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Use of Maize and Soybean Husk Fly Ash as an Adsorbent for Removal of Fluoride from Water

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ABSTRACT

Fluoride is an inorganic, monatomic anion of fluorine with the chemical formula (F^-) Fluoride is the simplest anion of fluorine. Excess fluoride in drinking-water causes harmful effects such as dental fluorosis and skeletal fluorosis. The fluoride-bearing minerals or fluoride-rich minerals in the rocks and soils are the cause of high fluoride content in the groundwater, which is the main source of drinking-water in India. Indian standards for drinking water recommended an acceptable fluoride concentration of 1.0 mg/l & an allowable fluoride concentration of 1.5 mg/l in potable water (CPHEEO, 1984). To evaluate the efficiency of fly ash from Soybean husk and maize husk for removal of fluoride from water. Optimization of the different parameters to be varied to find the equilibrium values in order to get maximum efficiency.

Keywords— *Maize husk fly ash, Fluoride removal, Batch study, Adsorption isotherms*.

1. INTRODUCTION

Fluorine, a fairly common element of the earth's crust, is present in the form of fluorides in a number of minerals and in many rocks. Excess fluoride in drinking water causes harmful effects such as dental fluorosis and skeletal fluorosis. The fluoride-bearing minerals or fluoride rich minerals in the rocks and soils are the cause of high fluoride content in the groundwater, which is the main source of drinking-water in India. Adsorption is an efficient and economically viable technology for the removal of fluoride. Recently, many naturally occurring materials such as activated carbon from plant materials, egg shell, bone char, Tamarind seed, rice husk, limestone and some commercially available adsorbent such as Activated Alumina, calcium hydroxide [$Ca(OH)_2$], calcium chloride [$CaCl_2$], and calcium sulphate [$CaSO_4$] have been used for removal of fluoride. However, the alternative absorbents have not displayed significant fluoride removal capacities and, thus, alumina still remains a valuable material to study and pursue. Despite decades of application-based research, the underlying science and specific mechanisms behind fluoride sorption to alumina-based absorbents is still unclear. Currently, a wide range of defluorination methods exist. These methods can be divided into the following categories: sorption, chemical precipitation, removal by ion exchange, and membrane filtration. The most currently used method utilizes alumina absorbents to remove fluoride from drinking water. In developing countries there is also a growing movement towards the use of natural materials such as clays, ash, and bone char, which, when found in local communities, can significantly increase the cost efficiency of defluorination methods. Adsorption is an efficient and economically viable technology for the removal of fluoride. Recently, many naturally occurring

2. METHODOLOGY

a) To determine pH on fluoride removal.

b) To determine contact time for fluoride removal.

c) To determine Adsorbent dose for fluoride removal.

d) To determine stirring rate for fluoride removal.

a) To determine pH on fluoride removal.

The range of pH between 0 to 7 acidic in nature and 7 to 14 basics in nature. For drinking purpose, the acceptable range for pH is 7 to 8.5. hence it is necessary to check the pH of water before treatment and then after treatment to monitoring the change in pH value of water sample.

b) To determine contact time on fluoride removal.

The effect of contact time on adsorption of fluoride onto fly ash (activated carbon extracted from Soybean Hush fly ash and Maize Husk). Batch adsorption studies using the concentrations 2 to 4 mg/l of fluoride solution and with 2.00 g of the adsorbent with particle size of 25-35 µm have to carried out at constant stirring rate of 160 to 240 rpm.

c) To determine Adsorbentdose on fluorideremoval.

The adsorbent dose on fluoride removal was kept 2 gm/100ml of water sample. The pH was maintained at 7, while initial fluoride ion concentration has to varies from 2 to 4 mg/l and contact time was kept as 20 to 50 minutes. Stirring rate of 160 to 240 rpm will be set to carry out the experimental work using the two adsorbents (activated carbon extracted from SH & MH).

d) To determine stirring rate on fluoride removal.

Studies on the effect of stirring rate (rpm) on fluoride removal efficiency (percentage) will be conducted by varying speeds from 50 rpm to 250 rpm by using the mechanical stirrers, at pH of 7(neutral) with adsorbent dose of 2 g/100 ml and contact time of 20 to 50 minutes. The initial fluoride concentration of the test solution/sample will be taken as 7 mg/l.

3. INSTRUMENTATION:

The fluoride Test kit contains a colour comparator, Which has 6 nos. colour slots of colour, ranging from Red to yellow corresponding to the fluorides content in ppm in water sample.

Muffle furnace

3.1 Collection of materials:

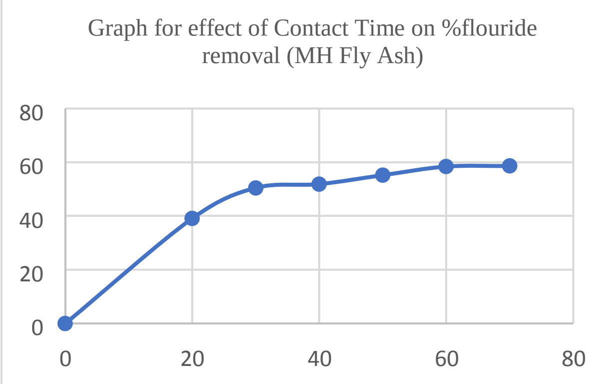
Materials are the main constituents which are required to perform experimentation. The various materials used in this study are water, natural adsorbents (activated carbon extracted from Soybean Husk fly ash, Maize husk fly ash), zicronyl acid reagent, spends solution and reference solution. The descriptions of these materials are as below.

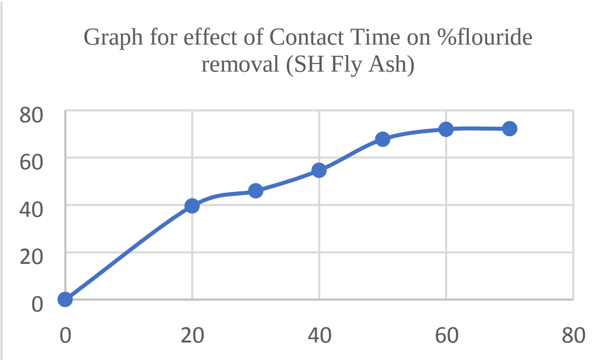
The maize husk and soybean husk were burn in the furnace at 400 to 500℃ as shown in image 1. Uniform particle size distribution in the 1 to 80 µm range. The main components of fly ash are silica,alumina, iron oxides, calcium oxide, and residual carbon. **3.2 Constituent of fly ash Table :-**

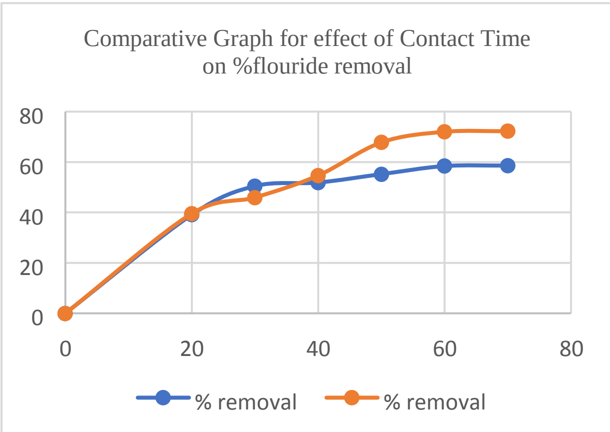
CONSTITUENT	FLY ASH AMOUNT %
SIO_2	40.16
K_2O	25.52
CaO	6.90
MgO	5.91
P_2O_5	4.01
Cl	3.37
SO_3	1.45
LOI	12.68

4. RESULT :-

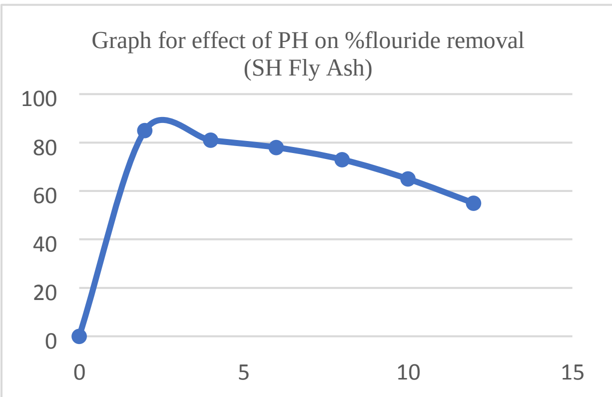
4.1 Effect of contact time on % of fluoride removal

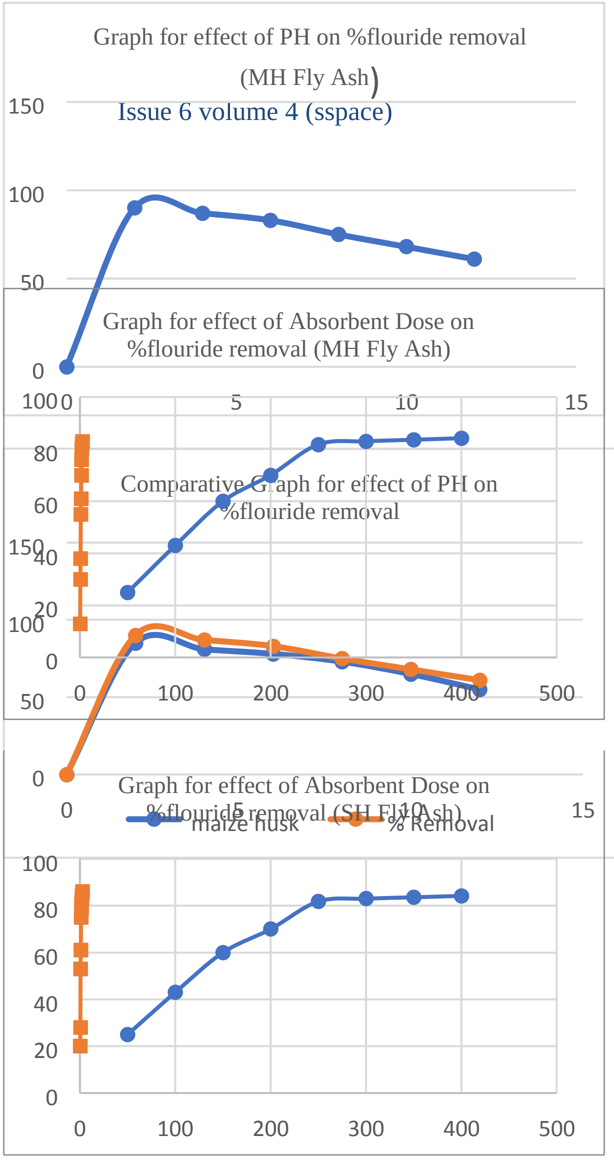




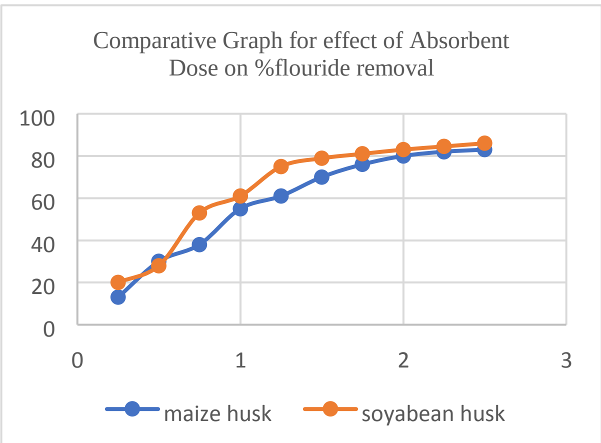


4.2 Effect of contact PH on % of fluoride removal

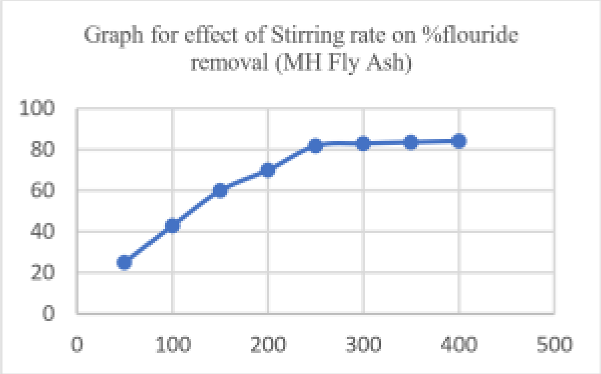


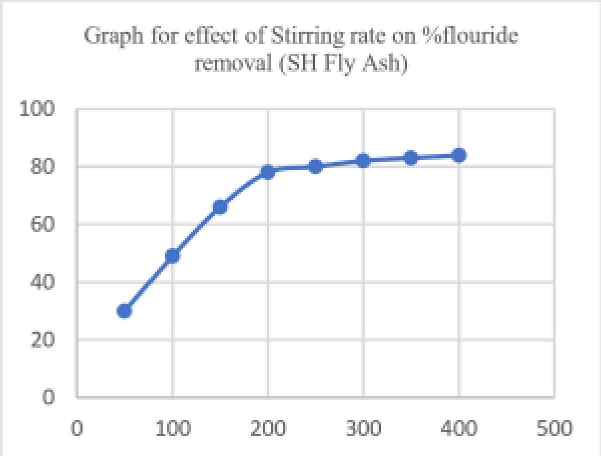


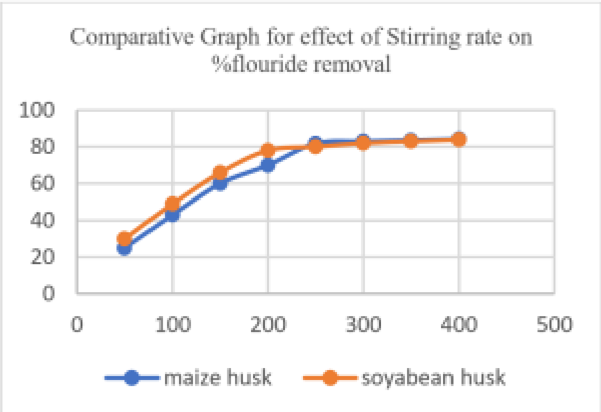
4.3 Effect of absorbent dose on % of fluoride removal



4.4 Effect of stirring rate on % of fluoride removal







5. CONCLUSIONS:

[1] Fluoride removal carried out in batch process in which, the removal efficiency of the two adsorbents used individually was tested for four different parameters, viz. Contact time, pH, adsorbent dose and stirring rate, to find the optimum conditions or equilibrium data.

[2] For the effect of contact time, equilibrium was achieved for 50 minutes in case of both the adsorbents.

[3] In case of both the adsorbents used, the percentage of fluoride removal was found to be a function of adsorbent dose and contact time at a given initial solute concentration.

[4] In case of effect of adsorbent dose, equilibrium dosage of 2g was found in case of both the adsorbents used. while the maximum efficiency was found to be 50.47% and 51.66% for MH fly ash and SH fly ash respectively.

6. REFERENCES

[1] Jamode A V., Sapkal V. S. and Jamode V. S.,
Defluoridation of water using inexpensive adsorbents‖, The Journal of Indian Institute of Science, 84, 2004, pp 163171.

[2] Ayamsegna J.A., Apambire W.B., Bakobie N and Minyila S.A., ―Removal of Fluoride from rural drinking water sources using geomaterials from 41
Ghana‖, 33rd WEDC International
Conference,Accra,Ghana, 2011, pp 441446.

[3] Bhaumik R, Mondal NK, Das B, Roy P, Pal KC, Das
C, Banerjee A and Datta JK, ―Eggshell Powder as an
Adsorbent for Removal of Fluoride from Aqueous Solution: Equilibrium, Kinetic and Thermodynamic
Studies‖, EJournal of Chemistry, Vol. 9, No.3, 2011, pp 1457-1480.

[4] Murugan M. and Subramanian E., ―Studies on defluoridation of water by Tamarind seed, an unconventional biosorbent‖, The Journal of Water and Health, 2006, pp 453-461.

[5] Srimurali M. and Karthikeyan J., ―Activated Alumina: Defluoridation of Water and Household
Application – A Study‖, Twelth International Water Technology Conference, IWTC12 2008, Alexandria,
Egypt, 2008, pp 153-165

[6] Bhaumik R, Mondal NK, Das B, Roy P, Pal KC, Das
C, Banerjee A and Datta JK, ―Eggshell Powder as an

Adsorbent for Removal of Fluoride from Aqueous Solution: Equilibrium, Kinetic and Thermodynamic Studies‖, EJournal of Chemistry, Vol. 9, No.3, 2011, pp 1457-1480.

[7] Murugan M. and Subramanian E., ―Studies on defluoridation of water by Tamarind seed, an unconventional biosorbent‖, The Journal of Water and Health, 2006, pp 453-461.

[8] Srimurali M. and Karthikeyan J., ―Activated Alumina: Defluoridation of Water and Household Application – A Study‖, Twelth International Water Technology Conference, IWTC12 2008, Alexandria, Egypt, 2008, pp 153-165

[9] Kaseva M. E., ―Optimization of regenerated bone char for fluoride removal in drinking water: a case study in Tanzania‖, Journal of Water and Health,Vol. 4, No.1, 2011, pp 139-147.