



## **An Investigation Of Fluoride Distribution In Nawa- Makrana Zone Of Nagaur District, Central Rajasthan, India And Defluoridation Of Water From Plant Material.**

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### **Abstract**

This work was carried on to evaluate fluoride contamination in ground water of the medial part of Nagaur district where ground water is the main source of drinking as well as irrigation. The current work involves assessment of water quality with special source to fluoride in nawa- makrana zone of Nagaur district. Fluoride concentration of groundwater samples from thirty one villages of nawa- kuchaman Zone was took over and 10 villages were set up to have a fluoride attention above 1.5 mg/ l. The logical results show that ten ground water samples are unable for drinking purpose. A map has been prepared which shows the fluoride concentration in the study region. The outward attention was marked in the Piprali village (5.8 mg/ l) while the minimum was set up in Bawali guta (0.3 mg/ l). Water samples holding high fluoride situations were defluoridated with low- cost paraphernalia prepared from plant by products. These paraphernalia successfully drop the fluoride ions attention to an esteemed limit ( from 0.5 to 1.5 mg/ L) without transferring drinking water quality standards.

**Keywords:** Fluoride, Groundwater, Central Part, Nagaur, Rajasthan , defluoridation, plant by products, carbon adsorbents.

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### **Introduction**

It is well established that India has two fine public- health problems convinced by application of groundwater as a origin of drinking water having extra fluoride and arsenic. Fluoride ranks 17th in cornucopia of rudiments in the earth's crust, characterizing 0.06 – 0.09 of the earth's crust. ( 1) Fluoride is one of the major life rudiments. It's needful for normal mineralization of bones and conformation of dental enamel. ( 2) When fluoride is held additional than the admissible limit, it becomes poisonous and would beget colored metabolic upsets in creatures and mortal being including dental and cadaverous fluorosis. ( 3- 6) Water is very vigorous in nature and can be a restricting resource for men and other living

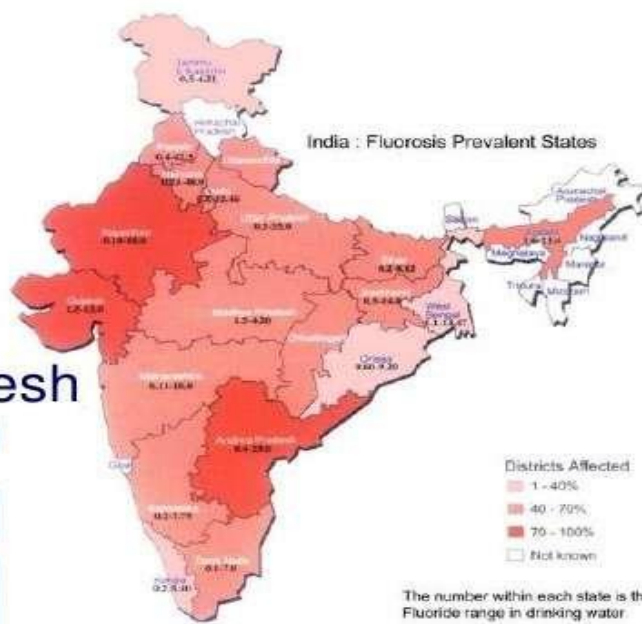
beings. Without a well running water force, it's delicate to imagine a productive mortal exertion be it agriculture or beast. The class of water is of nearly significance of volume in any water force planning. Water quality is told by natural and anthropogenic goods carrying regional climate, geology and irrigation practices. In the world, around 200 million people from 25 nations have lesser health risks, with high fluoride in the drinking water( 7). various employees in our country have carried out deep studies on water quality with reference to the fluoride attention( 8- 10). In India, the inordinate presence of fluorides in groundwater is present in nearly 177 sections covering 19 countries. It appears that high- well-conditioned fluoride may live in numerous further sections( 11).



## Fluoride Contamination -India

### Most Affected:

- Rajasthan
- Gujarat
- Andhra Pradesh



Source of Information: 1) UNICEF State of Art Report, 1999  
2) FR & RDF data bank

Rajasthan is the largest state of India( 342 239 km<sup>2</sup> wide) with a fairly low population density of 165 people/ km<sup>2</sup>. According to physiography divisions, the northern and western part of the state is under The Great Plain of North India while southern and middle as well as eastern corridor are categorized under the Peninsular Plateau.( 12) Rajasthan is unique, as all its 32 sections have had variable fluoride impurity in groundwater. Most of the fluoride- communed groundwater studies in Rajasthan have been concentrated on the western and southern corridor of the state, which are conventionally described as “ high fluoride ” areas.( 13) Review of the literature displayed that no studies have so far been accepted in the study zone with respect to fluoride and fluorosis. thus, this study was to conducted to measure the fluoride attention in drinking water( underground water). Civilians- grounded inverse distance weighting spatial interpolation fashion for fluoride distribution in south west part of Nagaur quarter. Several styles are in vogue to remove fluoride from drinking water. These includes use of alumina, bone housekeeper, factory by products, ion exchange resins and rear osmosis, but the literature check easily indicates the accoutrements used in the current studied not told any where. There are number of possible ways for

defluoridation of drinking water, but they're economically rich and non-applicability on mass scale. The current study presents the use and connection of adsorbent carbon accoutrements prepared from the dry fruits of various factory accoutrements and the attained results were compared with the commercially actuated carbon (CAC). In India, secure limit of fluoride in potable water is between 0.6 and 1.2 mg/l (14). Lower limit of fluoride (1.2 mg/l) than those of the recommended limit (1.2 mg/l) results in fluorosis. In the state, Thar Desert occupies about 61 of the total area. Groundwater is a major source for drinking and domestic and irrigation purpose (15). Nagaur District is located at latitude 26 °25' to 27 °40' N and longitude 73 °18' to 75 °15' E. Its moderate elevation is around 300 m, ranging below 250 m in the south and 640 m in the north. There are 1396 habitations in the quarter. The main lithological units include gneisses, schists, purposefulness, quartzites, phyllites, and limestones belonging to the Bhilwara and Delhi Supergroup of jewels of Archaean and Proterozoic periods, independently. Although groundwater occurs substantially under water table condition in all the conformations, the quaternary topsoil forms well-founded aquifers in Nagaur District. In the hard gemstone terrain, the circumstance and movement of groundwater are controlled by secondary porosity matching as fractures, crevices, joints, foliation, etc. A bibliographic check has also shown that no studies have been accepted in the quarter for assessment of the F – attention in its groundwater. This study was, thus, accepted to probe the quality of underground drinking water of the central part of Nagaur quarter of Rajasthan, India in respect of F – attention. Fluoride Content in obtainable Drinking water in sections of Rajdsthan There are multitudinous reports of fluoride content in drinking as per the checks handled in various sections of Rajasthan piecemeal from recently formed sections of Pratapgarh data from all the sections are available and being presented then in the table no. 1.

Table no. 1: Fluoride content in drinking water sources in different districts of Rajasthan

S No.	District	F-content groundwater	Reference
1.	Ajmer	0.1-12 0.25-16.9	Madhavan and Subramanian' 2003 Vikas et al 2009
2.	Alwar	1.5-9.9 2.22-7.62	Agrawal et al.1997 Sharma et al 2012
3.	Banswara	1.2-4.6	Choubisa 2001
4.	Baran	0.2-1.2	Seth et al 2005
5.	Barmer	0-10+	Ozha et al 2003
6.	Bharatpur	1.5-4.9	Agrawal et al. 1997
7.	Bhilwara	0.4-13	Hussain et al 1010
8.	Bikaner	1.5-9.9	Agrawal et al- 1997
9.	Bundi	0.0-5.0	Seth et al 2005
10	Chittorgarh	0.0-6.0	Seth et al 2005
11.	Churu	0.0-6.5	Seth et al 2005
12.	Dausa	1.5-9.9	Agrawal et al.1997
13.	Dholpur	1.5-4.9	Agrawal et al.1997
14.	Dungarpur	1.5-4.9 0.1-10 1.1-4.1 1.4—6.0	Agrawal et al.1997 Madhavan and Subram aniai 2004 Choubisa 200 Ayoob and Gupta 2006

15.	Hanumangarh	1.01-4.78 0.5-8.5	Suthar et al 2008 Chaudhary et al 2008
16.	Jaipur	1.5-10+ 4.5-28.1	Agrawal et al.1997 Madhavan and Subramanian 2004
17.	Jaisalmer	3.0-10+ 0.2-4.6	Agrawal et al. 1997 Madhavan and Subramanian 2004
18.	Jalor	1.5-10+	Agrawal et al. 1997
19.	Jhalawar	0.0-1.2	Seth et al 2005
20.	Jhunjhunu	0.6-8.8	Seth et al 2005
21.	Jodhpur	0.4-6.5	Seth et al 2005
22.	Karauli	0.5-4.5	Seth et al 2005
23.	Kota	1.2-4.8	Seth et al 2005
24.	Nagaur	1.5-10+ 0.0-10+ 1.1-14.62	Agrawal et al.1997 Ozha et al2003 Gautam et al2011
25.	Pali	Upto10+ 5.6 0.0-10+	Agrawal et al. 1997 Madhavan and Subramanian 2004 Ozha et al2003
26.	Pratapgarh		
27.	Raisamand	0.0-4.5	Seth et al 2005
28.	Sawai Madhopur	1.5-10+	Agrawal et al.1997
29.	Sikar	1.5-10+	Agrawal et al.1997
30.	Sirohi	1.5-9.9 <1.0-16.0	Agrawal et al.1997 Madhavan and Subramanian 2004 Maithani et al. 1998
31.	Sri Ganganaga	0.5-5.0	Chaudharv et al 2008
32.	Tonk	0.5-12.4 0.5-10.7 1.5-11.82	Seth et al 2005 Yadav and Khan, 2010 Bhargava and Bhardwaj, 2009
33.	Udaipur	0.1-11.7 0.2-4.7	Madhavan and Subramanian 2004 Choubisa 2001

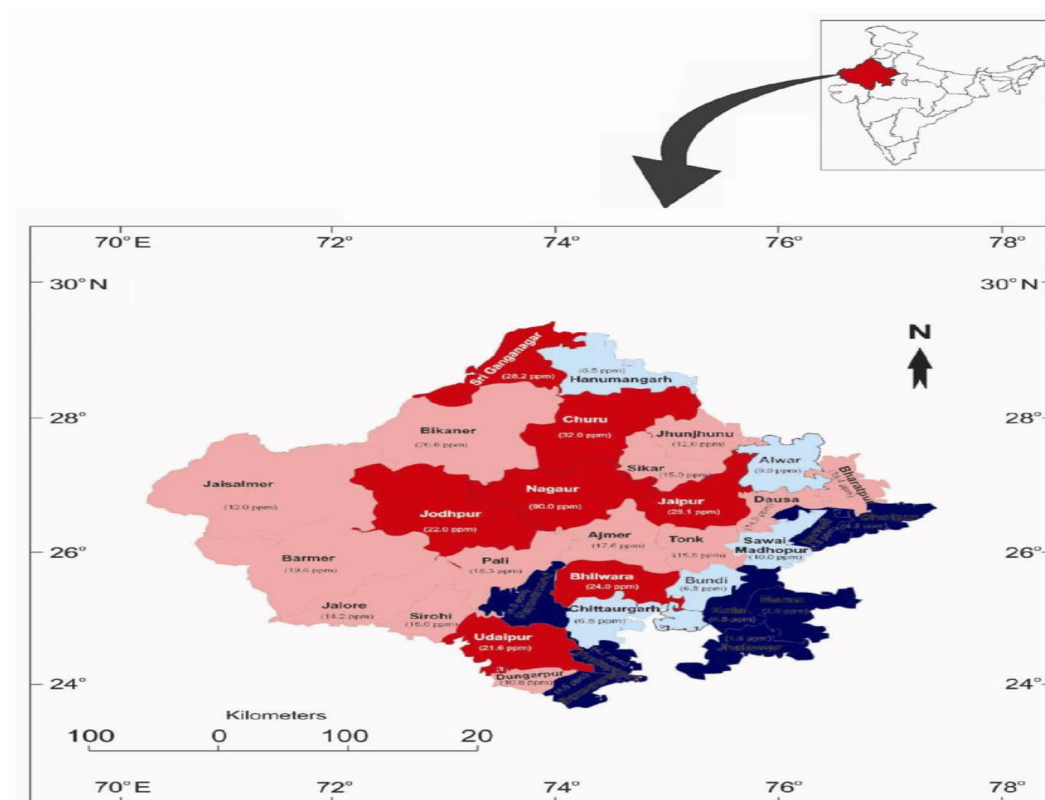
It is apparent that while the WHO waters in various villages of selected pockets standards and BIS: 1 0500 -19912(1983) permit only 1.5 mg/l as a safe limit of fluoride in drinking water for human consumption. People in several Districts in Rajasthan are consuming water with fluoride concentrations of up to 24 mg/l.

**Objective:**

- A study of fluoride distribution in Rajasthan.
- To study the fluoride concentration in groundwater in Nawa- Makrana zone of Nagaur district, Central Rajasthan, India.
- To study of defluoridation of water from plant material .

## Study Area:

The nagour district is located between Latitude 26°25' and 27°40' and longitude 73°18 and 75°15 E, because of its central situation in Rajasthan, it shares its border with several other district of the state. The total geographical area of , the district is 17718 sq. km. The study area nawa located between Latitude 27°1' and 34°15 N and longitude 75°0' east.and makrana is located between latitude 27°01' to 46°62' N and longitude 74°71' to 58°76' E .(15)



## Material and Method

### Water Sample Collection

Groundwater samplings of thirty one townlets located in nawa- makrana division of Nagaur district were collected in pre cleaned polythene bottles with required preventives. The samples were contained, in year 2022, from manually operated public hand pumps and public walls in household points of residencies.

### Methodology

The fluoride attention in water was determined electrochemically, operating fluoride ion choosy electrode( 16). This technique is applicable to the dimension of fluoride in drinking water in the attention range of 0.01- 1000 mg/ l. The electrode used to be an Orion fluoride electrode, coupled to an Orion electrometer. norms fluoride results(0.1- 10 mg/ l) were prepared from a stock result( 100 mg/ l) of sodium fluoride. As per experimental demand, 1 ml of total ionic strength conforming buffer grade III( TISAB III) was added in 10 ml of sample. The ion meter was calibrated for a slop of  $-59.2 \pm 2$ . The composition of TISAB result was 385.4 g ammonium acetate, 17.3 g of cyclohexylene diamine tetraacetic

acid, and 234 ml of concentrate hydrochloric acid per liter. All the tests were carried out in triplet and the results were set up reproducible with  $\pm 2$  error.

### **Preparation of TISAB- III**

Take 250 ml de-ionized water and add 234 ml of concentrated hydrochloric acid. Add 385.4 gm of Ammonium acetate. Add 17.3 gm of 1, 2- cyclohexylene- diaminetetraacetic( CDTA). Stir to dissolve and refrigerate at room temperature. form it up to 1000 ml.

### **Procedure**

- 1) measurement of instrument ready a series of standards over the suitable attention range (0.1 mg/ l, 1.0 mg/ l and 10.0 mg/ l) Calibrate the instrument to gain  $-59.2 \pm 2$  mv slop.
- 2) hold 10 ml sample add 1 ml of TISAB III and measure fluoride attention.

### **Spatial Distribution of Fluoride Using Inverse Distance Weighted Method**

Geographic Information System( Civilian) is a self-operating data predicated system for prisoner, warehouse, reclamation, analysis and show of spatial data. Civilian is a common aspiration technology for handling geographic data in digital form, and satisfying the following specific requirements, among others. The Inverse distance ladened( IDW) interpolation explicitly implements the supposition that effects that are close to one another are more likewise than those that are further piecemeal. To read a value for any unmeasured position, IDW uses the measured values girding the vaticination position. The measured values closest to the vaticination position have further influence on the prognosticated value than those further down. IDW assumes that each measured point has a domestic influence that diminishes with distance. It gives lesser weights to points closest to the vaticination position, and the weights deplete as a function of distance, hence the name Inverse distance ladened.

Defluoridating accoutrements were prepared from the dry fruits, collected from the factories Enterolobium saman( ESC), Acasia arabica( AAC), Prosopis juliflora( PJC) belongs to Mimosideae family and Citrus limon( CLC) belongs to Rutaceae family in the factory area. These accoutrements are available as agrarian wastes and carbonized at 400 °C to 500 oC in muffle furnace. The set imitations were chemically acted with 0.5 M HNO<sub>3</sub> result and also washed with distilled water and eventually settled in to 75 µm patches size. CAC was used to analogize with other material and the procedure to set CAC was below 0.5 g of adsorbent carbon was mixed with 100 ml of water samples and stirred at 100 rounds/ nanosecond speed on Remi shaker for 30 twinkles. result was filtered through Whatman no 42 sludge paper and the filtrate were queried for farther ion choosy electrode. Experimental conditions were attained with the below set carbon adsorbents in batch mode study as 40 twinkles agitation time, 5 g/ L adsorbent attention; optimum pH range is 6.9-9.0. The same conditions were referred in defluoridation of drinking water samples in batch mode study. For water samples, which contain fluoride range between 3.0 and 6.0 mg/ L, the cure of adsorbent is 5 g/ L and for those water samples, which hold fluoride, classifying from 1.5 to 3.0 mg/ L, the cure adsorbent is 4.0 g/L. Ground water is the only source of drinkable water for maturity of people in the study area. still, the occupants then are moderate to drink drag well water or water from open water system. They say that water drawn from great depths isn't flavorful, hence their preference to uncloset well water or hand pump water. A check of residers of the named townlets in the study area on the impact of water used for drinking on health of the druggies revealed that, utmost of the residers suffer from dental abrasion, early tooth decay and bone distortions. The rehearsing croakers of the study area also verified our compliances.

## Results and Discussion

Fluoride attention in groundwater of 31 habitations of Nawa- makrana zone was examined. All the habitations were distributed according to following attention range( Table 1)

- order I — Fluoride attention below 1.0 mg/ l;
- order II — Fluoride attention between 1.0 and 1.5 mg/ l;
- order III — Fluoride attention between 1.5 and 3.0 mg/ l;
- order IV — Fluoride attention between 3.0 and 5.0 mg/ l; and
- order V — Fluoride attention above 5.0 mg/l.

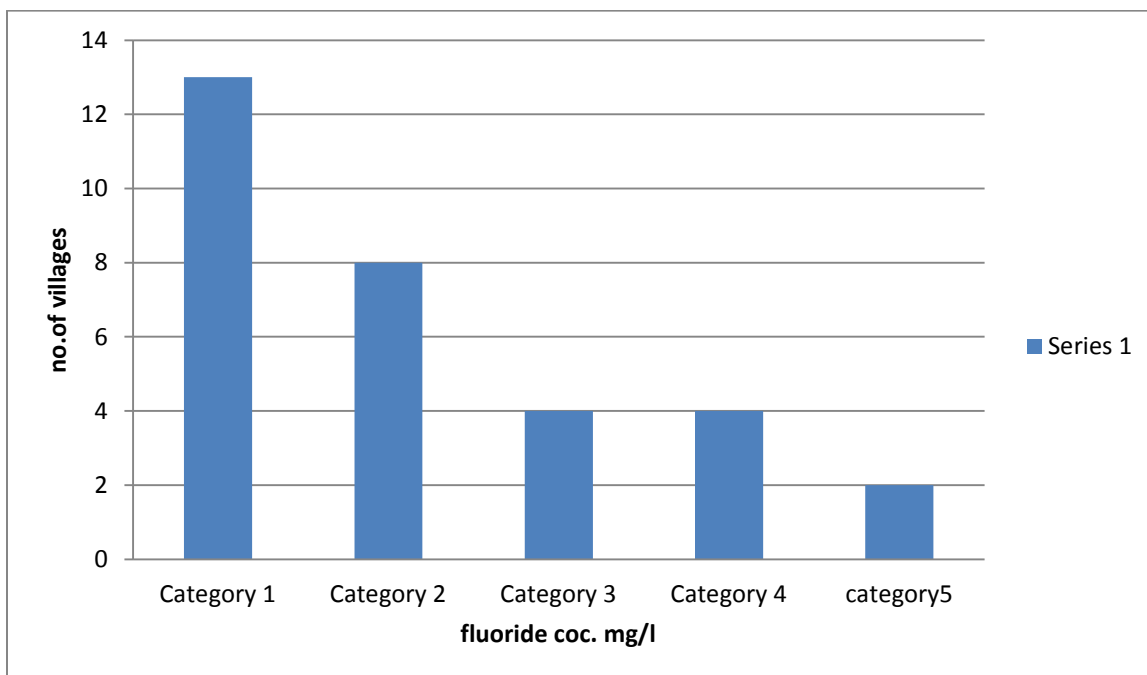
The distribution of fluoride in the groundwater of Nawa- makrana zone is shown in Figure 1. Fluoride attention ranges from 0.3 to 5.8 mg/ l. The minimum attention was recorded in the Bawali guta vill while maximum attention was recorded from Piprali vill (5.8 mg/ l). It's clear that the maximum townlets belong to the attention of below 1.0 mg/L. a maximum desirable limit of norms for drinking water recommended by WHO. There's no possibility of fluorosis in these habitations because this attention of fluoride is salutary for calcification of dental enamel especially for children below 10 times of age.. Out of 31 habitations of Nawa- makrana zone, 8 habitations ( 25%) have fluoride attention between 1.0 and 1.5 mg/ l and fall in order II. The maximum admissible limit of fluoride in standard for drinking water is 1.5 mg/ l WHO. In 25% population of these habitations, fluoride input through drinking water is further than 4 mg/ day in an existent. thus, an prevalence of first and alternate degree dental fluorosis is possible in original residents of these habitations. About 12% of the population of 4 habitations ( 12%) consumes water with fluoride attention between 1.5 and 3.0 mg/ l, which is above the maximum admissible limit as recommended by WHO. thus, dental fluorosis is common in these habitations. At this attention, the teeth lose their candescent appearance and chalky black, argentine, or white patches develop known as mottled enamel. In four habitations ( 12%), fluoride attention in groundwater is above 3.0 mg/ l and below 5.0 mg/ l, and this fall in order IV. The input of fluoride per day by an grown-up in these habitations is veritably high. About 6 population of these habitations may have all degrees of dental fluorosis ( mild, moderate, relatively severe, and severe fluorosis) including cadaverous fluorosis after 30 times of age. still, the probability of alternate stage cadaverous fluorosis age may be more common after the age of 45 ( 17%). In the entire check, Piprali and sirsi was vill that falls in order V, which contributes 1 population of Nawa zone. In this vill, fluoride attention is above 5.0 mg/ l, which may affect in all types of fluorosis among occupants. In the alternate clinical stage, the affected persons may have pain in bones, which causes further calcification in ligaments. A detailed check of health hazards particularly fluorosis- convinced symptoms and empirical data on affected population are needed in Nawa.

**Fluoride categorization of villages of Nawa and makrana tehsil**

Order I (Below 1.0 mg/l)	Order II (Between 1.0 and 1.5 mg/l)	Order III (Between 1.5 and 3.0 mg/l )	Order IV (Between 3.0 and 5.0 mg/l)	Order V (Above 5.0 mg/l)
Adaksar 0.8	Panchota 1.3	Kooni 2.3	Prempura 3.0	sirsi 5.6
Muwana 0.4	Bhatipura 1.1	Mindha 1.6	Padampura 4.0	Piprali 5.8
Jeenwar 0.9	Kasari 1.2	Joosri 2.4	Nimbani 3.3	

Ulana 0.5	Lalas 1.3	Khardiya 2.2	Raithaliya 4.1	
Nalot 0.8	Parewadi 1.4			
Chitawa 0.8	Githala 1.3			
Kukanwali 0.9	Laroli 1.1			
Nagwara 0.8	Indokha 1.3			
Maroth 0.7				
Bawali 0.3	guta			
Bajoli 0.8				
Barwala 0.5				
Devangar 0.8				

**Categorization of villages as per their fluoride concentration range.**





Fluoride when consumed or inhaled in excess (more than 1 ppm) can cause several health problems. It affects young and old alike

: Relation between concentration of fluorides and biological effects [18]

Concentration of fluoride in mg/l	Medium	Effect
0.002	Air	Injury to vegetation
1	Water	Dental carries reduce
2 or more	Water	Mottled enamel
8	Water	100% osteosclerosis
50	Foods and water	Thyroid changes
100	Foods and water	Growth retardation
120	Foods and water	Kidney changes

### Defluoridation studies of potable water samples

Water samples collected from various townlets of nawa and makrana tahsil( Tables 1 and 2) indicate that 8 samples from hand pump, 18 samples from bore well water and 4 samples from open well-conditioned water contain excess of fluoride beyond the admissible world health association limit 1.5 mg/ L( WHO, 1996). Hence the defluoridation studies have been carried out on these particular samples using set memoir adsorbents from ESC, AAC, PJC and CLC. The optimum contact time is 40 minutes with constant shifting at 200 rpm speed. The attention of fluoride ion in these samples after defluoridation have also been reported in the same tables. A relative study of the results of some physico- chemical analysis of water from drag well, hand pump and open well before defluoridation and after defluoridation, indicate that water quality parameters like pH, EC, TDS, PO<sub>4</sub><sup>3-</sup>, SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, Ketc. values were increased slightly, but negligible in numerous water samples when the adsorbents ESC, AAC, PJC, CLC and CAC are used for the Defluoridation process. Among the adsorbents, ESC, AAC and PJC drop the fluoride content in drinkable water samples to a considerable extent without affecting the admissible limits of other water quality parameters. The order of adsorption capacity in the junking of fluoride by these adsorbents is ESC> AAC> PJC> CLC> CAC.

### Conclusions

The lack of resources and low- cost effective technology respectable to the affected populations circumscribe the development of an effective fluoride and fluorosis control and forestallment program in developing countries. Construction of piped networks for the purpose of drinkable water. It's suggested that the sources of external water force must be established in a region where acceptable situations of fluoride have been observed. The dilution of high fluoride water with rainwater will make small quantum of rainwater to last long. A public health programme should be designed by taking into account all the fluoride sources, including salutory fluoride. The low cost adsorbents ESC, AAC and PJC remove fluoride content from drinkable water to a larger extent compared with the other adsorbent CLC. Hence the adsorbents ESC, AAC and PJC can be used for the defluoridation of drinkable water at house hold position. Eventually the results also suggest that the area is completely defiled with fluoride and not suitable for drinking purpose and proper care must be taken by the people.

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