



ELIMINATION OF IMPURITIES AND FLOURIDE BY NATURAL PROCESS (WATER PURIFIER)

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Abstract: Water the major natural resource on earth, Nowadays there are many reasons left for the contamination of water. According to the survey done by UNICEF states that abundance of contaminated water has a disastrous effect on Children. Excessive intake of fluoride (F), mainly through drinking water, is a serious health hazard affecting humans worldwide. There are several methods used for the defluoridation of drinking water. Fluoride in excess of the permissible limits in drinking water causes a number of endemic conditions referred to collectively as fluorosis. Endemic fluorosis remains a challenging national health problem in India. Telangana is the worst affected states in India though a wide range of chemical and physical defluoridation systems were evolved and tried. The primary reason for the diseases like fluorosis, paraplegia, arthritis and many other cardiovascular diseases in rural areas like Nalgonda a district in Telangana, INDIA is the high content of fluorine in their drinking water. For optimal dental health, the World Health Organization recommends a level of fluoride from 0.5 to 1.0 mg/L (milligrams per liter), depending on climate. Fluorosis becomes possible above this recommended dosage. Activated alumina, charcoal, sand defluoridation filter method can be used as it occupies less space, works automatically, can be used for large-scale purification and also consumes less energy.

Index Terms - Active charcoal, alumina, sand, filters, water purifier, impurities

I. INTRODUCTION

The Water is the fundamental component for the survival of man and is the key resource for every activity that a man has to face in his lifetime. And yet, 85% of the world population lives in the driest half of the planet. 783 million people do not have access to clean water due to lack of usable water resources and contamination of the available resources. Water that is supplied for public use, may it be potable or for domestic should essentially come from a pollution-free source. That is, the water should be harmless considering its chemical composition and the biological characteristics. Majority of the impure water resources can be made usable through the use of various filtration methods but due to lack of awareness among the public in rural areas, they still are subjects to these contaminated water. As of 2015, the United States Health and Human Services Department recommends a maximum of 0.7 milligrams of fluoride per liter of water – updating and replacing the previous recommended range of 0.7 to 1.2 milligrams issued in 1962. The new recommended level is intended to reduce the occurrence of dental fluorosis while maintaining water fluoridation.

IMPACTS ON HUMANS:

1. Consumption of fluoride at levels beyond those used in fluoridated water for a long period of time causes skeletal fluorosis skeletal fluorosis is endemic. It is known to cause irritable-bowel symptoms and joint pain.
2. Fluoride induced nephrotoxicity is kidney injury due to toxic levels of serum fluoride, commonly due to release of fluoride from fluorine-containing drugs, such as methoxyflurane.
3. The only generally accepted adverse effect of fluoride at levels used for water fluoridation is dental fluorosis, fluoridation to 1 mg/L is estimated to cause fluorosis
4. Fluoride's suppressive effect on the thyroid is more severe when iodine is deficient, and fluoride is associated with lower levels of iodine
5. Fluoride accumulates in the bone tissues of fish and in the exoskeleton of aquatic invertebrates. The mechanism of fluoride toxicity in aquatic organisms is believed to involve the action of fluoride ions as enzymatic poisons.
6. For optimal dental health, the World Health Organization recommends a level of fluoride from 0.5 to 1.0 mg/L (milligrams per litre).

FLOURIDE EFFECTED AREAS:

Fluoride problem in Batlapally, Vattapally villages. These three villages are 85km away from Hyderabad city and they (altogether) have a total population of 10,000 people out of which only 2000 people have access to safe water supply. Rest of them supplied with water pumped through panchayath bore wells and sometimes from the Krishna river water. Water samples from the above mentioned villages were collected by our team from various sources and the same were analyzed. The water samples were tested to contain excess amounts of Fluoride content up to 3.5mg/liter while the normal level of content is lesser than 1mg/liter. Interactions with people in the villages who were affected by fluorosis and other fluoride ailments gave us a clear understanding of their misfortune. This project is expected to bring the basic necessity of safe drinking water to the under privileged people of that region.

SOLUTION FOR THE PROBLEM:

Defluoridation is the downward adjustment of the level of fluoride in drinking water. Worldwide, fluoride is one of the most abundant anions present in groundwater. Fluoride is more present in groundwater than surface water mainly due to the leaching of minerals. Groundwater accounts for 98 percent of the earth's potable water. The World Health Organization has recommended a guideline value of 1.5 mg/L as the concentration above which cause dental fluorosis.

While various defluoridation techniques have been explored, each has its limitations. Existing techniques are often too costly (because the geographic areas prone to fluorosis are among the poorest regions on the planet), ineffective or even dangerous (some of the remediation processes add other contaminants to the water). The main techniques that have been, and continue to be, investigated with varying degrees of success include: adsorption, precipitation, ion exchange and membrane processes

II. FILTER MATERIALS AND METHOD

Activated alumina is one of the most widely used and liked defluoridation material currently available. Non regenerable and specialty alumina offer tremendous scope to defluoridate drinking water. Indian industries are manufacturing regenerable activated alumina for defluoridation of drinking water. In order to ensure application of an adsorbent, which caters the desired results with minimum interferences, health risks and long service life span, it is inevitable to draw out dimensions which define precisely the attributes of activated alumina. Specifications for activated alumina intended for defluoridation of drinking water, specific operating and performance requirements, and limitations

Activated carbon, also called activated charcoal, is a form of carbon processed to have small, low-volume pores that increase the surface area available for adsorption or chemical reaction. The use of special manufacturing techniques results in highly porous charcoals that have surface areas of 300-2,000 square meters per gram. These so-called active, or activated, charcoals are widely used to adsorb odorous or colored substances from gases or liquids. attaches to it by chemical attraction. The huge surface area of activated charcoal gives it countless bonding sites. When certain chemicals pass next to the carbon surface, they attach to the surface and are trapped. Activated charcoal is good at trapping other carbon-based impurities (organic chemicals), as well as things like chlorine. Many other chemicals are not attracted to carbon at all sodium, nitrates, etc. so they pass right through. This means that an activated charcoal filter will remove certain impurities while ignoring others. It also means that, once all of the bonding sites are filled, an activated charcoal filter stops working. At that point you must replace the filter.

Sand filters are used in water purification for treating raw water to produce a potable product. They are used primarily to treat surface water. The length and breadth of the tanks are determined by the flow rate desired by the filters, sand filters differ from all other filters used to treat drinking water in that they work by using a complex biological film that grows naturally on the surface of the sand. The sand itself does not perform any filtration function but simply acts as a substrate, unlike its counterparts for UV and pressurized treatments. sand filters work through the formation of a gelatinous layer (biofilm) called the hypogeal layer in the top few millimetres of the fine sand layer. The surface biofilm is the layer that provides the effective purification in potable water treatment, the underlying sand providing the support medium for this biological treatment layer. As water passes through the hypogeal layer, particles of foreign matter are trapped in the mucilaginous matrix and soluble organic material is adsorbed. The contaminants are metabolised by the bacteria, fungi and protozoa. The water produced from an exemplary slow sand filter is of excellent quality with 90–99% bacterial cell count reduction

Filter sheets are made of plastic material. Filter sheets placed between the layers of filter. They removes solid waste ,dust particles and other impurity particles. They are designed as net shaped structure to trap the impurity particles

Tab1. Materials

S.no	Material	Height (mm)
1	Charcoal	30
2	Aluminium balls	80
3	Sand	10
4	filters	5

FILTER DESIGN AND WORKING:

In this design, materials are arranged in the form of layers. These layers are arranged as follows : Activated alumina, Activated charcoal and Sand respectively. Filter covers or sheets are used in between these layers. These all layers are arranged in plastic bottle (proto type). In filter design, Aluminium balls are placed as top layer and pure sand as the bottom layer



Fig.1 Filters (proto type) front view



Fig.2 Filter layers



Fig.3 Filter bottom side (Exit)



Fig.4 Filter upper side (Entry)

Hard or fluoride water poured from the top side of the filter. Water passes through plastic filter sheets, which remove the solid waste particles and dust particles from the water content. Water enters into the activated alumina layer, where sodium, magnesium, fluoride, etc. salts and carbides are absorbed and filtered into activated charcoal. Filter sheets are placed at each layer exit. In activated charcoal, the organic compounds are absorbed or stacked. Activated charcoal is good at trapping other carbon-based impurities as well as things like chlorine. Many other chemicals are not attracted to carbon at all, sodium, nitrates, etc., so they pass right through. Finally, the water enters into the sand layer where some minerals are added and bacteria, algae, and living organisms are removed, and water is collected from the exit of the filter.

III. RESULTS AND DISCUSSIONS

To affirm the quality of water, our team collected different water samples like municipal water, bore water used for drinking purposes from these villages. The main source of water for these villages is from the gram panchayath bore, hand pumps, and Krishna water. The majority of the population in these villages prefer to drink gram panchayath water, which is highly fluorinated. After meeting people suffering from fluorosis, we managed to collect useful information from them, and they have shared information regarding the quality of water.


Water Quality Laboratory The Institute of Health Systems			
HACA Bhavan, Hyderabad, TS 500004, India. E-mail: ihs@ihs.org.in Tel: 91(40) 23210135/9; 23211013/4; Fax: 91(40) 23241567; http://www.ihs.org.in			
Water Analysis Report			
Bottle Id: CB699	Receive Date: 26-08-2015, 4:30 pm	Report Date: 27-08-2015	
Place of Sample & Description : Collected directly from hand pump on borewell of Source as in WCR + Clarification Over Tel, if any.			
Sample Collection Date (as in WCR)	: 26-08-2015, 12:00 pm	Requested Testing Service & Code	: Fluoride in Water Analysis (FLD)
Sample Collected by (as in WCR)	: Mohd Kareem - 8977628611		
Test Requested by (as in TRL/Receipt)	: Mohd Kareem - 8977628611		
Client concerns	: Project purpose		
A. Chemical Characteristics:			
0 Fluoride	: 3	mg/l	1 1.5
B. Notes and Recommendations:			
1. Fluoride level is in excess of the maximum permissible limit. Long term and regular use of this water for drinking purposes carries risk of irreversible dental fluorosis.			
2. Not fit for drinking.			
 Director			

Fig.5 WATER ANALYSIS REPORTS BEFORE TESTING

Water collected from the villages were tested at the Water Quality Laboratory (The Institute of Health Systems) Hyderabad, and we found that water contains 3 mg/L of fluoride. The water has other impurities like sodium, magnesium salts, nitrates, etc., which is not used for daily use.

Recommendations given the laboratory:

1. Fluoride level an excess of the maximum permissible limit. Long term and regular use of this water for drinking purpose carries risk of irreversible dental flurosis.
2. Not fit for drinking
3. Fluoride contain level increases in the body which leads to other problems in the human health system.

VISON LABS
Environmental Consultants & Analytical Services
Recognized by NABL, MADEE-4401,
ISO : 9001:2008, OHSA : 18001:2007 &
MOEF, S.O. 1680(6), valid upto 01/07/2019

WATER ANALYSIS REPORT

Issued to:
**M/s. M.J. Engineering Collage,
Banjara Hills, Hyderabad.
C/o. Mr. MD. Kareem.**

Date: 28.08.2015
Our ref No: VL/W/1308031281626
Your ref No: Verbal
Date: 26.08.2015

Sample Particulars: **Bore Well Water.**
Sample Collection Date: 26.08.2015
Sample Tested as Received basis.

S. No	Parameters	Units of Measurement	Test Method	Test Results	Drinking Water Limits As per IS: 10000-2012	
					Desirable Limits	Permissible limit in absence of alternative source
PHYSICAL EXAMINATION						
1	pH at 25°C		IS: 1022 Part 11 1983	7.88	6.5 to 8.5	6.5 to 8.5
2	Conductivity at 25°C	µmhos/cm	IS: 1022 Part 14 1984	282		500 (resistivity)
3	Total Dissolved Solids	mg/l	IS: 1022 Part 16 1984	343	500 max	5000 max
4	Turbidity	NTU	IS: 1022 Part 18 1984	1.48	1 max	5 max
5	Colour	Hazen	IS: 1022 Part 4 1983	<0.1	5 max	15 max
CHEMICAL EXAMINATION						
6	Total Hardness as CaCO ₃	mg/L	IS: 1022 Part 21 1984	379	200 max	500 max
7	Alkalinity - Phenolphthalein	mg/L	IS: 1022 Part 22 1984	Nil		
8	Alkalinity - Methyl Orange	mg/L	IS: 1022 Part 23 1984	330	200 max	500 max
9	Calcium as Ca	mg/L	IS: 1022 Part 40 1991	64	75 max	200 max
10	Magnesium as Mg	mg/L	IS: 1022 Part 46 1994	26.4	30 max	100 max
11	Non - Carbonate Hardness	mg/L	IS: 1022 Part 51 1993	Nil		
12	Chloride as Cl	mg/L	IS: 1022 Part 32 1984	45	250 max	1000 max
13	Sulfate as SO ₄	mg/L	IS: 1022 Part 45 1993	75.5		
14	Nitrate as N	mg/L	IS: 1022 Part 43 1993	3		
15	Sulfate as SO ₄	mg/L	IS: 1022 Part 24 1984	18.0	200 max	500 max
16	Nitrate as NO ₃	mg/L	IS: 1022 Part 34 1984	4.4	45 max	100 max
17	Silica as SiO ₂	mg/L	IS: 1022 Part 33 1984	3.2	15 max	Not regulation
18	Iron as Fe	mg/L	IS: 1022 Part 33 2003	0.08	0.3 max	Not regulation
19	Fluoride as F	mg/L	IS: 1022 Part 60 2006	0.80	1.5 max	1.5 max

NOTE:
1. Sampling & Analysis were done as per standard methods prescribed by IS.

Fig.6 WATER ANALYSIS REPORT AFTER FILTERIZATION

After filterization process the impurities in the water are removed. The levels of the impurities are decreased to certain level which is suitable for daily usage. The fluoride contains in the water decreases to 0.7 mg/L and it doesn't leads to any health issues. Other impurities like nitrates, salts, carbides are also removed in the process of filterization.

Advantages of Deflouridation model:

1. This process of filterization simple and easy.
2. The capital cost and operating cost of the plant is less.
3. Maintains is not required any skilled person and power consumption also less
4. Needs minimum of mechanical and electrical equipment.
5. No energy except muscle power for domestic equipment.
6. Provides defluoridated water of uniform acceptable quality.
7. Local skills could be readily employed. Readily available chemicals used in conventional municipal water treatment are only required.
8. Highly efficient removal of fluorides from 1.5 to 10 mg/L to desirable levels.

Tab2. Parameters of water

Sl.no	Parameters	Before Filterization	After Filterization
1	PH	8.56	7.84
2	FLOURIDE	3 mg/L	1.42 mg/L
3	CALCIUM	86	64
4	MAGNISIUUM	32	26.4

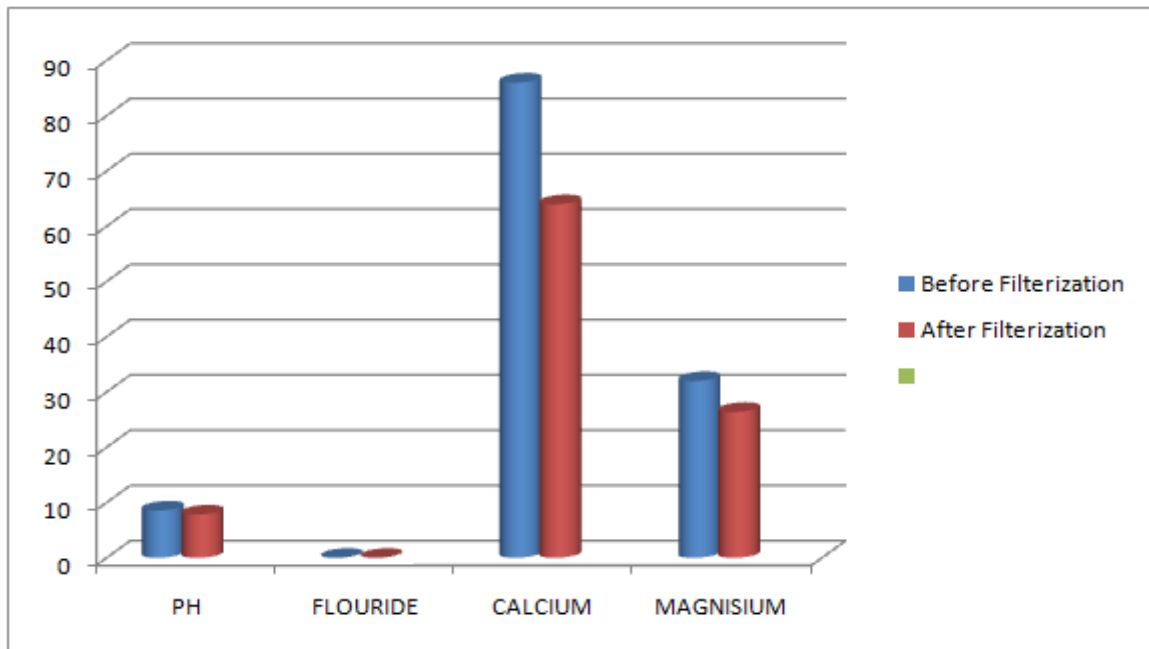


Fig 7. Before filterization vs After filterization

III. Conclusion

The fluoride contains in the water is excess which is not fit for the drinking purpose and daily usage. After filter process the excess amount fluoride and other impurities are reduced to certain level and it is used for daily usage. In this process the filterization of water is simple and maintains is easy.

REFERENCES:

- 1] www.pottersforpeace.org
- 2] www.unicef.org
- 3] Ole Fejerskov, Jan Ekstrand, Brian A. Burt. Fluoride in Dentistry. 2nd ed; Munksgaard: John Wiley & Sons, Limited; 1996. p.167.
- 4] Aloyce Menda, Tanzania: Challenges and successes of water defluoridation, Science in Africa, August 2004. Available from: URL: <http://www.scienceinafrica.co.za/2004/july/fluoride.htm>
- 5] Fluoride in water: An overview, Unicef. (Accessed on 29-09-2007). Available from: URL: <http://www.unicef.org/programme/wes/info/fluor.htm>.
- 6] S. Kumar and K. Gopal. A Review on Fluorosis and its Preventive Strategies. Indian J. Environmental Protection. June 2000;20(6):430-6.
- 7] Wang Hongtao, JiJunfeng, Chen Jun. Defluoridation of drinking water with hydrotalcite-like compounds. Denver Annual Meeting of The Geological Society of America (GSA), Oct 27-30, 2002. Available from: URL: <http://gsa.confex.com/gsa/2002AM/finalprogram/index.html>. Accessed on 29