An Experimental Analysis of Adsorption Behavior of HTB for the Removal of Fluoride

Ranjit N. Patil[1], Dr. P. B. Nagarnaik[2], Dr. D. K. Agrawal[3]
[1.] Research Scholar, G.H.R.C.E, Nagpur (M.S.), INDIA
[2.] Dean Academics, G. H. Raisoni College of Engineering, Nagpur (M.S.), INDIA
[3.] Professor, Civil Engineering Department Bapurao Deshmukh College of Engineering, Sevagram (M.S.), INDIA

***Abstract*-Fluoride is an essential element for the human as well as animal & plants. It is beneficial for the growth of bones and teeth. Fluoride in drinking water can be either beneficial or detrimental to health depending on its concentration. Removal of fluoride from water using Hirda Tree Bark (HTB) was studied in batch analysis. The maximum fluoride removal was obtained at pH of 6-8 for the optimal dose of 45 g/L. Langmuir model was best fitted than Freundlich.**

***Keywords: Fluoride.* Defluoridation, Adsorption, HTB**

I. INTRODUCTION

Fluoride ion is potentially toxic for human; therefore its ingestion in food or drinking water must not exceed a narrow range of concentrations. According to the World Health Organization the maximum acceptable concentration of fluoride ions in drinking water lies below 1.5 mg/L (WHO, 2004) [1] Indian standards for drinking water recommend an acceptable fluoride concentration of 1.0 mg F litre-1 and an allowable fluoride concentration of 1.5 mg F litre -1 in potable waters (CPHEEO, 1984) [2]. The National Environmental Engineering Research Institute (NEERI), Nagpur, India, developed a method known as the Nalgonda Technique (Bulusu et al., 1979) [3]. Higher fluoride concentration above the permissible limit also causes several neurological damages in severe cases [4]. India is one among 25 nations in the world where fluorosis problem is persisting due to consumption of excessive fluoride bearing drinking water. The main source of fluoride in groundwater is from rock. Fluoride in water plays a dual role for human and animal health and is of great environmental concern.[5]

MATERIALS AND METHOD

A. Stock solution

Fluoride stock solution was prepared by dissolving known quantity of amount 221 mg in 1L of deionized double distilled water. The concentrate fluoride of 5 ppm was prepared from the stock fluoride solution by the known dilution.

B. Material preparation

The hirda bark (HRD) was collected into clean plastic bags. The bark was then broken in small size pieces and sundried for three days. The dried bark of HRD washed with tap water three times and by distilled water many times so that the colour, trash and dust were removed easily [6]. This washed HRD was dried in oven at 105^{0}C for 24 hrs. and cooled to room temperature in a desiccators. The material pulverized and sieved by 150 micron sieve and stored into safe plastic bag for use.

II. EXPERIMENTAL METHODS

Effect of various batch study parameters were studied in 100 ml volume of sample of aqueous solution in 250 ml plastic bottles containing 5 mg/L fluoride concentration.

III. RESULTS AND DISCUSSION

A. Proximate Analysis of HTB

Table I
PROXIMATE ANALYSIS OF SSC CARBONIZED SAMPLE

% Moisture Content	3.00 %
% Volatile Matter	65.18 %
% Ash Content	17.72 %
% Fixed Carbon	14.10 %

Figure 2.Proximate Analysis of HTB

B. Effect of Adsorbent Dose

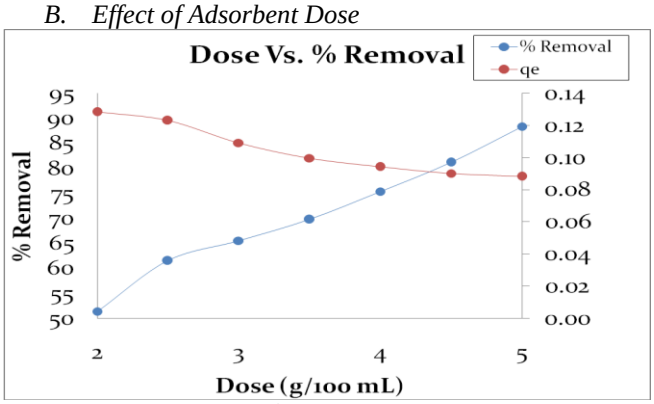


Figure 1.Dose of Adsorbent Vs. % Removal.

Conditions:
Initial fluoride concentration 5 mg/L; pH 7; agitation 150 rpm; temp.30^{0}C; Volume of sample 100 mL

The effect of dose of adsorbent experiments were carried out by adding different amount of adsorbent doses 20 – 50 g/L for the initial fluoride concentration of 5.0 mg/L. This was put inside the 250 ml capacity plastic bottles containing 100 ml of fluoride solution. The plastic bottles then being put into the incubator shaker which operated at 150 rpm and with constant temperature 30^{o}C up to 24 h. From the Fig.2 it is observed that the optimal dose of adsorbent was found 45g/L and was used for further study.

C. Effect of pH

The removal of fluoride ions from aqueous fluoride solution was highly dependent on the solution pH in many cases, as it altered the surface charge on the sorbents. In this study the pH experiment was carried out for the range 2 -12 and found that the removal of fluoride was increased up to pH 8 and then decreased. Maximum adsorption of fluoride was found to be 70.4 to 78.8 % in the pH range 6 and 8.

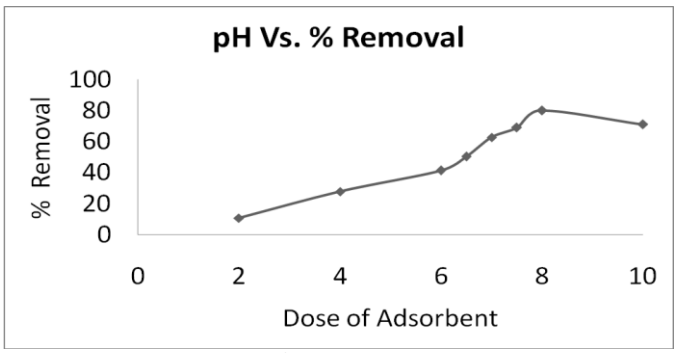


Figure 2.Dose of Adsorbent Vs. % Removal.

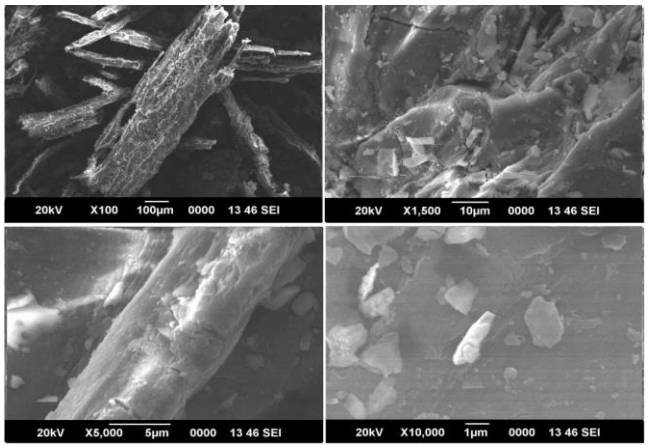
Conditions:

Initial fluoride concentration 5 mg/L; agitation 150 rpm; temp.30^{0}C; Dose 45 g/L; Volume of sample 100 mL

D. Scanning electron microscopy (SEM)

Scanning electrons microscopes analysis was performed to understand the morphology. From Fig.3 it is observed that the openings are enough to remove fluoride from water.

Figure 3.SEM, Image



IV. ADSORPTION MODEL

The data was fitted to Langmuir Fig.8 and Freundlich Fig.9 isotherm models; it is observed that, the experimental data is fitted in Langmuir model and in Freundlich model.

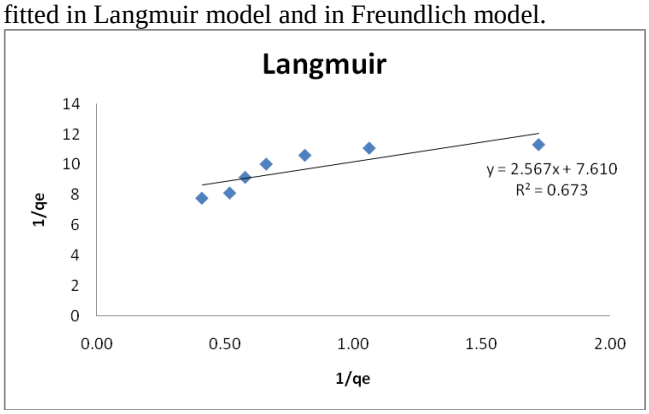


Figure 4.Langmuir Adsorption Isotherm

This shows that Freundlich model is best fitted than Langmuir.

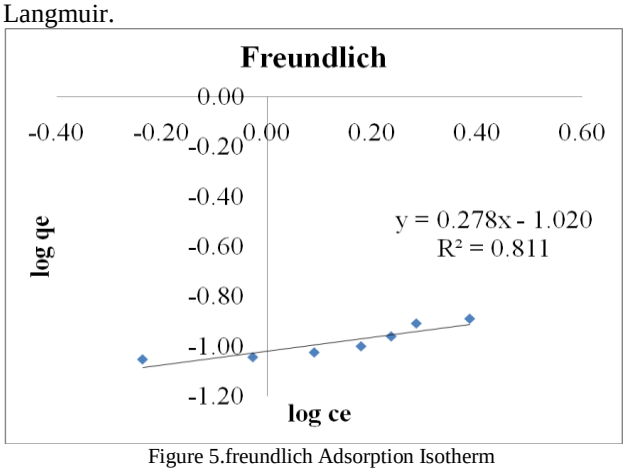


Figure 5.freundlich Adsorption Isotherm

V. CONCLUSION

- The results show that the HTB is a promising adsorbent for the removal of fluoride.
- This is a locally available adsorbent hence suitable for the removal of fluoride ions.
- The optimum dose of HTB was found 45 g/L for the removal of fluoride concentration of 5 mg/L.
- Adsorption efficiency found more in the pH range of 6-8.
- The defluoridation using sagargota seed coat study shows that the equilibrium data fits better to Freundlich isotherm than the Langmuir isotherm.
- It is suggested that, the use of Hirda Tree Bark for removal of fluoride ions from ground water is an effective and low cost adsorption process.

VI. REFERENCES

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