Comparative Study on Removal of Fluoride from Ground Water by Different Samples from Different Villages

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Abstract- Due to the occurrence of fluorine in ground water various effects on human physiology has been seen. The low or high concentration of fluorine makes the groundwater unsuitable for various purposes. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. Fluoride (F^-) concentration above the permissible limits (1.5 mg/l) in drinking water leads to human health hazards, such as dental and skeletal fluorosis. The weathering of rocks, leaching of soils, mining processing and infiltration of rainfall through it increases fluoride concentration in groundwater. Several rocks have fluoride bearing minerals like apatite, fluorite, biotite and hornblende. The present investigation attempt to study the concentration of fluoride in groundwater's of different areas like Dongargaon, Sakra village and Pandharkawda.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, Sakra and in pandharkawda which is higher than permissible limit. Treatment of water containing fluoride ions requires a suitable and effective method. The various treatment method have been studied here are Reverse Osmosis (RO), Activated Alumina, Black Carbon, Electrodialysis (ED).

KEY WORD:- Fluoride, Skeletal Fluorosis, Dental Fluorosis, Reverse Osmosis (RO).

I. INTRODUCTION

There are three kinds of water available namely rain water, ground water and surface water. People are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. Rain water is clean and it is suitable for cooking and drinking. But storage of rain water requires large storage reservoirs which are expensive to build and to maintain. Rain fall is also uneven groundwater sources are bore wells and wells. Surface water sources are tanks, dams, canals and rivers. Due to scarcity of waters, the people depend on well water and bore well waters. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. Natural water contaminates due to weathering of rocks and leaching of soils, mining processing etc.
The major chemical parameters of concern are fluoride. It is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. It is estimated that around 37.7 million Indians are affected by waterborne diseases annually. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life.

The quality of ground water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of the particular region. Industrial waste and the municipal solid waste have emerged as one of the leading cause of pollution of surface and ground water**.** In many parts of the country

available water is rendered non- potable because of the presence of chemical impurities in excess. Contamination of water resources available for household and drinking purposes with chemical impurities is one of the serious major health problems. So it become necessary to treat the chemical impurities. Treatment of water containing fluoride ions requires a suitable and effective method. The various
treatment method have been studied here.

II. METHODOLOGY

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.

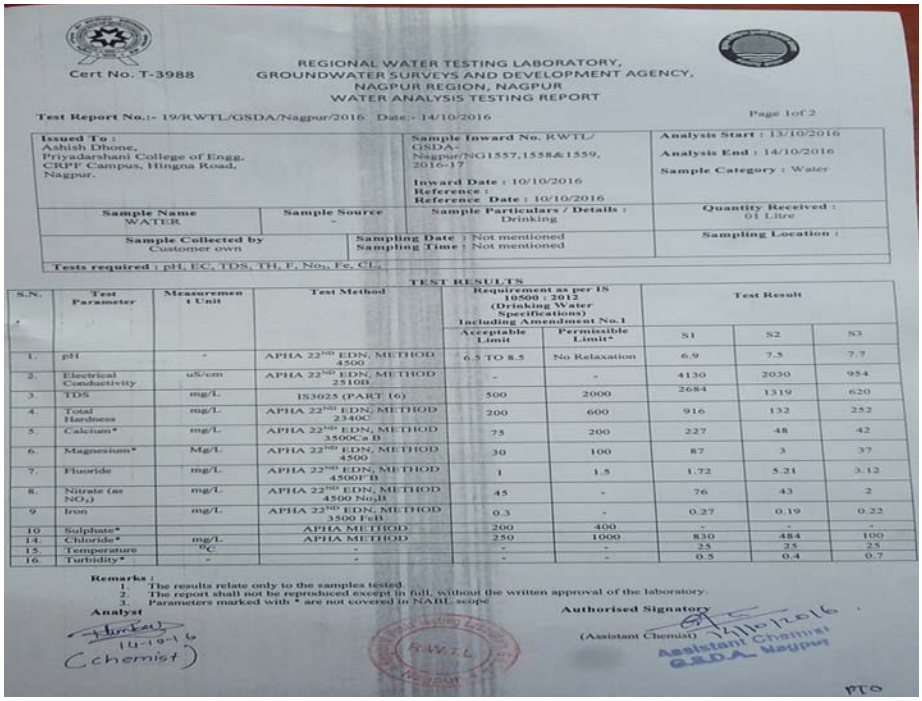
2. Laboratory Analysis

Laboratory tests were carried out at Ground Water And Development Agency (GSDA), Regional Water Testing Laboratory in Nagpur Region for each of the sample obtained in accordance to the Standard Methods for the Examination of Water (APHA 22nd EDN, Method).

III. TEST RESULTS

The testing procedure for Fluoride required 50ml of water sample and it is conducted using the standard methods as described in APHA 22nd EDN, Method 4500FB. The test results were then compared to the WHO standard value of 1.5 mg/l.

Collected Water Sample



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

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

Tests required : pH, EC, TDS, TH, F, No3, 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 4500FB	1	1.5	1.72	5.21	3.12
8.	Nitrate (as NO3)	mg/L	APHA 22ND EDN, METHOD 4500 No3B	45	-	76	43	2
9	Iron	mg/L	APHA 22ND EDN, METHOD 3500 Fe B	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

RWTL

PTO

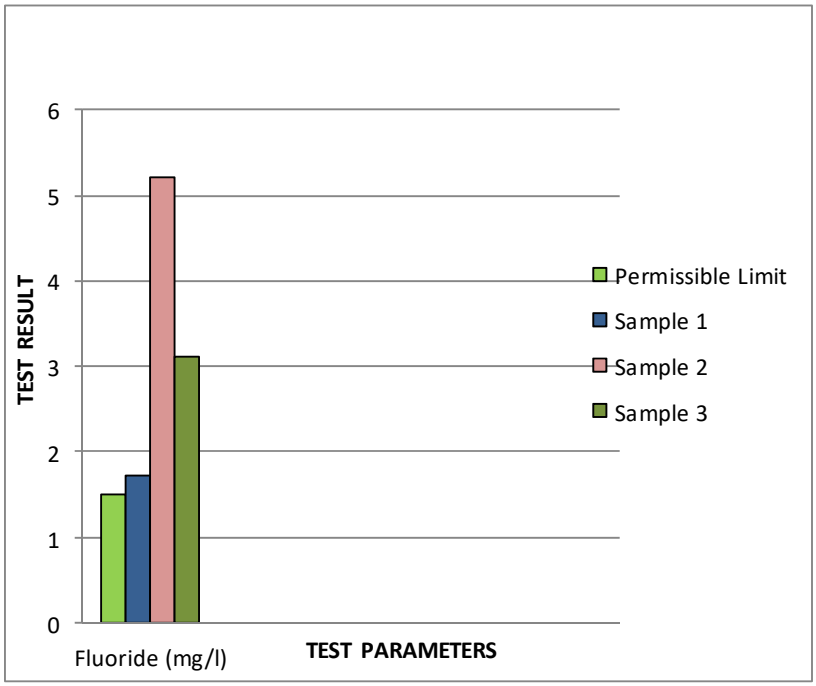
Authorized Report

S.N.	Test Parameters	Measurement Units	Test Methods	Requirement as per IS 10500:2012 (Drinking Water Specifications) Including Amendment No. 1		Test Results		
				Acceptable Limit	Permissible Limit	S1	S2	S3
1	Fluoride	mg/l	APHA 22ND EDN, METHOD, 4500FB	1	1.5	1.72	5.21	3.12
2	pH	-	APHA 22ND EDN, METHOD, 4500	6.5 TO 8.5	No Relaxation	6.9	7.5	7.7
3	Electrical Conductivity	uS/cm	APHA 22ND EDN, METHOD, 2510B	-	-	4130	2030	954
4	Temperature	°C	-	-	-	25	25	25
5	Turbidity	-	-	-	-	0.5	0.4	0.7

6	Chloride	mg/l	ALPHA METHOD	250	1000	830	484	100

Test Results of Three Samples For Different Parameter.

From the above parameters fluoride content is maximum as compared to its permissible limit.



Comparative Study of Fluoride Parameter of Three Samples.

IV. Treatment Method Of Fluoride Removal

1. Reverse Osmosis: Reverse osmosis (RO) represents a reverse of normal osmotic processes. It relies on pressure and a semi-permeable membrane to remove contaminants from water. RO can be used as a stand-alone treatment for most source waters, Beside fluoride molecules also other molecules will be retained.

2. Activated alumina: Fluoride is strongly attracted to activated alumina (corundum/aluminum oxide) which has a large surface area with a huge array of tunnel-like pores. For this reason, activated alumina is the most commonly used fluoride removal media.

3. BC-Carbon: Bone-Char (BC) Carbon has been used for centuries to remove naturally-occurring fluoride from water. It works similar to the way bones in the human body attract fluoride. Bone contains a porous matrix that is rich in surface ions.

4. Electrodialysis (ED): Electrodialysis (ED) is a membrane process similar to RO, except that ED uses an applied d.c. potential(electric current), instead of pressure, to separate ionic contaminants from water. Because water does not physically pass through the membrane in the ED process, particulate matter is not removed. Thus, ED membranes are not technically considered filters.The EDR process product water quality is comparable to RO, and may require post treatment stabilization. The EDR process is often used in treating brackish water to make it suitable for drinking.

Sr.no	Treatment method	Removal performance	Cost	Advantages	Disadvantages
1.	Reverse Osmosis	90%-95%	Very High	RO is EPA-listed Best Available Technique for both F and As.	High treatment technology increased capital costs, Skilled operator required.
2.	Activated alumina	98%	Medium	Proven effectiveness, will treat current F and S.	Spent regeneration solution contains high F concentrations
3.	BC-Carbon	90%	Low	Locally available, simple and easy to build.	may give taste; degenerates not universally accepted.
4.	Electrodialysis (ED)	85%-90%	Very High	Familiarity with membrane separation system.	Water loss, high costs, brine discharge.

Comparison of different techniques for removal of Fluoride from Water

V. CONCLUSION

It was found that the three samples were collected had fluoride content above the permissible limit 1.5mg/l. Reverse Osmosis (RO) where found as most appropriate method for removal of fluoride as compared to other treatment methods. But, the disadvantage of RO is, it is very costly than other treatment methods. It has been seen for removal of small quantity of fluoride Bone-Char (BC) Carbon is used at domestic level which is most economical.

REFERENCES

[1] Tanuja Gwalani & Dr. J. L. Tarar,Distribution of Fluoride in ground waters of Nagpur city (Maharashtra, India).Imperial Journal of Interdisciplinary Research (IJIR),Institute of science, Nagpur, Maharashtra, India Ex Head of Department, Environmental Science, Institute of science, Nagpur, Maharashtra, Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-7, 2016 ISSN:2454-1362, http://www.onlinejournal.in Imperial

[2] Prof. Dilip Patil, Prof. Prashant Deshmukh, Prof. Ravindra. A. Fursule and Prof. Pravin.O.Patil "Geochemical studies of fluoride and other water quality parameters of ground water in Dhule region Maharashtra, India".Articles from Journal of Natural Science, Biology, and Medicine are provided here courtesy of Medknow Publications.

[3] Mary Tiemann Specialist in Environmental Policy "Fluoride in Drinking Water: A Review of Fluoridation and Regulation Issues", January 3, 2011 Congressional Research Service 7-5700 www.crs.gov RL33280.*c11173008*

[4] Sanghratna S. Waghmare and TanvirArfin "Fluoride Removal from Water by various techniques: Review",National Environmental Engineering Research Institute,Nagpur, IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 9, September 2015. www.ijiset.com ISSN 2348 – 7968

[5] International Journal of ChemTech Research CODEN (USA) Removal Of Fluoride From Water And Waste Water By Using Low Cost Adsorbents N. Gandhi1*, D. Sirisha1, K.B. Chandra Shekar2 and Smita Asthana3, IJCRGG ISSN : 0974-4290 Vol.4, No.4, pp 1646-1653, Oct-Dec 2012

[6] Sandip Shukla (Head Research Incharge), The Central Water Commission Department (CWC), block 'c', third floor, seminary hills, Nagpur.

[7] Ganesh Singh Amar Singh Thakur (Junior Chemist), The Groundwater Survey And Development Agency (GSDA), Regional Water Testing Laboratory, Nagpur.

[8] L. Feenstra L. Vasak J. Griffioen, "Fluoride in groundwater: *Overview and evaluation of removal methods"* Utrecht September 2007, Report nr. SP 2007-1