Strategies for Reducing Chemical Contamination in Water: A Case Study Approach

Marie Dubois[1], Jacques Lefèvre[2]

[1](Assistant Professor, Civil Department, École Nationale des Ponts et Chaussées, Paris, France.)
[2](Assistant Professor, Civil Department, École Nationale des Ponts et Chaussées, Paris, France.)

ABSTRACT

People on globe are suffering from various problems due to undesired changes in physical, chemical and biological characteristics of air , water and soil. Apatite , fluoride and biotite are the several rocks having fluoride bearing minerals. The weathering of this rocks and infilteration of rainfall through it increases fluoride concentration in ground water. Human population suffers from various water bond disease due to contaminated drinking water therefore it is neccessary that the quality of drinking water should be checked at regular interval. Fluorides and fluorosis issues are common in fue nations including India . Flourides higher than 1.5mg/l causes dental and skeletal fluorosis . The ground water sample was collected from three villages Dongargaon , Sakharagaon and pandharkawda of Maharashtra containing fluoride concentration. The result show that Sakhara contains maximum fluoride concentration 5.21mg/l . The various studied techniques for defluoridation are coagulation, precipitation and adsorbtion process. For defluoridation, adsorbtion process is more favoured and economical. The various adsorbent including activated carbon, chalk powder, agricultural waste (orange peels, pineapple peels , banana peel) is used to keep up standard limit of fluoride concentration in drinking water

Keywords: Fluoride, Defluoridation, adsorption ,Dental Fluorosis, Skeletal Floursis]

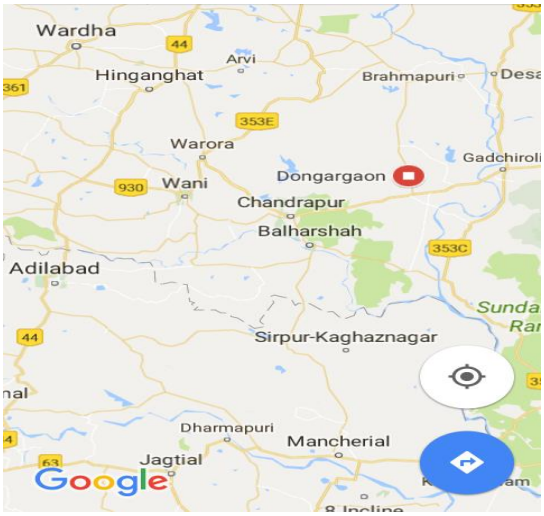
I. INTRODUCTION

For shaping the land and regulating the climate the most important factor is Water. It is one of the most important compounds that profoundly influence life. All over the world Groundwater is used for domestic, industrial water supply and for irrigation purposes also. Due to rapid growth of population and the accelerated pace of industrialization the demand for fresh water there has increased tremendously from last few decades. According to WHO organization, about 80% of all the diseases are caused to the human beings is due to water . If the water gets contaminated then its quality cannot be get improved easily. One of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers is Water quality index.Thus it becomes an important parameter for the management of groundwater and assessment. The water used for drinking domestic, agricultural or industrial purpose is essential and important to be tested before its use. Water must be tested with different physic-chemical parameters. .The testing of water depends upon selection of parameters for what purpose we going to use water and at what extent we need its quality and purity.

The present investigation attempted in different areas like Dongargaon , Sakhara and Pandharkawda. to study the concentration of fluoride in ground water . The Sakhara village having maximum fluoride content in ground water which is 5.21mg/l for bring the fluoride concentration upto permissible limit. Adsorption process is used in which pineapple peels is used as an adsorbent material. Designing a treatment unit model by using adsorbents materials and filtermedia.

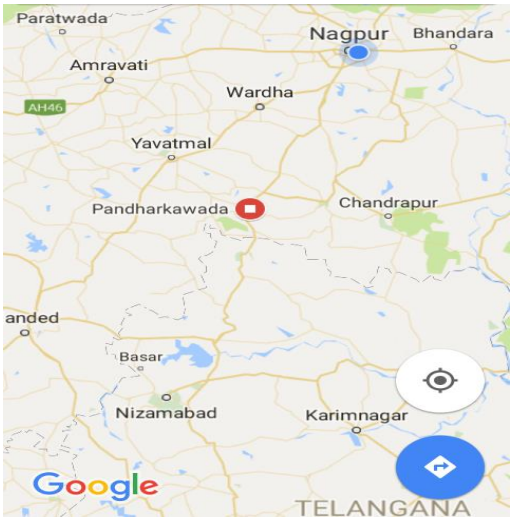
A. Location of villages

dongargaon :-
District : Chandrapur
State : Maharashtra
Total population : 3066
Population percentage: male =51%
Female=49%
Source of water : bore well



Sakhara village :-
District : Yavatmal
State : Maharashtra
Total population : 279
Population percentage: male =49%
Female=51%
Source of water : tube well
Ground water

Pandharkawda village :-
District : Yavatmal
State : Maharashtra
Total population : 560
Population percentage: male =51%
Female=49%
Source of water : tube well



B. **Objectives**

- To reduce chemical impurity present in water.
- To determine the chemical impurities present in the villages pandharkawda ,sakhra and dongargaon .
- To minimize the one of the chemical impurity from water and giving technical solutions .
- To reduce fluoride content from water which reduces health hazard.
- To minimize fluoride content upto its permissible limit by designing filter unit using pineapple peel and sugarcane baggase as a filter media.
- The objective of this project is to contribute in the search of less expensive adsorbents and their ultilization possibilities in adsorption process for the elimination of fluoride from drinking water.

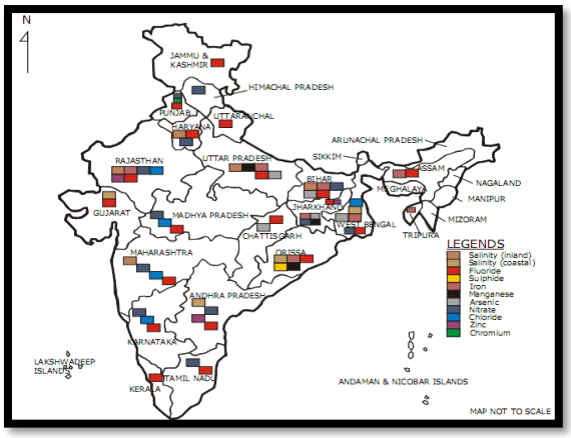
C. **Limitations :-**

- It is limited to small villages having less population.
- It takes time for preparation of filter media .
- The life of treatment unit as less as we are using pineapple peel and sugarcane baggase .

D. ***Chemical impurities present in water , permissible limit and diseases :-***

Table I

Sr.no.	**Chemical impurities**	**Permissible limit**
1	Ph	6.5 -8.5
2	Fluoride	1.5mg/l
3	TDS	2000mg/l
4	Total hardness	600mg/l
5	Magnesium	100mg/l
6	Nitrate	45mg/l
7	Iron	0.3mg/l
8	Chloride	1000mg/l



fig(a). Chemical impurity of water found inIndia

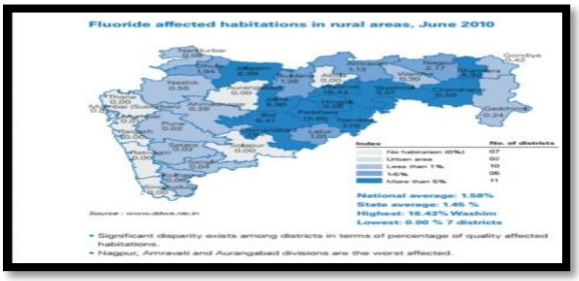


fig.(b)Chemical impurity of water found inMaharastra

E. Fluoride Water borne diseases :-

Dental fluorosis :

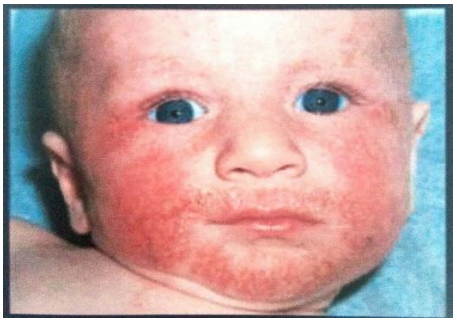
It is an extremely common disorder characterized by hypo mineralization of tooth enamel caused by ingestion of excessive fluoride during enamel formation.

Skeletal fluorosis :

It is a bone disease caused by excessive accumulation of fluoride in the bones. In advances cases, skeletal fluorosis causes pain and damaged bones and joints.

Eczema:-

A medical condition in which patches of skin become rough and inflamed with blisters which causes itching and bleeding mostly occur in children and adults.



II. COLLECTION AND TESTING OF WATER SAMPLE

1. Sampling

For analysis sampling is a major step. The water was being pumped continuously from the borehole hence the assumption that the pipe materials had not affected the sampled water. Two samples were taken and put in clean labeled 2 litre plastic canes for easy identification. The sample bottles were then sealed with clean corks.

2. Preacautions

The method of sampling has a direct impact on the quality of analytical findings. Basic precautions must be taken to obtain a representative sample for minimizing the risks of sample contamination by the sample collector and to ensure sample integrity. The contamination of samples is observed due to careless sampling techniques. Therefore it is the responsibility of the sample collector to ensure the quality of sample collection, preservation and suitable transportation of samples which are sent to the laboratory.

For the prevention of water contamination the following precautions must be taken such as :

- The Samples collected for chemical analysis must be during normal operating hours.
- While handling the samples, for prevention of subsequent contamination (by sweat, chemical residues, etc), it is necessary that the hands of the persons who is collecting the samples must be extremely clean.
- Collect a sample of water in clean and dry plastic bottle of 125ml.
- An air space between the surface of the liquid and the container lid should always be at least 2.5cm which helps to produce a homogenized sample for laboratory analysis.

Fig 1. Collected Water Sample

3. Laboratory analysis :-

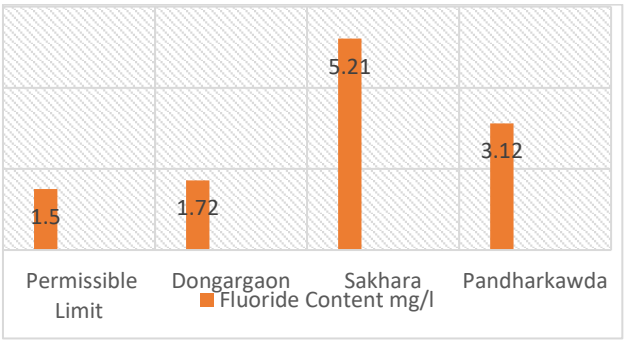
Laboratory tests were carried out at Ground Water And Development Agency (GSDA), Regional Water Testing Laboratory in Nagpur Region.

The testing procedure forpH, electrical conductivity, total dissolved solids, total hardness, calcium, magnesium, fluoride, nitrate, sulphate,iron, chloride,turbidity temperature,was conducted using the standard methods as described in table no.1.1. The test results were then compared to the WHO standard values and it is found that the Sample having high pH, TDS, total hardness, calcium, fluoride concentration.

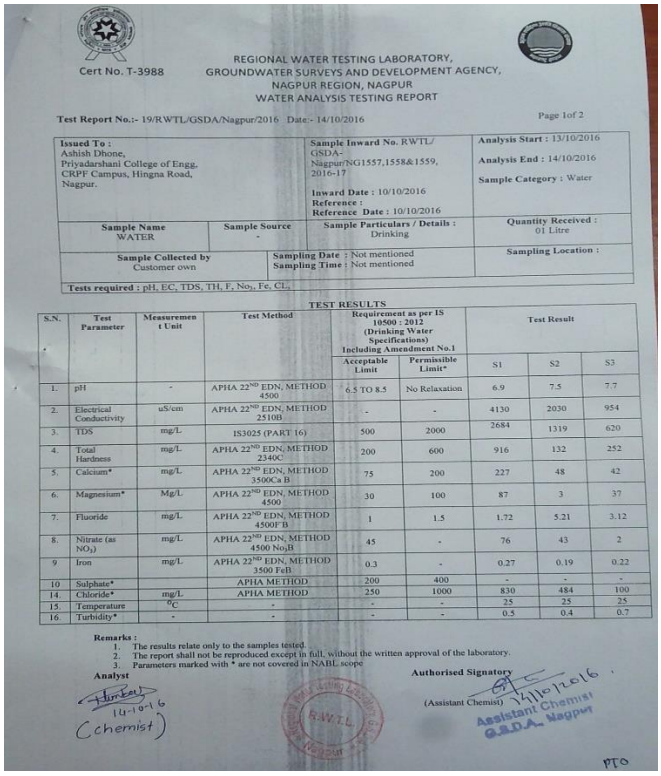
4. Test results:

The testing procedure forchemical parameters required 50ml of water sample and it is conducted using the standard methods and the test results were then compared to the WHO standard value both as described *in table1.1*.

Authorized laboratory test result of samples are mentioned in Appendix.



From the above parameters fluoride content is maximum as compared to its permissible limit.The study reveals that the concentration of fluoride was found as 1.72 mg/l, 5.21 mg/l and 3.13mg/l in Dongargaon, Sakhara and in Pandharkawada which is higher than permissible limit.Water containing fluoride ions requires a suitable and effective method for treatment.



Cert No. T-3988

REGIONAL WATER TESTING LABORATORY,
GROUNDWATER SURVEYS AND DEVELOPMENT AGENCY,
NAGPUR REGION, NAGPUR
WATER ANALYSIS TESTING REPORT

Test Report No.:- 19/RWTL/GSDA/Nagpur/2016 Date:- 14/10/2016 Page 1of 2

Issued To : Ashish Dhone, Priyadarshani College of Engg, CRPF Campus, Hingna Road, Nagpur.
Sample Inward No. RWTL/GSDA-Nagpur/NG1557,1558&1559, /2016-17
Inward Date : 10/10/2016
Reference :
Reference Date : 10/10/2016
Analysis Start : 13/10/2016
Analysis End : 14/10/2016
Sample Category : Water

Sample Name	Sample Source	Sample Particulars / Details :	Quantity Received :
WATER	-	Drinking	01 Litre

Sample Collected by	Sampling Date : Not mentioned Sampling Time : Not mentioned	Sampling Location :
Customer own		

Tests required : pH, EC, TDS, TH, F, No_3, Fe, CL,

TEST RESULTS

S.N.	Test Parameter	Measurement Unit	Test Method	Requirement as per IS 10500 : 2012 (Drinking Water Specifications) Including Amendment No.1		Test Result		
				Acceptable Limit	Permissible Limit*	S1	S2	S3
1.	pH	-	APHA 22ND EDN, METHOD 4500	6.5 TO 8.5	No Relaxation	6.9	7.5	7.7
2.	Electrical Conductivity	uS/cm	APHA 22ND EDN, METHOD 2510B	-	-	4130	2030	954
3.	TDS	mg/L	IS3025 (PART 16)	500	2000	2684	1319	620
4.	Total Hardness	mg/L	APHA 22ND EDN, METHOD 2340C	200	600	916	132	252
5.	Calcium*	mg/L	APHA 22ND EDN, METHOD 3500Ca B	75	200	227	48	42
6.	Magnesium*	Mg/L	APHA 22ND EDN, METHOD 4500	30	100	87	3	37
7.	Fluoride	mg/L	APHA 22ND EDN, METHOD 4500F B	1	1.5	1.72	5.21	3.12
8.	Nitrate (as NO_3)	mg/L	APHA 22ND EDN, METHOD 4500 No_3B	45	-	76	43	2
9	Iron	mg/L	APHA 22ND EDN, METHOD 3500 FeB	0.3	-	0.27	0.19	0.22
10	Sulphate*		APHA METHOD	200	400	-	-	-
14.	Chloride*	mg/L	APHA METHOD	250	1000	830	484	100
15.	Temperature	°C	-	-	-	25	25	25
16.	Turbidity*	-	-	-	-	0.5	0.4	0.7

Remarks :
1. The results relate only to the samples tested.
2. The report shall not be reproduced except in full, without the written approval of the laboratory.
3. Parameters marked with * are not covered in NABL scope

Analyst
14-10-16
(Chemist)

Authorised Signatory
(Assistant Chemist) 14/10/2016
Assistant Chemist G.S.D.A., Nagpur

R.W.T.L. Nagpur

PTO

Authorized test result

Test results:

Table 2

S.N.	Test Parameters	Measurement Units	Test Methods	Requirement as per IS 10500:2012 (Drinking Water Specifications) Including Amendment No. 1		8.7Test Results	
				Acceptable Limit	Permissible Limit	S1	S2
1	PH	-	APHA 22ND EDN, METHOD 4500	6.5 to 8.5	No relaxation	8.7	8.2
2		mg/l	IS3025(PART 16)	500	2000	-	
3		mg/l	APHA 22ND EDN, METHOD 2340C	200	600	88	

4	Calcium	mg/l	APHA 22ND EDN, METHOD 3500CaB	75	200	21	37
5	Fluoride	mg/l	APHA 22ND EDN, METHOD 4500FB	1	1.5	1.97	1.81
6	Nitrate	mg/l	APHA 22ND EDN, METHOD 4500NO3B	45	-	25	27

III. TREATMENT METHODS FOR REMOVAL OF FLUORIDE:

Due to its considerable impact on human physiologythe presence of fluorine in ground water has drawn its attentionworldwide. Major issue is the presence of low or high concentration of certain ions as they make the groundwater unsuitable for various purposes. Many parts of India affecting millions of people human health such as dental and skeletal fluorosisas Fluoride (F^-) present in drinking water is above the permissible limits that is 1.5mg/l.

The Removal methods are:

[A] REVERSE OSMOSIS : Reverse osmosis (RO) is a process which represents a reverse of normal osmotic processes. To remove contaminants from water, the pressure and a semi-permeable membrane is released. Reverse osmosis [RO] systemsare generally not affordable fordaily and personal use.

[B] ACTIVATED ALUMINA:Activated Alumina is a process in which the filters are used in locales where fluorosis is prevalent. This filters are relatively expensive and require frequent replacement. But this filters are choosen as an option for home water filtration.

[C] ACTIVATED CARBON:-In this method most of the carbons prepared from different carbonaceous sources showed fluoride removal capacity after alum impregnation. It has been reported thatvarious types of activated carbonsare there removal of high concentration of fluoride from water.

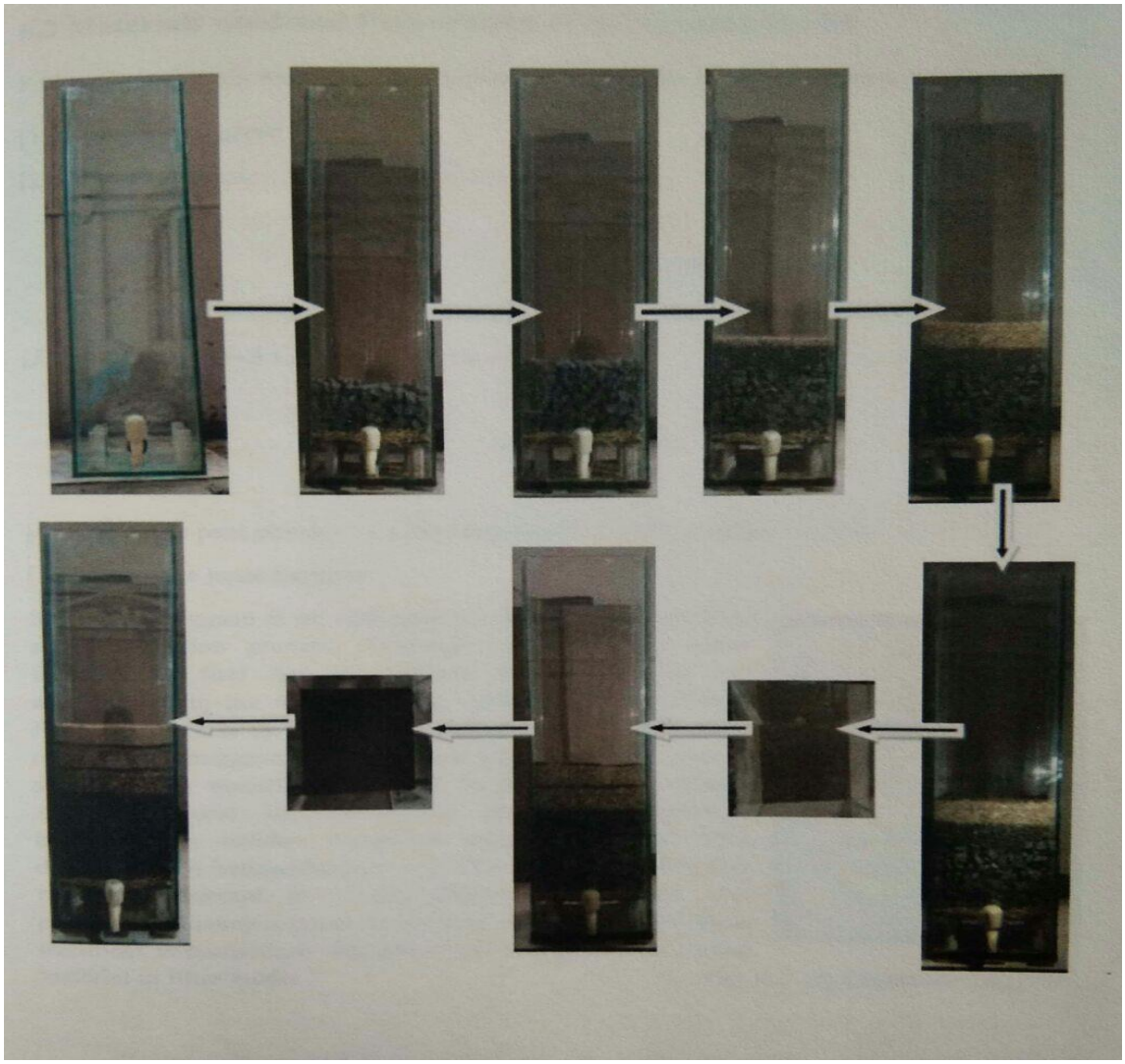
[D] BONE CHAR (BC):- Bone char is a method which was one of the early methods suggested for defluoridation of water supplies. The process was one of the ion exchange in which carbonate radical of the apatite comprising bone, Ca(PO4)6.CaCO3, was replaced by fluoride for the formation of an insoluble fluorapatite. At 1100-1600ºC temperature the Bone char is produced by carbonizing bone which has superior qualities than those of unprocessed bone and hence replaced bone as defluoridating agent.

[E] NALGONDA :-The combination of several unit operations is known as Nalgonda technique and this Nalgonda process involves rapid mixing, chemical interaction, flocculation, sedimentation, filtration, disinfection and sludge concentration to recover waters and aluminium salts. Alum (hydrated aluminium salts) is a coagulant commonly used for water treatment and is also used to flocculate fluoride ions in the water.

IV. METHODOLOGY

Filter unit preparation :-

- 1.Support steel mesh use PVC pipe .
- 2. 1st layer above mesh oven dried fine thread of sugarcane baggase .
- 2ndlayer coarse aggregate of 20mm, 25mm, 4.75mm upto 9cm ,8cm,7cm thick layer.
- 3rd layer fine aggregate of 2.36mm,1.18mm upto 6cm thick layers.
- 4thlayer of adsorbant material i.e. pineapple peel upto 1cm thick layer.
- 5th layer fine sand of 600micron upto 7cm thick layer



Fig(C) Preparation Of Filter unit

Materials Used In The Filter Media:-

(a) Pineapple peel powder

(b) Sugarcane baggase

(c) Coarse and fine aggregate :-

C. Treated water sample :-

Fine sand = 600micron **(7cm)**

Pineapple peel powder = 850 micron**(1cm)**

Sand = 1.18mm **(6 cm)**

Sand =2.36mm **(6cm)**

Coarse aggregate =4.75mm **(7cm)**

Coarse aggregate =20 mm **(8cm)**

Coarse aggregate =25 mm **(9cm)**

Sugarcane baggase

Bottom (filtered water contain)

D. Treated water sample :-

Water sample treated withWater sample treated with pineapple peel and sugarcane bagasse. pineapple peels.

V. CONCLUSIONS

1. We came across the problem faced by people living in Sakhra, Pandharkawda and Dongargaon villages caused due to chemical impurities present in water.
2. Consumption of fluoride concentration has been reduced by provision of filteration unit .
3. Design of treatment unit can fullfill the demand for fluoride removal of people living in sakhra village.
4. Using pineapple peels as an absorbent material in filtration reduces the wastage of pineapple peels.
5. Fluoride content removed by pineapple peels and sugarcane baggase is more suitable as compared to treated with pineapple peels.
6. From the result, the fluoride reoved by pineapple peels with sugarcane baggase reduces fluoride content in water upto 1.81mg/l , whereas pineapple peels reduces upto 1.97mg/l . But pineapple peel which sugarcane baggase increases the turbidityof water sample and also impart pale green colour . Therefore , it conclude that fluoride removed by pineapple peels is more suitable than the filter with pineapple peel and sugarcane baggase.

VI. ACKNOWLEDGEMENTS:

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