International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Adsorption of Fluoride from Aqueous Phase by Agro Based Adsorbent

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Abstract: ***The presence of fluoride in higher concentration is probably the most common problem faced by the consumers and water treatment professionals. It may cause dental fluorosis. Hence to remove fluoride from water among the methods available, adsorption has gained popularity due to several advantages. A batch study adsorption has been conducted by adsorption process usingactivated carbon prepared from Bale fruit (Limoniaacidissima) shell as adsorbent and the removal efficiency is determined by optimizing the parameters such as dosage, time, pH and concentration. The maximum removal efficiency was found to be more than 63%.This experimental study proves to be an economical method of fluoride removal since the developed product is a waste product. Even small industries, with fluoride bound wastewater can adopt this method of treatment and hence prevent the polluted water entering the stream.***

Keywords: Adsorption,Isotherm,Fluoride,Activated carbon,Limonia Acidissima

1. Introduction

The aromated fluorinated compounds are quite stable and they have no stable and they have no natural decompositions. Hence the detoxification of these compounds under mild condition becomes necessary. The cleavage of C-F bond of fluorinated compounds results in the formation of fluoride ions. Fluoride is one of the essential nutrients for human beings. Excess fluoride consumption causes dental, skeletal fluorosis. Hence the surface and ground water sources containing excessive fluorides are required to be defluoridated before consumption(Bhargava.D.S,2008).

The use of activated carbon prepared from the shell of bale fruit(LimoniaAcidissima)is tried for fluoride removal .For defluoridation study, activated carbon was prepared by activating the bale friut shell at 600˚C using muffle furnace. Batch made adsorption studies was conducted with varying concentrations .The experiments were carried out by varying the time interval, concentration, dosage and Ph content. The effect of contact time, initial concentration, adsorbent dosage and ph of the solution were studied. The influence of various factors, were studied and Langmuir model was used to analyze the adsorption equilibrium (Manvi.A.H, 2004)

2. Experimental Methodology

Preparation of Stock Solution

A stock solution was obtained by dissolving 4.36 mg of sodium fluoride in 1 litre distilled water. From the stock solution standard solution was prepared by dissolving 250 ml of the solution from the stock solution in 1 litre of water.

Sorbent Preparation

The shells of bale fruit were collected, dried and powdered and packed in air tight container. The sealed container was heated in the muffle furnace in the absence of oxygen by slowly raising the temperature up to 850°C and maintaining the same for one hour and then the material was allowed to cool at room temperature.(Raju.P,2010)

Adsorption Studies

The adsorption studies were carried out using a batch reactor. The prepared solution containing iron was bottled in BOD bottles of 150 ml and agitated using orbital shaker for required time period. The concentration was varied from 0.05mg/L to 2 mg/L. The pH (1,3,5,7,8,9) of each test solution was adjusted to the required value with suitable acid and alkali solutions. The time was varied from 5 minutes -25 minutes and the adsorbent dosage was varied from 0.5g -2.5 g. After agitating the sample for the required contact time, the contents were filtered through whatman No.41 filter paper and were analysed using UV-visible spectrophotometer and residual concentration was determined.

3. Results and Discussions

Effect of Contact Time

Figure 1 shows the effect of contact time on the uptake of Fluoride onto the carbon. The contact time was varied from 15 minutes to 30 minutes and the optimum contact time was found to be 20 minutes.

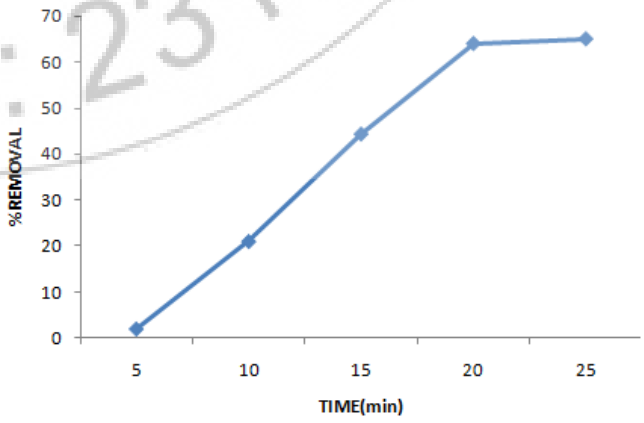

Figure 1: Adsorption curve for different contact time

Effect of pH

The pH of the solution is an important parameter controlling adsorption process. The adsorption of fluoride from aqueous solution is dependent on pH of the solution .The adsorption of fluoride was studied at various pH values(1, 3, 5, 7, 9, 11) (Fig.2).The uptake of fluoride was dependent on pH and the optimal fluoride removal efficiency occurred at pH 5.

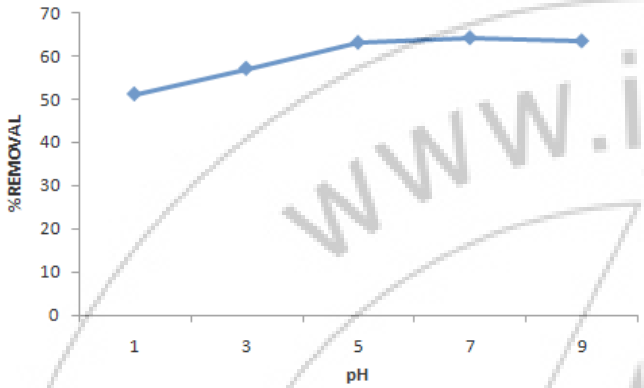

Figure 2: Adsorption curves for different pH value

Effect of Adsorbent

The amount of adsorbent on the efficiency of adsorption was studied. The adsorption dose was varied from 0.5g to 2.5 g and the adsorption studies were performed at pH 5(Fig.3).The maximum removal of fluoride was attained at an adsorbent dose of 1.5g with no further appreciable increase in the removal percentage after 1.5g.

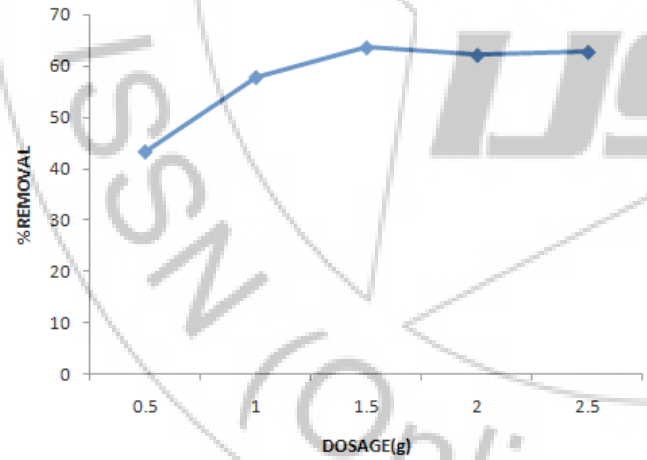

Figure 3: Adsoprtion curve showing different dosages of adsorbent

Isothermal Studies

Analysis of the isotherm data is important in order to develop an equation that accurately represents the results and which could be used for design purposes. The Langmuir isotherm model (Fig.4)were used to describe the relationship between the amount of fluoride adsorbed and its equilibrium concentration for activate carbon prepared from LimoniaAcidissima.

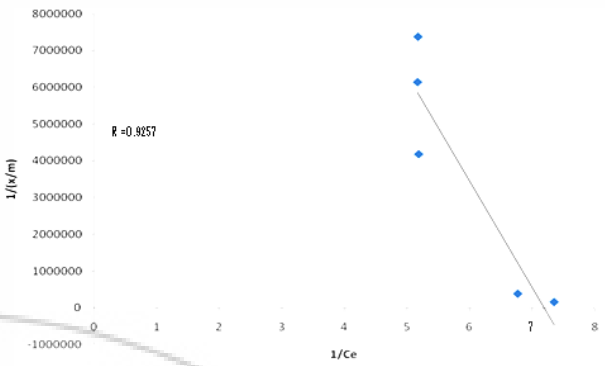

Figure 4: Langmuir isotherm for LimonaAcidissima

Here the R=.9587< 1 which shows that the adsorbent process is favourable for fluoride uptake.

4. Conclusion

The adsorption capacities of sludge were strongly dependent of the Ph of the solution. The sorption capacity was decreased with an increase in the ph and an increase in the initial concentration and after reaching the optimum value there was no appreciable increase with increasing contact time. The rate of increase of fluoride was more significant up to a contact time of 20 minutes. From this study it may be concluded that sludge powder may be used as low-cost natural sorbent and it is available in abundant sources and may also in effective in removing fluoride present in wastewater.

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