

# **Correlation of Fluoride Concentrations with Time through Geochemical Evolution in the Surface and Ground Waters of Ibrahimpatnam Mandal, Ranga Reddy District, Telangana State (India) - A State Of Art**



**T.Sanjeeva Kumar**

**Asst Professor, Dept of Civil,  
Institute of Aeronautical Engineering and Technology,  
Dundigal, Hyderabad.**

## **Abstract:**

Presence of Fluoride, both in the surface and ground waters, has become a strong subject for the researchers, since the problem has not shown any conclusive results as to how it could be completely eliminated such that the users could be protected against the hazards leading to bone, dental fluorosis issues. The parts of Telangana state in India have become more vulnerable for higher fluoride concentrations thus affecting the health of the inhabitants. Of such fluoride affected areas of the state, the district Ranga Reddy is the one, wherein the present studies have been focused. In this research activity, an attempt is made to correlate the fluoride concentrations with the time by means of subjecting the surface and ground water samples for geochemical analysis for the purpose water samples was carried in two phases i.e. in and post monsoon periods (December, 2014 and April 2015 respectively). A total number of seven water samples are analyzed by adopting the methods given in BIS 10500, 1983 (year). The results indicate that there is an increase in the fluoride concentrations in the post monsoon (from 0.01 ppm to 0.06 ppm in the surface waters and from 0.805 ppm to 0.940 ppm in the ground waters) is attributed to evaporation losses and also to ground water withdrawals, the which necessitated a time to act upon. This paper describes the analysis and the results obtained these to arrive at the role of time factor, in specific.

## **INTRODUCTION:**

The present concern of the research work is about the excessive Fluoride in surface and ground waters since excessive consumption of fluoride over a lifetime may lead to increased likelihood of bone fractures in adults, and may result in effects on bone leading to pain and tenderness, besides developing pits in the tooth enamel, particularly in children. Keeping this in view, in 1974 "Safe Drinking Water Act" has become in force so that the level of contaminants in drinking water at which no adverse health effects are likely to occur could be determined before the use of water. Such health hazards are very common in parts of Telangana state in India. Hence an attempt is made in the present research programme by choosing Ibrahimpatnam mandal of the district, which is prone for fluoride occurrence in water. Accordingly, the fluoride levels that are in amounts, greater than the drinking water standard set by World Health Organization (WHO), are found through geochemical evaluations by adopting methodologies set in Bureau of Indian Standards (BIS), 1983. Of the several water parameters obtained, only the concentration of fluoride is accounted in this work and the rest have been reported for reference purpose. While comparing the fluoride levels with time and to draw the conclusive inferences, the data provided in one of publications made by the author (Ref ISSN NO: 2348-4845) is also used water samples was carried in two phases i.e. in and post monsoon periods (December, 2014 and April 2015 respectively).

The results thus obtained indicate that there is an increase in the fluoride concentrations in the time period between December 2014 and April 2015. The raise in the concentrations from 0.01 ppm to 0.03 ppm in the surface waters and from 0.805 ppm to 0.940 ppm in the ground waters at two locations is attributed to evaporation losses and also to ground water withdrawals. Though most water supplies contain some naturally occurring fluoride, it even enters drinking water in discharge from fertilizer or aluminum factories. As there are agricultural fields in the surroundings of sampled locations there is every need to look for appropriate fluoride treatment method(s) that have been proven to be effective for removing fluoride to below 4.0 mg/L or 4.0 ppm: distillation or reverse osmosis. The papers describes various methods adopted in water sampling, data acquisition, methods adopted in data analysis, data interpretation and the results thereof along with remedial measures thereto.

#### LOCATION:

The area is located between 17°10'17" N and 78°62'93" E of Survey of India Toposheet No.56k (plate-1). The area under study in this geographical location encompasses two villages namely (1) Ibrahimpatnam and (2) Sheriguda.

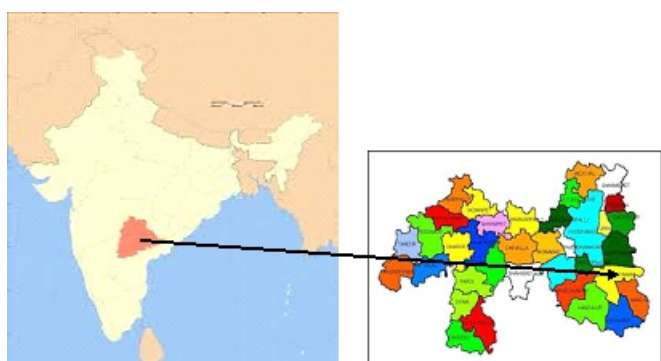


Plate.1 Location Map of Study Area

#### Hydro geology :

Hydrogeological studies are necessiated to understand how water interacts with geological systems and where it is and how it moves under the ground such that the results pertaining to fluoride levels could be ascertained more appropriately in the selercted area. Ground water occurrenc in the area takes place in the weathered, fractured, jointed and fissured granite rocks since these rocks are basically poor aquifers and hence lack primary porosity.

In summer season (i.e. March to May) there will not be monsoon effect and in this pre-monsoon period there will not be a scope for grondwater recharge through precipitation and hence the watertable will be at depleting stage. However, the onset of monsoon season, which persists from June to October, allows good groundwater recharge. But in post-monsoon period (i.e. from November to February), there will be more ground water withdrawals than its recharge. Thus there will be fluctuations in the water table seasonally and also on the rainfall intensity.

The investigations carried on the above context indicate that The area is underlain by granites of Archean age, intruded by dolerite dykes of later ages. These are poor aquifers primarily. However, the secondary porosity is developed by virtue weathering, fracturing and jointing. Groundwater occurs under water table conditions in the weathered portions of the rock and in confined conditions in the deep fractured/ jointed portions of this rock. The depth of dug wells varies from 10.3 m to 14.8 m bgl. and depth to water table varies from 8.1 m to 12.2 m bgl.

The depth to bore wells ranges from 50 m to 100 m bgl. The depth at which water struck in the fractured/ jointed rocks varies from 38.0 m and 52.0 m bgl. How ever the depth at which water standards could not be obtained due to already installed pumping machines. The thickness of weathered zone ranges from 3.1 m to 12.2 m. and that of fractured zone 1.2 m to 1.8 m. The yield of the wells varies from 360 lph to 480 lph

**Soils:** the area is covered with red soil with varying thickness from 2to 3 meters below which weathered granite encounters.

**Drainage pattern:** the area is drained by Tatty stream .it is dendriic type.there are four orders streams drain the study area.

#### 1.2.1 CROPPING PATTERN:

The main seasonal crops (khariff/ rabi) in the area are white rice, Sweet corn, groundnuts. Vegetables like tomato, ladies fingers potato etc. These crops are mostly grown with groundwater and the rain fed crops groundnut, jowar, corn, maize etc.

## 2.0 METHODOLOGY:

The methodology adopted in ground-water quality investigations includes both field analysis of physical characteristics, as well as laboratory analysis for various parameters viz. Ph, fluoride, chloride, hardness etc. A brief discussion of the methods and results of each type of analysis is presented in the below given paragraphs. A table of summary consisting of the complete results is also provided in this paper as table No 2

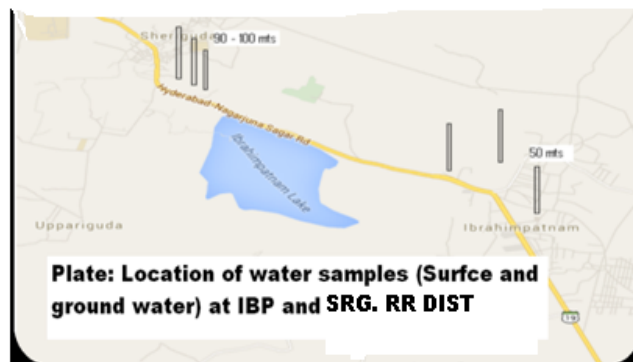
### 2.1 Sample collection and analysis:

The in the present investigations, samples were collected by following the procedures adapted for the collection of samples in Phase-I. Thus it uses the clean sampling procedures specified by the USGS National Water-Quality Assessment (NAWQA) program (Shelton, 1994). Sampling procedures were mainly focused to evaluate potential changes in concentrations from acidic to neutral and then from neutral to basic nature, besides evaluating short-term (0 - 25 minutes) variations in chemical composition of drinking water. Unsoftened water samples were collected from domestic wells by connecting to external, garden hose taps. All tubing used in sample collection was Teflon-lined, with high-density poly-ethylene (HDPE) or Teflon fittings and connectors. At wells selected for the short interval, time-series sample collection, unfiltered samples are collected at intervals ranging from 30 seconds to 2 minutes for the first 20 to 25 minutes of well pumping. Due care was taken while sampling such that the wells are not purged prior to collecting the first sample.

The samples thus collected are analyzed using the pH meter for determining pH and chemical buffer solution (4.0, 7.0 and 9.2) and potassium chloride solution. By inserting the sample, the pH value is noted. The Chloride is determined using reagents potassium chromate and silver nitrate (Ag NO<sub>3</sub>). The Hardness is determined using titration method. The buffer solution (16.9 gm) and Magnesium salt of Ethyl ediaminetetraacetate (EDTA) are used as reagents in this test for Hardness. The Fluoride is determined using Calorimeter (DR 850 Hack instrument). In this a wavelength of 27 is set out and a sample of 10 ml is taken to which 2 ml Spadder is added to it. Thus the sample is calibrated and virtue of which Fluoride value is determined.

Physical characteristics like pH, hardness etc. are measured at the well-site with a Hydro lab H2o connected in-line through a flow-through cell. Before a ground-water sample was collected for laboratory analysis, wells were purged for a period of at least 20 minutes until the above field characteristics had stabilized. Stability was determined on the basis of the criteria that: pH variation less than 0.05 pH units, Alkalinity titrations were performed on filtered samples in the field.

The details of samples collected for analysis both in Phase-I and Phase-II are given in Table 2. Similarly, their locations are exhibited in Plate-2.



**Table-1**  
**Details of Sampling Locations**

Sno	Sample Location	Date of sample Collection	
		Phase-1	phase-2
1	lake	11-12-2014	16-04-2015
2	Ibrahimpattanam(b1)	08-12-2014	15-04-2015
3	Ibrahimpattanam(b2)	08-12-2014	15-04-2015
4	Ibrahimpattanam(b3)	08-12-2014	15-04-2015
5	Sheriguda (b4)	11-12-2014	16-04-2015
6	Sheriguda (b5)	11-12-2014	16-04-2015
7	Sheriguda (b6)	11-12-2014	16-04-2015

## 3.0 DATA ANALYSIS:

By following the procedure given in para-2, the samples (surface and Groundwater) are subjected to the chemical analysis. In this analysis the pH is analyzed by using a buffer solution of pH 4.0, 7.0 and 9.2. Then the sample is taken and inserted in pH meter for finding Ph value of surface water. The Fluoride content in it has been analyzed by keeping the sample in calorimeter passing a wavelength of 27 is passed and the displayed value of fluoride is noted.

The Chloride is analyzed from 100 ml sample by adding 1 ml. Potassium Chromate solution and titrating it with Silver Nitrate. As there a change in the color from black to yellow, it is inferred titration is over and the end point is recorded in the burette. In analyzing Hardness, a sample of 20 ml is added to distilled water and then two drops of buffer (10) is further added. This is titrated with EDTA till there is a change in color from reddish to blue. Finally the EDTA value is noted.

#### 4.0 RESULTS:

The results of geochemical analysis carried for the water samples at selected locations both for pre and post monsoons, aiming for comparative studies, are presented as under.

For pre monsoon periods (October-January-2014):

- » The indicates the P H value in the surface water is 7.7, EC 500, Total dissolved solids ( TDS) as 335mg/l Total Alkanyity as 212 mg/l, Hardness is 170 mg/l, Chlorides as 62 mg/l and fluoride as 0.01 mg/l
- » The ground water sample no B1 indicates that the parameters of Hardness, Chloride and Fluoride are with in the admissible limits of Indian Standards..
- » The ground water sample no B1 indicates that hardness is higher(940 mg/l than that of B1 Similarly, both fluoride and chloride contents in this sample are as higher levels when compared with those of B1sample. How ever ,the values are not with in the admissible limits of Indian standards
- » The ground water sample No B3 indicates that : the Hardness vlue (844mg/l)lies in b/w the values of B1and B2 samples . Apart from this, the Fluoride and Chloride values are also lie in b/w the values of B1and B2amples . However according Indian standards, the Fluoride and Chloride values are with in the admissible limits. But the Hardness is at exceeding level(44mg/l).
- » The ground water samples at SRG(OB4,B5and B6) indicates that :the P H value is more acidic (7.0-6.9). However, the Hardness this sample (400,640and 780) is With in the Indian standard limits. Like wise, Chloride value is are With in the admissible limits for B4and B5( 116 and218mg/l).
- » Pertaining to sample at B4 it is with in the permissible limits of Indian standards. But as regards to B5 and B6, the percentage of fluoride is at an exceeding levels ( 1.13and 1.24mg/l) than the top Indian standards.

For post monsoon periods (February-may 2015):

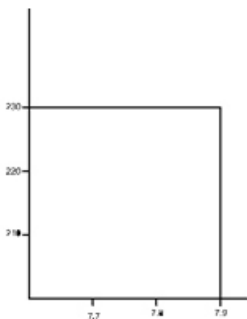
- » The indicates the P H value in the surface water is 7.9, EC 636, Total dissolved solids ( TDS) as 413mg/l Total Alkanyity as 184 mg/l, Hardness is 232 mg/l, Chlorides as 96 mg/l and fluoride as 0.06 mg/l
- » The ground water sample no B1 indicates that the parameters of Hardness, Chloride and Fluoride are with in the admissible limits of Indian Standards..
- » The ground water sample no B1 indicates that hardness is higher(780 mg/l than that of B1 Similarly, both fluoride and chloride contents in this sample are as higher levels when compared with those of B1sample. How ever ,the values are not with in the admissible limits of Indian standards
- » The ground water sample No B3 indicates that : the Hardness value (608mg/l)lies in b/w the values of B1and B2 samples . Apart from this, the Fluoride and Chloride values are also lie in b/w the values of B1and B2samples . However according Indian standards, the Fluoride and Chloride values are with in the admissible limits. But the Hardness is at exceeding level(44mg/l).
- » The ground water samples at SRG (B4, B5and B6) indicates that :the P H value is more Neutral(7.2-7.7). However, the Hardness this sample (304,640and 268) is With in the Indian standard limits. Like wise, Chloride value is are With in the admissible limits for B4and B5( 224 and357mg/l).
- » Pertaining to sample at B4 ,it is with in the exceeding levels(1.20mg/l) limits of Indian standards. But as regards to B5 and B6, the percentage of fluoride is less than the values of Indian standards (0.60 mg/l- 0.97 mg/l)

The results were tabled below in Table No.2.

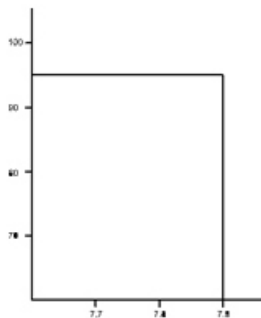
S.No	LOCTION	PH	EC	TDS	TOTAL ALKANIT Y	HARDNESS	CHLORIDE	FLORIDE
1	LAKE .IBP	7.9	636	413	184	232	96	0.06
2	Ibrahimpatnam	6.8	2380	1666	256	780	328	.68
3	Ibrahimpatnam	7.0	1823	1184	308	500	243	0.95
4	Ibrahimpatnam	6.9	1948	1266	240	608	344	1.30
5	Sheriguda	7.7	1479	961	216	304	224	1.20
6	Sheriguda	7.5	2390	1673	300	600	357	0.60
7	Sheriguda	7.2	1145	745	348	268	70	0.97

**SURFACE WATER**

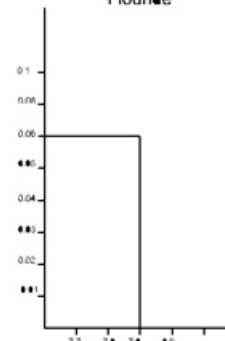
Hard ness



Chloride

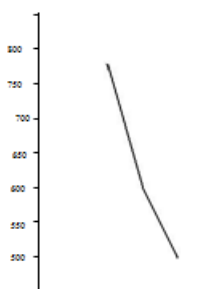


Flouride

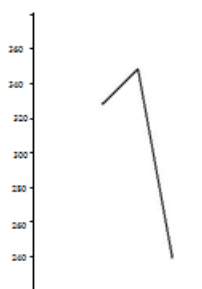


**IBRAHIMPATNAM BOREWELLS**

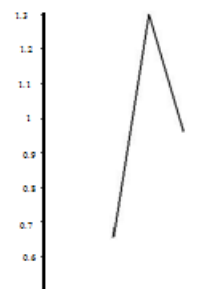
Hardness



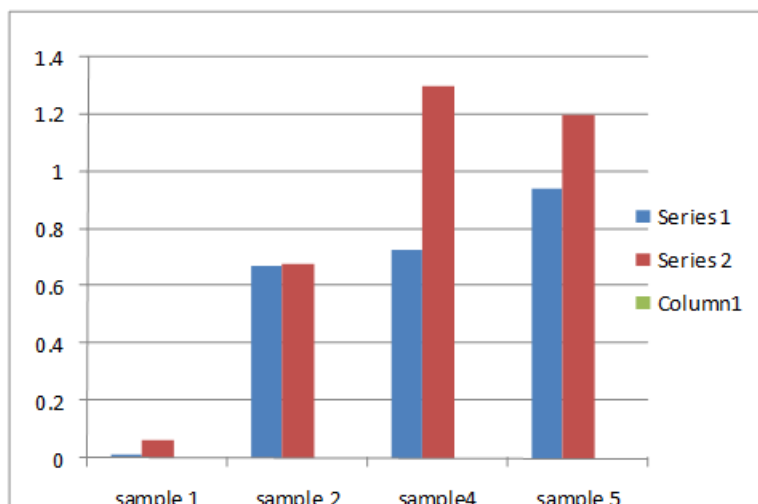
Chloride



Flouride



**SHERIGUDA BOREWELLS**



**5.0 Discussions:**

» The Comparative study of the above results for both pre and post monsoons indicate that :The P H value of the surface water( lake) increased by 0.7 (7.0 to 7.7) from pre monsoon to post monsoon. This increase of P H is attributed to evaporation phenomena such that soluble fluoride content in the water gets more concentrated by virtue of their solidification nature.

» Similarly, The groundwaters samples at SRG(B4, B5 and B6) have attained more acidic nature in post monsoon periods (7.7, 7.5 and 7.2) When compared to those of pre monsoon values (7.0, 6.9 and 6.9). this change is attributed to variations in the use of pesticides and as well use of for crops. .In fact less pesticides and less water are used in pre monsoon for want of rains and in this non-rainy period there will be an increase in the fluoride level relative to that of rainy period

» There is an increase in the level of fluoride in the samples at location B4 by 0.57mg/l(that is 0.73-1.30) . this might be related to dilution of fluoride in the preceding monsoon waters.

Likewise there is a decrease is in the fluoride level

» There is an decrease in the level of fluoride in the samples at location B2 by 0.536mg/l(that is 1.31-0.95) . This is attributed to the reason that the well (B3) kept » Unused for quite long time due to repairs. .Hence accumulation of ground water in the region on permanent cone of depression such that there is more dilution activity in the fluoride.

**• CONCLUSIONS:**

The various chemical parameters derived from the geochemical analysis for both surface and groundwater’s at the selected locations in two different phases (that is premonsoon and postmonsoon periods ) show no much variations except in the levels of flouride concentrations.

o The level of fluoride appears to be more (1.31 mg/l) in the premonsoon period, contributing only to the waters of in the bore holes numbers B2. However this level is reduced to 0.96 in post monsoon period. Besides, the fluoride level in pre monsoon period in the waters of borehole number B3 was in normal limits (0.73mg/l) and it has been raised to above normal limits (1.31mg/l). Thus it can be concluded that there are variations in the fluoride concentrations in respect to the time. However other factors like role of pesticides, water with drains, water recharge, agricultural activities cannot be neglected. The influence of such factors on fluoride concentrations can be put as a research programme for future workers on the subject in the region.

o The evaporation also has a direct impact on the fluoride concentration as seen from the results that: The pH value of the surface water (lake) increased by 0.7 (7.0 to 7.7) from pre monsoon to post monsoon. This increase of pH is attributed to evaporation phenomena such that soluble fluoride content in the water gets more concentrated by virtue of its solidification nature.

o Similarly, the recharge to ground water through precipitation also has control over the fluoride concentration as seen from the results that: The ground water samples at SRG (B4, B5 and B6) have attained more acidic nature in post monsoon periods (7.7, 7.5 and 7.2) when compared to those of pre monsoon values (7.0, 6.9 and 6.9). This change is attributed to variations in the use of pesticides and as well use of fertilizers for crops. In fact less pesticides and less water are used in pre monsoon for want of rains and in this non-rainy period there will be an increase in the fluoride level relative to that of rainy period.

o From the above it is concluded that "time" is the main factor, and the other viz water recharge / discharge, evaporation, application of pesticides etc., that have been counted for fluoride concentration in the studies have invariably tied up with the main factor. Thus an indirect relation b/w time and fluoride concentration could be assessed through the present studies.

## 7.0 RECOMMENDATIONS:

- » The surface water having the color of cherry red is undesirable and requires to be removed by filtration and sedimentation processes.
- » De-fluoridation is needed when the naturally occurring fluoride level exceeds recommended limits. It can be accomplished by percolating water through granular beds of activated alumina, bone meal, bone char or tricalcium phosphate by coagulation with alum or by precipitation with lime. Besides, construction of percolation tanks, developing Grid tanks systems, educates the public to avoid open toilets in sanitary conditions and eliminating from industrial residential effluents are advocated.

And also

1. System percolation tanks construction.
2. Surface water to be supplied to the proposed Grid tanks system.
3. Educate the public to avoid open toilets in sanitary conditions.
4. From industrial residential effluent should be eliminated.

## 7. References:

1. BIS 10500.
2. Environmental Engg. By Duggal.
3. Water supply Engg by Gorg.
4. Water supply and sanitary Engg by B.C.Punmia.

## MEASURES FOR CONTROLLING FLUORIDE:

De-fluoridation is needed when the naturally occurring fluoride level exceeds recommended limits. It can be accomplished by percolating water through granular beds of activated alumina, bone meal, bone char or tricalcium phosphate by coagulation with alum or by precipitation with lime.