



**MONITORING THE FLUORIDE CONCENTRATION IN THE  
GROUND WATER OF TEA GARDENS AND BRICK  
INDUSTRY AREAS OF DIBRUGARH DISTRICT,  
ASSAM, INDIA  
JITUMONI BORAH**

Department of Chemistry, Duliajan College, DIBRUGARH (Assam) INDIA

**ABSTRACT**

In this study, ground water samples collected from different locations of the Dibrugarh district were measured for fluoride concentration and some other physico-chemical properties. Water samples were collected from tea gardens and brick industry areas of the district in the month of January-February of 2011. Ground water of the study area was found slightly acidic in nature with pH range 5.3-7.3. Ion selective electrode method is employed for measuring the fluoride concentration. Fluoride level is found in the range from 0.0222 to 0.5789 mg/L, which is quite below the maximum permissible level, 1.5 mg/L. No case of fluorosis was found in the study area.

**Key words:** Ground water, Fluoride, Fluorosis.

**INTRODUCTION**

Fluorine, the lightest element of the halogen group is always present as fluoride ( $F^-$ ) in solution because of its maximum electronegativity. However, at lower pH, HF form could occur<sup>1</sup>. Leaching of fluoride bearing minerals is the principal source of fluoride in ground water<sup>2</sup>. Some man made activities are also responsible for the rise of fluoride level in ground water of some places. Cryolite, a mineral of fluoride is used for the production of aluminium and pesticide. Similarly, another mineral, rock phosphate is used for the production of phosphate fertilizer<sup>2</sup>. These fertilizers and pesticides are used in large scale in agriculture and thus, they contribute to the rise of fluoride level in ground water. Manufacturing processes of Ni, Cu, steel, glass, brick, ceramic, glues, adhesives, drugs and cosmetic products have contributed to the rise of fluoride level in ground water<sup>3</sup>.

---

\* Author for correspondence; Mo.: 9954236079; E-mail: [bjitumoni@gmail.com](mailto:bjitumoni@gmail.com)

Both types of effects, beneficial and adverse can be caused from fluoride exposure. A concentration less than 0.6 mg/L results in dental carries, whereas high level ( $> 1.2$  mg/L) results in fluorosis<sup>4</sup>. Hence, it is essential to maintain a safe limit of fluoride level between 0.6 and 1.2 mg/L in drinking water. The maximum permissible level of fluoride in drinking water is 1.5 mg/L<sup>5</sup>.

Fluorosis is endemic in several countries of the world. One of the worst effected countries is China, where ground water as well as air is polluted from fluoride. In China, about 38 million people are reported to suffer from dental fluorosis and about 1.7 million from skeletal fluorosis<sup>2</sup>. People of different regions of India are also badly affected from Fluorosis. It is estimated that about 65 million people of India are suffering from fluorosis<sup>6</sup>. Rajasthan, Gujarat, Tamilnadu, Kerala, Andhra Pradesh, Delhi and Punjab are the examples of some of the severely affected states.

Ground water of Assam is also contaminated by fluoride. The worst affected district is Karbi Anglong. The fluoride level in ground water collected from Bagpani of Bagpani area, Karbi-Anglong district<sup>7</sup> was found to be 8.02 mg/L and in another sample collected from Nopak-Killing of Bagpani area, it was 14.36 mg/L. People of these areas are suffering from dental as well as skeletal fluorosis. Dutta et al.<sup>8</sup> studied the ground water samples for fluoride and found high level in some parts of Nagaon, Marigaon and Golaghat districts. Dutta et al.<sup>9</sup> studied the fluoride level in the ground water of small tea garden in Sunitpur district of Assam and found the range from 0.17 to 5.602 ppm. Borah et al.<sup>10</sup> reported the fluoride concentration 0.0912-0.2283 mg/L in the Tinsukia town master plan area of Tinsukia district, which is one of the neighboring district of the Dibrugarh district.

The district extends from 27° 5' 38" N to 27° 42' 30" N latitude and 94° 33' 46" E to 95° 29' 8" E longitude. It is a plain district of Assam. The soil of the district is mostly fertile alluvial soil and in adjoining area with river Brahmaputra, it is composed of sand and clay in varying proportions. The average annual rainfall of Dibrugarh city is 276 cm with a total number of 193 rainy days while at Naharkatia in the south, the average annual rainfall is 163 cm and with 147 rainy days. The average annual temperature in Dibrugarh city and Naharkatia are 23.9 and 24.3 degree Celsius, respectively<sup>11</sup>.

The district is famous for tea production. About 144 numbers of big tea gardens with a large number of small tea gardens are present in the district and the number of small tea garden is increased in every year<sup>12</sup>. These tea gardens, whether small or big, use huge amount of fertilizers and pesticides in every year. Fluoride level in the ground water of tea

garden area of the district may increase due to these two sources. There are numbers of brick and other industries in the district. These industries particularly, brick industries may accelerate the concentration of fluoride in the ground water. Fluoride level in the ground water of tea garden and brick industry areas are not estimated earlier. Therefore, this investigation has been made.

## **EXPERIMENTAL**

### **Sample collection**

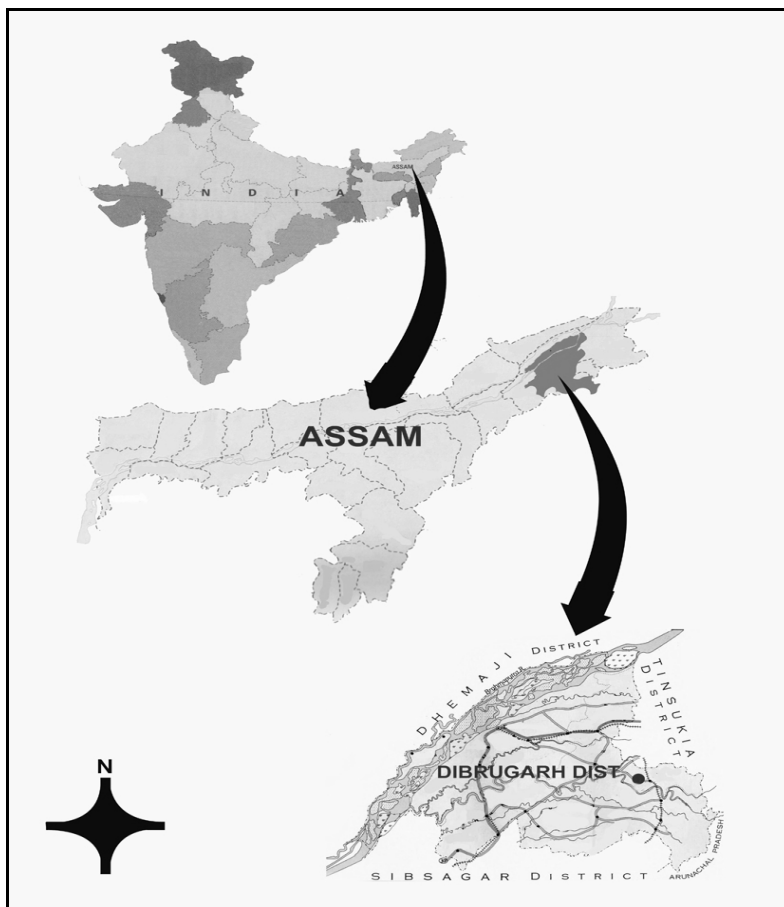
Good quality half liter polythene bottles were used for sample collection. Ground water samples were collected from tube wells or motor pumps for analysis. After operating for about ten minutes, water was collected in the pre-rinsed bottles without using any preservatives. All the samples were analyzed in the month of January-February, 2011.

### **Analytical**

Ion selective electrode method was employed for measuring the fluoride concentrations. ELICO ion analyzer (Model LI 126) with the electrode ORION 9609BNWP was used for the fluoride measurements. EC and TDS were measured with the help of a soil and water analysis kit (LT-61). pH of the water samples were measured at the time of collection by using a pocket pH meter (HANNA made). Ca, Mg and total hardness were estimated by EDTA titrimetric method. Cl was estimated by standard silver nitrate solution. All the measurements were done according to the methods described in APHA<sup>13</sup>.

## **RESULTS AND DISCUSSION**

The results of the observations are shown in Table 1. Sample No. 1 to 11 were collected from tea gardens or near the tea garden areas and rests were from brick industry areas. It is clear from the analysis that the ground water of the study area (93%) is slightly acidic in nature with pH range 5.3 to 7.3. Fluoride level was found in the range 0.0222 to 0.5789 mg/L that is much lower than the maximum permissible range 1.5-mg/L. Low level of fluoride in the study area may be attributed to the absence of fluoride bearing minerals. Although huge amount of fertilizers and pesticides containing fluoride impurities are used in the tea gardens, these do not raise the fluoride level. It may be due to the adsorption of fluoride by acidic soil and dilution because of heavy rain. No cases of dental or skeletal fluorosis were found in the area.



**Fig. 1: Map of the study area**

**Table 1: Concentration of fluoride and other physico-chemical properties of water samples**

S. No.	Name of locations	Depth Ft.	pH	EC $\mu\text{S/cm}$	TDS ppm	TH mg/L	Cl mg/L	F mg/L	Ca mg/L	Mg mg/L
1	Longjong	23	5.5	301	255	249	16	.1307	35	38
2	Borbam	26	5.3	180	125	165	42	.0269	20	28
3	2 No. Balijan	45	5.4	245	240	130	25	.0268	25	17
4	Dhadumia	45	6.2	209	195	156	21	.0222	30	39
5	Disam	46	6.0	333	200	280	17	.0263	32	60

Cont...

S. No.	Name of locations	Depth Ft.	pH	EC $\mu$ S/cm	TDS ppm	TH mg/L	Cl mg/L	F mg/L	Ca mg/L	Mg mg/L
6	S.Valley	45	7.1	126	123	102	18	.0263	14	18
7	Kathalani	60	7.3	442	335	320	36	.0263	30	58
8	Sarujini	65	6.1	95	80	75	39	.1958	14	10
9	Sat Nambar	45	6.6	110	96	86	22	.2128	15	16
10	Khatkhathi	50	6.0	181	177	106	18	.2059	9	20
11	Borbarua	60	6.2	289	145	200	29	.3581	29	34
12	Assam-1	65	5.4	510	488	420	39	.2241	70	76
13	Assam-1	45	5.5	410	332	380	41	.2628	65	40
14	Assam-1	45	5.4	195	130	165	20	.2628	32	10
15	Assam-2	100	5.4	455	395	400	28	.2568	65	30
16	Assam-2	65	5.7	302	200	260	23	.2528	10	32
17	Assam-2	65	5.3	189	100	96	16	.2644	30	65
18	Shakti	90	5.3	98	80	80	37	.2628	42	40
19	Shakti	45	6.2	200	123	155	19	.2644	10	11
20	Shakti	45	5.5	255	217	201	28	.2628	9	12
21	B.D.	65	6.2	300	287	280	36	.5315	30	9
22	B.D.	45	5.9	181	129	130	19	.5789	40	10
23	Tridip	65	5.1	375	299	285	28	.1620	40	46
24	Tridip	65	6.0	250	171	150	27	.1520	9	18
25	Sankar	45	6.7	159	156	120	38	.1828	55	35
26	Sankar	65	6.5	582	390	395	18	.1828	16	19
27	Juala	50	5.8	186	177	148	29	.1801	8	13
28	Juala	45	5.9	304	293	160	31	.1999	50	55
29	NHK	65	5.8	256	213	211	27	.1710	32	8
30	NHK	65	6.0	198	187	170	19	.1710	18	20

### ACKNOWLEDGEMENT

The author wishes to acknowledge Dr. A. K. Gogoi, Principal, Duliajan College for his constant inspiration and valuable suggestions.

**REFERENCES**

1. J. D. Hem, Study and Interpretation of the Chemical Characteristics of Natural Water, University Press, Hawaii, (1970) p. 177.
2. WHO, Fluoride in Drinking- Water (2006).
3. <http://www.greenfacts.org/en/fluoride/fluorides-2/02-environment.htm#3>
4. ISI, Indian Standard Specification for Drinking Water. IS: 10500. Indian Standard Institution, New Delhi (1983).
5. WHO, Guidelines for Drinking Water Quality, World Health Organization, **1** (2004).
6. A. K. Susheela, Fluorosis Management Programme in India, *Curr. Sci.*, **7**, 1250-1256 (1999).
7. D. Chakraborti, Fluorosis in Assam, *Curr. Sci.*, **78(12)**, 1421-1423 (2000).
8. R. K. Dutta, G. Saikia, B. Das, C. Bezboruah, H. B. Das and S. N. Dube, Fluoride Contamination in Groundwater of Central Assam, India, *Asian J. Water Environ. and Poll.*, **2(2)**, 1199-1208 (2010).
9. J. Dutta, M. Nath, M. Chetia and A. K. Mishra, Monitoring of Fluoride Concentration in Ground Water of Small Tea Gardens in Sunitpur District, Assam, India : Correlation with Physico-Chemical Parameters, *Int. J. Chem. Tech. Res.*, **2(2)**, 1200 (2010).
10. J. Borah and D. Saikia, Estimation of the Concentration of Fluoride in the Ground Water of Tinsukia Master Plan Area of the Tinsukia District, *Scholars Res. Lib.*, **3(3)**, 202-206 (2011).
11. [www.Dibrugarh.nic.in](http://www.Dibrugarh.nic.in)
12. [www.Dibrugarh.nic.in/glance](http://www.Dibrugarh.nic.in/glance)
13. APHA. Standard Method for the Examination of the Water and Wastewater, 17<sup>th</sup> Edition, American Public Health Association, New York, U.S.A (1989).

*Accepted : 09.08.2011*