

Defluoridation of Ground Water Using Various Methods

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Abstract

Fluoride is a chemical element that has to cause significant effects on human health through drinking water. This paper is aimed to analyze the fluoride concentration in groundwater. Fluoride can also be quite detrimental at higher concentrations at skeletal fluorosis. The Darmapuri district is a hard rock and alluvial plain marked as one of the Fluoride-increase area in Tamilnadu due to occurrence of various rock types including fluoride-bearing minerals. The F⁻ content of groundwater can thus originate from the dissolution of Fluoride-bearing minerals in the bed rock. The fluoride concentration in groundwater of this region ranges from 0.5 to 6.5 mg/l. concentration exceeded the maximum permissible limit of the drinking water standards of BIS 1.5 mg/l. The present study focused on defluoridation of groundwater by adsorption method using various economically feasible material like Alum, brick powder and amla powder. Adsorption is the surface phenomenon adsorption techniques such as batch and column study were applied to remove the fluoride. The results of adsorption techniques show that removal of fluoride in the domestic domain is possible. The concentration of fluoride is considerably reduced in the column study with the layer of alum and brick from 6 mg/l to 1.5 mg/l. The study also identified the optimum dosage of adsorbent for alum, brick powder and amla powder by using different batch study.

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. Natural water contains fluorides in varying amounts. Consumption of water that contains fluoride in a concentration of approximately 1mg/l has been found to be effective in reducing tooth decay. For this reason fluoride compound are usually added to water supplies which contain less than the desired concentration. In communities where the fluoride content in the water is at an optimum level, tooth decay has been shown to be almost 65% less than in communities with little or no fluorides in water. Most un fluoridated water contains less than 0.3mg/l fluoride. In Dharmapuri district, the fluoride content is relatively high and in this study, water samples are collected from Palacode and Pennagaram.

The present study was confined to defluoridation of ground water.

Excessive fluoride was found in dharmapuri district continuous exposure shown in studies to reduce a person's intelligence quotient (IQ), increase the risk of bone cancer in males, impede thyroid functioning and cause neurotoxicity in developing children. High doses of fluoride can create tooth discoloration in young children and can also weaken bones and ligaments. Low doses obtained in community water are considered safe. This study Addressing these problems by removing fluoride water at lower cost and with less energy in the domestic domain itself, while at the same time minimizing the use of chemicals and impact on the environment.

Methodology

This study has an attempt to reduce the fluoride content in domestic levels using low cost materials as

adsorbents. Adsorption technique is a surface phenomenon which may be defined in terms of an unit operation in the chemical engineering sense and that operation which deals primarily with the utilization of surface forces. The removal rate of fluoride is estimated for 2g, 4g, 6g and 8g of adsorbents (alum, laterite, amla) using jar test. 4 jars with different concentrations of adsorbents in 1000ml of water is taken and kept in the stirrer, with paddles positioned identically in each beaker. For first 10 minutes 100 rpm is set and for the next 15 minutes the rpm is reduced to 50. Turn the mixer off and allow settling to occur. After settling for the period of 10 minutes the removal rate is determined (Table 1&2). In column study, a column is fabricated with pvc pipe (length-90cm, internal diameter-7.5cm, external diameter-11.5cm) and pebbles, sand, laterite, amla are arranged in alternative layers (Fig 4). The water received

from this column will contain fluoride content in reduced levels (Table 3).

Table 1

s.no	Amount of Adsorbents (g/l)	Fluoride concentration (mg/l)		
		Alum	Laterite	Amla
1	0	6	6	6
2	2	1.5	3	1.5
3	4	2	1.5	2
4	6	2	3	2
5	8	3	3	3

Table 2

s.no	Amount of Adsorbent (g/l)	Fluoride concentration (mg/l)		
		Alum	Laterite	Amla
1	0	5	5	5
2	2	2	3	1.5
3	4	2	1.5	2
4	6	2	2	3

5	8	3	3	3
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Table 3

Sample	Initial Fluoride concentration n	Final Fluoride concentration n
Palacode	6	2
Pennagaram	5	1.5

Results

In batch study for Palacode sample fluoride is removed upto 75% in optimum dosage of adsorbents. For Pennagaram it is removed upto 70% in optimum dosage.

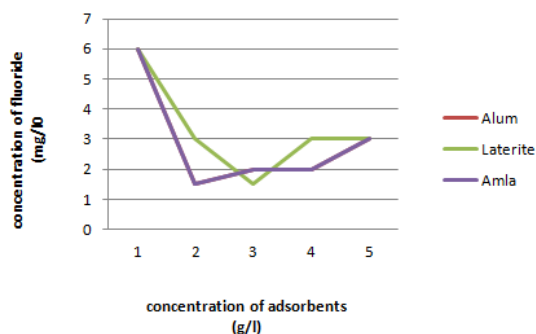


Fig1 Removal of fluoride in Palacode Sample using adsorbents

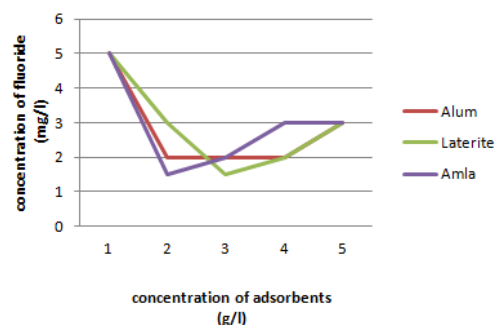


Fig.2 Removal of fluoride in Pennagaram Sample using adsorbents

In column sample and 1.5 ppm for Pennagaram sample. The results of column study is explained in fig 3.

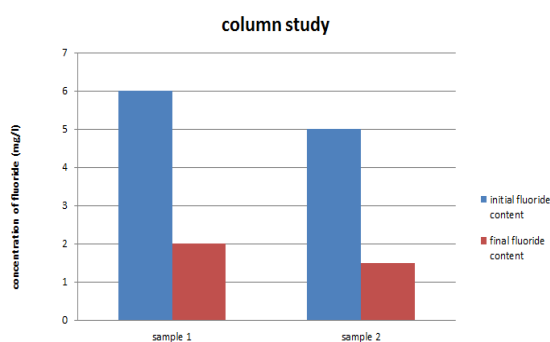


Fig 3 Column study

Cost estimation

As this study gives importance to removal of fluoride in economic manner the cost is estimated for two samples. One gram of alum and laterite cost Rs 0.434 and Rs 0.0015 respectively.

For Palacode population the cost estimated is Alum - Rs. 30,02,464

Laterite- Rs. 21,722 Similarly for Pennagaram population the cost estimated is Alum - Rs. 1,32,751.92 Laterite- Rs. 960

Discussions

Through this study it is very clear that laterite is very economic compared to other two adsorbents. Thus, we can set a column in areas where fluoride concentration is high and water is collected, stored and used for drinking and cooking purposes.

Conclusion:

The present study made an attempt to remove fluoride contamination from groundwater using cost

effective and natural material as adsorbents and also identified the optimum dosage of each and every material. The cost estimation analysis reveals that the laterite is effectively remove the fluoride

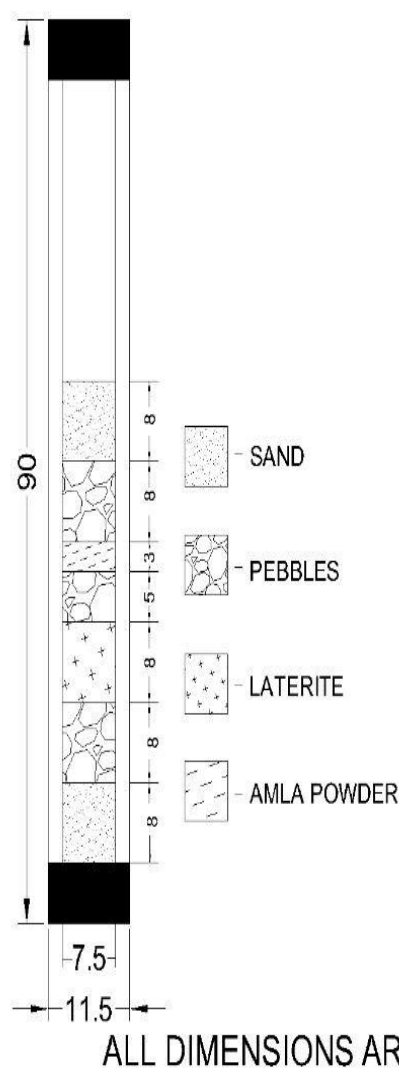


Fig 4 Column

concentration. Batch study is a preliminary test to determine

whether the absorbents remove the fluoride or not. From fig 4.1 and 4.2 it is clear that all the absorbents has reduced the fluoride content upto 75%. According to column study the fluoride is reduced from 6 ppm to 2 ppm for palacode and from 5 ppm to 1.5 ppm. Thus we recommend setting a column in villages where the fluoride content is higher, we can collect and store the water and used it for drinking and cooking purposes. All these can be done in domestic households as the materials required for column study is easily available. Through this, we can reduce the fluoride content to optimum level and can prevent people from skeletal and dental fluorosis.

REFERENCES

1. **Ground water** by **H.M.Raghunath** published by New age International publishers.
2. **Ground Water Hyrodlogy** by **David Keith Todd** published by John Wiley and Sons, Newyork.
3. **Water supply engineering** by **Santhosh kumar Garg** published by Khanna publishers, New Delhi.
4. **Guidelines for drinking water supply** A.I.T.B.S Publishers and distributors, New Delhi.