Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2016, 8(8):905-908

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Removal of flouride from wastewater using *Aegle marmelos* fruit shell as adsorbent

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ABSTRACT

Water of good standard is needed for human life and is used for industrial, agriculture, domestic and commercial uses. All these activities are also answerable for polluting the water. Fluorosis is a disease caused by excessive ingestion of fluoride through water and food. The problem of excess fluoride in drinking water is a recent case in Tamil Nadu. The initial amount of fluoride in the sample water was found to (C_i) 3.52×10^{-4}g / 100ml. The effect of individual adsorbent dose was studied and the percentage of fluoride removed was found to increase with increase in adsorbent dose. These may be due to the increase in surface area. The boiled samples were found to be better when compare to unboiled adsorbent. Similarly, shells heated at higher temperature where found to be more effective. Adsorption isotherm of sample Adsorbents were studied to calculate adsorption efficiency of adsorbent systemThe Freundlich adsorption isotherm was based on heterogeneity of the surface for fluoride removal. Based on the adsorption isotherm, shell of A.marmelos is capable of adsorbing fluoride from water. In this present study, fluoride is removed from waste water by using activated charcoal of Aegle marmelos fruit's shell.

Keywords: *Aegle marmelos* fruit*'s* shell, adsorbent, flouride, waste water

INTRODUCTION

Water of good standard is needed for human life and is used for industrial, agriculture, domestic and commercial uses. All these activities are also answerable for polluting the water. Billions of gallons of waste from all these sources are thrown to freshwater bodies every day. Fluoride is a naturally occurring element in minerals, geochemical deposits and natural water system. Fluoride is beneficial to human body for the calcification of dental enamel and maintenance of healthy bones, but Fluorosis is a disease caused by excessive ingestion of fluoride through water and food.[1] The problem of excess fluoride in drinking water is a recent case in Tamil Nadu.[2] Several methods for defluoridation of drinking water involves use of lime softening alum and lime addition, activated alumina, charcoal, synthetic calcium hydroxyl apatite bauxite, ion exchange resin, electro dialysis and reverse osmosis etc.,[3-10]

Aegle marmelos is one of the most significant tree species used in various native systems of medicine. *Aegle marmelos* fruit tree, is a moderate sized, slender, aromatic tree, 6.0 -7.5 m in height, and 90 to 120 cm in width, with a somewhat fluted bole of 3.0-4.5 meter growing wild throughout the deciduous forests of India, ascending to an altitude of 1200 meter in the western Himalayas and also occurring in Andaman island.[11] In this present study, fluoride was removed from waste water by using activated charcoal of *Aegle marmelos* fruit*'s* shell.

EXPERIMENTAL SECTIION

Collection of sample

Shells from *Aegle marmelos* were collected from tree growing from P.S.R Engineering College. Shells were washed to remove attached pulp. These were dried under sun for 48 hours.

Preparation of adsorbent

100g of shell were heated in a muffle burners at 300°C, 400°C and 500°C. These were ground into fine powder. One part of ash was then boiled in water at 120°C for one hour. These were then dried at 80°C for overnight. Both boiled and unboiled samples were used as adsorbent.

Collection of water sample

Water sample was collected from Sivakasi municipal area. This was filter using whattman No.1 filter paper. And was stored for further analysis.

Adsorption studies

0.1, 0.3, 0.5g of individual adsorbent was added to 20ml of water sample. These was kept in mechanical shaker for one hour and was filter using whattman No.1 filter paper. These was Concentration of fluoride is determined by using formula:

$$\mathbf{V_1N_1=V_2N_2}$$

Estimation of adsorbed fluoride

The amount of fluoride adsorbent per unit adsorbent, qe was calculated by the formaula[12]:

$$\mathbf{q_e = [\{C_i\text{-}C_f\}/m]}$$

Where, V= volume of water sample.
m= mass of absorbent.
C_i = concentration of fluoride before absorbent.
C_f = concentration of fluoride after absorbent.
The percentage removal of fluoride was calculate from the formula

$$\mathbf{\% \ removal = [(C_i\text{-}C_f)/ C_i] \times 100}$$

Study of adsorbent isotherm

The adsorption characteristic of adsorbent were determine using Freundlich isotherm models.

$$\mathbf{q_e = K_f(C_f)^{1/n}}$$

Regenerations of adsorbent

The exhausted adsorbents were regenerated using 10% NaOH solution. These were then washed and heated at 80°C for 1h.

RESULTS AND DISCUSSION

The initial amount of fluoride in the sample water was found to (C_i) 3.52×10^{-4}g / 100ml. The effect of individual adsorbent dose was studied and the percentage of fluoride removed was found to increase with increase in adsorbent dose. These may be due to the increase in surface area. The boiled samples were found to be better when compare to unboiled adsorbent. These may be due formation of pores.[13] which increase the surface area. Similarly, shells heated at higher temperature where found to be more effective. This may due to the complete combustion of shell which produces good quality of activated
Charcoal.

Table 1: % removal of fluoride

	300°C				400°C				500°C			
	Boiled		unboied		Boiled		Unboiled		Boiled		Unboiled	
	Fluoride adsorbed (q_e)	% Removal	Fluoride adsorbed (q_e)	% Removal	Fluoride adsorbed (q_e)	% Removal	Fluoride adsorbed (q_e)	% Removal	Fluoride adsorbed (q_e)	% Removal	Fluoride adsorbed (q_e)	% Removal
0.1g	-2.19	18.33	-2.11	10.79	63.92	-1.34	63.92	-1.34	-1.25	79.35	73.57	-1.29
0.3g	-2.009	41.73	2.09	34.4	66.53	-1.82	70.63	-2.82	-1.744	80.27	74.30	-1.76
0.5g	-2.152	50	-2.20	44.6	70.63	-2.00	71.56	-2.60	-1.95	81.64	75.71	-2

Adsorption isotherm was studied to calculate adsorption efficiency of adsorbent system. The Freundlich adsorption isotherm was based on heterogeneity of the surface for fluoride removal. Based on these two adsorption isotherm, *A.marmelos* is capable of adsorbing fluoride from water.

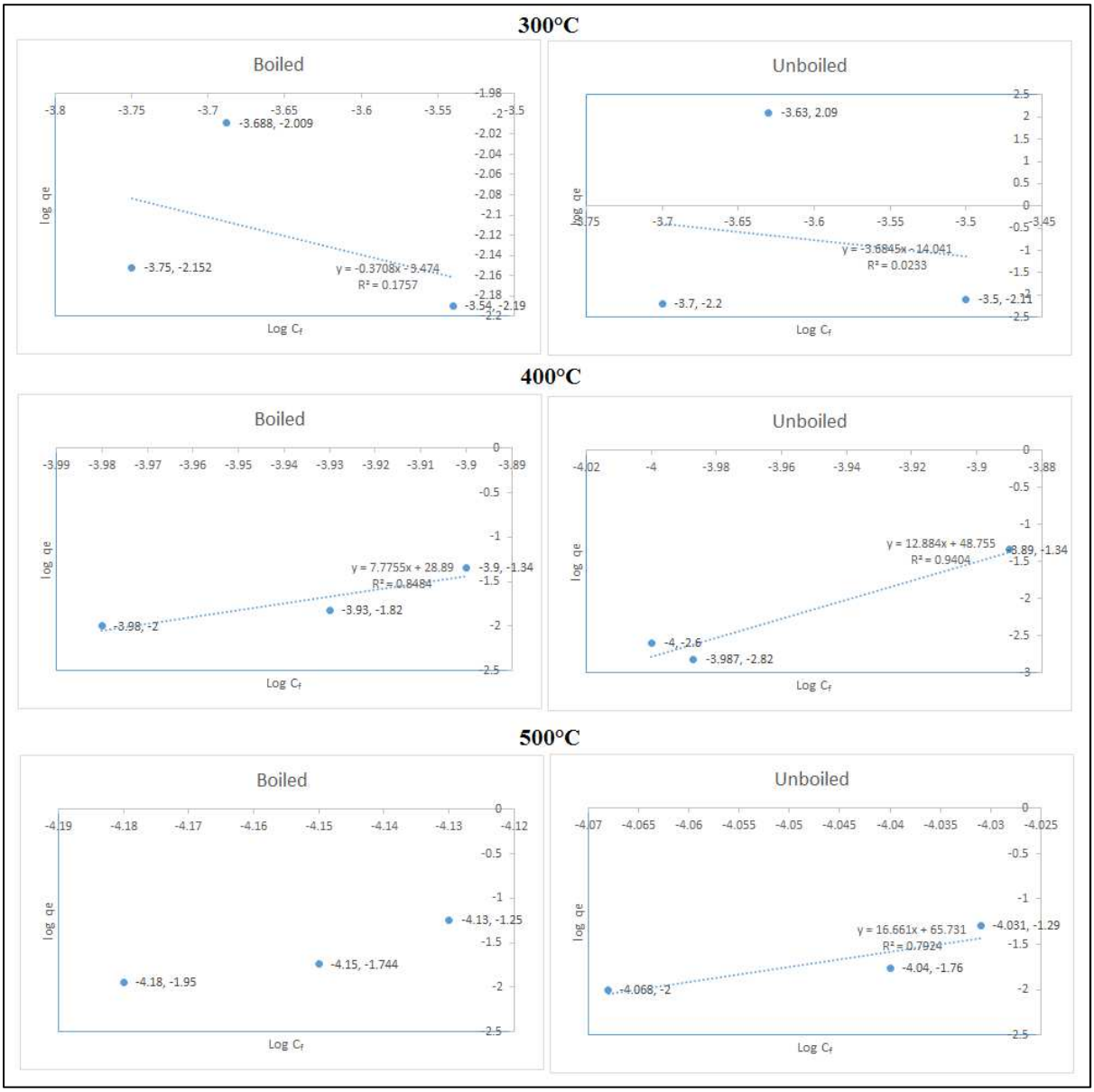

Figure 1: Freundlich Adsorbtion Isotherm

CONCLUSION

Based on the study done, it was found that charred shell of *Aegle marmelos* was found to adsorb foul smell in municipal waste water as well as fluoride content in water. Boiled adsorbent were effective than their unboiled counterpart. Simillarly temperature plays a major role. It was found the charcoal formed at 500°C was an active adsorbent compared to other temperature. The study concludes that shell of *Aegle marmelos* is effective in treating waste water, hence can be used in water treatment.

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