoride ions from water by adsorption using crop wastes.

To review on the effect of pH, contact time, initial fluoride concentration, and activated crop wastes on removal of fluorides from water.

1.3 Occurrence of Fluorine

Fluorine (F_2) is a pale, yellow-green, corrosive gas which almost cannot be found in natural environment in elemental form due to its high electronegativity and reactivity. Fluoride ion (F^-) is characterized by small radius, great tendency to behave as ligand and easiness to form a great number of different organic and inorganic compounds in soil, rocks, air, plants and animals. Some of those compounds are quite soluble in water, so fluoride is present in surface and groundwater as an almost completely dissociated fluoride ion.

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