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Estimation of the concentration of Fluoride in the Ground-water of Tinsukia Town Master Plan area of the Tinsukia district, Assam, India

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ABSTRACT

We monitored the quality of ground water of Tinsukia town master plan area of the Tinsukia district, Assam which is a major industrial town of North – East India. In this study, fluoride concentration along with metals - calcium and magnesium and some physico-chemical properties were measured. Using Elico Ion Analyzer (Model: LI 126) and ORION 9609BNWP electrode, fluoride concentrations were measured and EDTA Titrimetric method was employed to measure the metals -calcium and magnesium. pH was measured at the time of collection of water samples with pocket pH meter(HANNA made). 30 water samples were collected from different locations of the study area. All the water samples were collected from hand tube wells, motor pumps and public water supply schemes. Ground water of the study area is found slightly acidic in nature. Fluoride level varies from 0.0912 mg/L to 0.2283 mg/L. In all the water samples fluoride concentration is found quite below than the acceptable range 0.6 mgL⁻¹ to 1.2 mgL⁻¹. No case of dental or skeletal Fluorosis is found in this area.

Keywords: Ground water, fluoride and Fluorosis.

INTRODUCTION

Safe drinking water is the basic need of every human being and other living organisms. Drinking water is supplied from surface, stored and ground water sources. But sources of this drinking water are continuously deteriorated either by some natural phenomenon or by some man made activities. Currently about a billion people around the world routinely drink unhealthy water. In India two acute health problems arise from drinking water. These are – fluoride and arsenic contamination in ground water.

Excessive fluoride in ground water is a major concern all over the world. The problem is found in several countries of the world viz. Sri Lanka, China, South Africa, Spain, West Indies, Italy,

Mexico and North and South American countries [1]. Fluorosis is endemic in 17 states of India. It affects 65 million people including six million children [2]. Severely effected states are Andhra Pradesh, Tamilnadu, Karnataka, Gujarat, Rajasthan, Punjab, Haryana, Bihar and Kerala. Fluoride level 5.2 mg/L has been reported in Medak district, Andhra Pradesh; 15.0 mg/L in Nawabganj block, Uttar Pradesh and 18.0 mg/L in Jaiypur of Rajasthan [3].

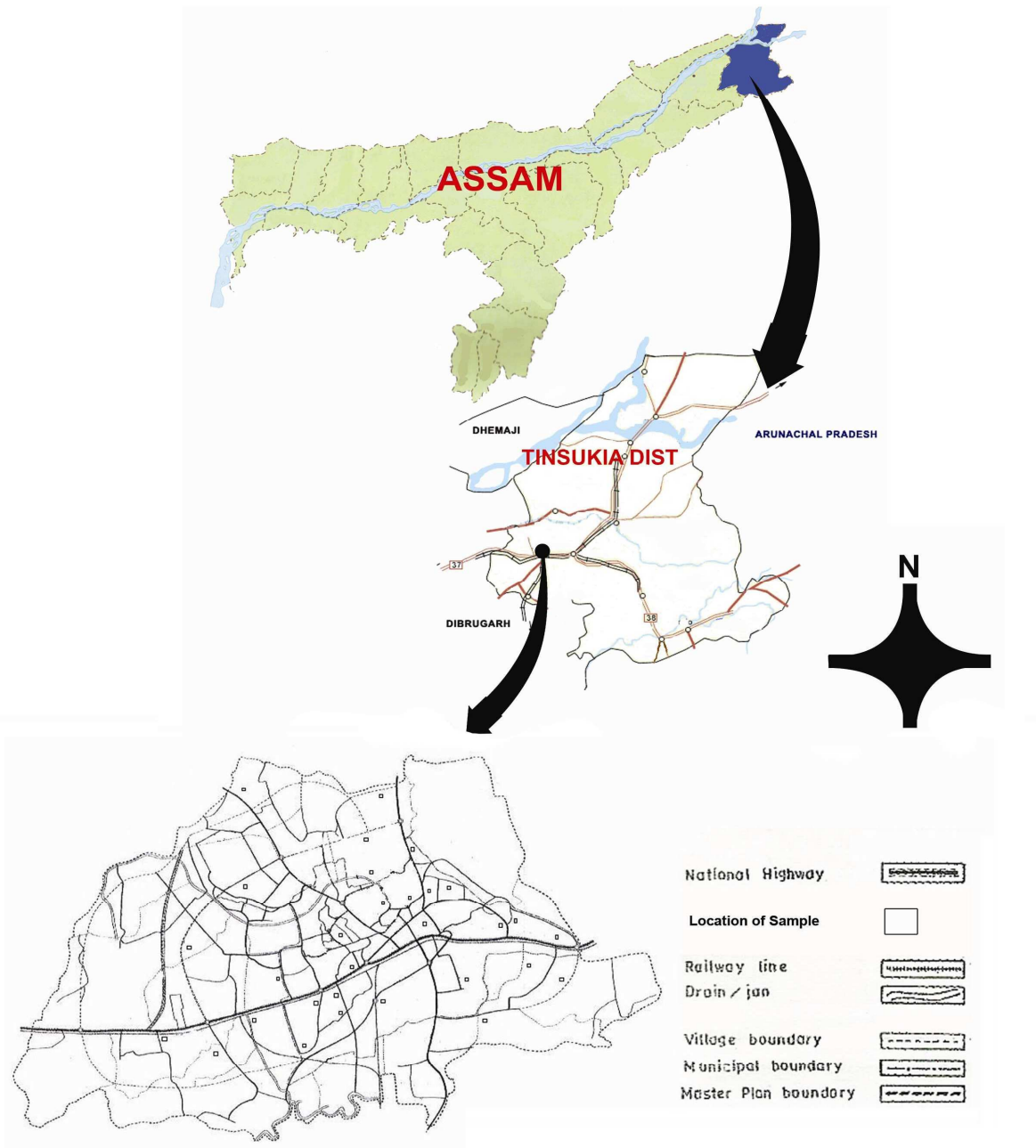
Due to maximum electronegativity of fluorine, it is always present as fluoride (F^-) in the environment. The average crustal abundance of fluoride is 300 mg/Kg [4]. Fluorides are found in different types of minerals, which include fluorspar, rock phosphate, cryolite, apatite, mica, hornblende, and many others. Rock phosphate is widely used in the production of fertilizers and cryolite is used for the extraction of aluminium and manufacturing pesticides [4]. Fluoride in ground water is due to the leaching of these minerals. Manufacturing processes of Ni, Cu, steel, glass, brick, ceramic, glues, adhesives, drugs, cosmetic products, and wide spread use of phosphate fertilizers and pesticides added fluoride to the ground water [5].

The permissible level of fluoride in drinking water is 1.5 mg/L in the absence of alternate source [6]. Fluoride concentration in drinking water less than 0.6 mg/L causes dental caries, whereas high level (> 1.2 mg/L) leads to Fluorosis [7]. Fluoride level up to 10 mg/L causes dental Fluorosis. Elevated level of Fluoride in ground water causes skeletal Fluorosis. Other factors, which contribute to the skeletal Fluorosis, are climate, water consumption, nutritional status, diet and exposure to other substances, which modify the adsorption of fluoride into the body [4].

High levels of fluoride in ground water have been reported in many parts of Assam. Water sample taking from Ramsapather, Karbi Anglong, found 20.6 mg/L of fluoride [8]. Dental and skeletal Fluorosis is found in many people of this district. Fluoride level in ground water of several districts of Assam viz. Sunitpur [9], Guwahati [10], Morigaon and Golaghat [11] are also studied.

MATERIALS AND METHODS

The study area is situated between the longitude $95^{\circ}22'E$ to $95^{\circ}38'E$ and latitude $27^{\circ}23'N$ to $27^{\circ}48'N$ in the Tinsukia district of Assam. Tinsukia is the second largest city in Assam after Guwahati. It is 532 Km by road from the State Capital Dispur, Assam and about 147 metres above the sea level. The average maximum temperature is about $31.1^{\circ}C$ and minimum 8.9° with an average annual rainfall of 250 cm. Soils are characterized by sandy to clayey and acidic in nature. The industrial and commercial are two main functions of the town. Because of unique location and better communication link a large number of industrial establishments have been grown here. The industries like steel manufacturing, oil supported industries, plastic based industries, petroleum based industries, tea based industries, paper and wood products, candle brick and cement products, construction and repairing workshops and many other small scale industries are situated here. Moreover, the level of fluoride in the ground water of this area is not measured earlier. Therefore the present investigation is made.



TINSUKIA

For sample collection, good quality half litre polythene bottles were used. The samples were collected directly in the rinsed bottles without adding any preservatives. Total 30 water samples were collected from 30 different locations of the town. All the people of the study area have been used ground water as for drinking purpose, therefore, only ground water was taken for analysis. This analysis was done during March of 2011.

For measuring fluoride concentration, Ion Selective Electrode method was employed. For this purpose, the electrode ORION 9609BNWP was used in ELICO ion analyzer (Model: LI 126). Concentrations were measured according to APHA [12]. pH of the samples were measured at the time of collection using a pocket pH meter(HANNA made). Conductivity and TDS were measured with the help of a water and soil analysis kit (LT-61). Concentrations of calcium and magnesium were measured by EDTA Titrimetric method. Chloride was measured by using standard silver nitrate solution.

Table-1: - Concentration of Fluoride and other properties of different water samples

Sl. No.	Name of locations	Depth ft.	pH	EH μ S/cm	TDS ppm	TH mg/L	Cl mg/L	F mg/L	Ca mg/L	Mg mg/L
1	Sukan pukhuri	52	6.1	440	401	118	15	.0912	33	9
2	Lohari kachari	50	5.9	410	310	186	15	.0983	32	26
3	Thermal	120	6.2	159	389	114	13	.1041	18	17
4	Bikashpur (Balugada)	50	5.8	358	301	80	20	.0983	20	7
5	Sabjibari	50	5.7	325	290	68	14	.1641	9	12
6	Porbotia Road	52	6.2	318	291	241	20	.1134	33	38
7	Jyoti Nagar	112	5.9	218	200	228	20	.2061	32	35
8	Chirapatti	70	6.0	560	480	46	18	.1787	40	8
9	Bhimpara	50	6.1	355	312	156	17	.2134	18	12
10	Near Tinsukia college	66	5.7	290	292	160	48	.1828	16	12
11	Kachujan goan	50	6.0	310	219	130	21	.1801	13	18
12	Jail road	65	5.8	470	401	201	26	.1999	19	25
13	Borguri	46	6.3	361	300	185	25	.1725	18	20
14	Borguri court	46	5.8	299	201	122	20	.1710	15	22
15	Bordoloi Nagar Namghar	66	5.7	355	356	215	15	.1075	33	32
16	Chaliha Nagar	46	5.7	377	255	218	17	.1182	32	33
17	Devi Pukhuri	47	5.9	321	217	141	13	.1026	26	18
18	Harijan colony	100	5.9	114	111	133	20	.2283	27	16
19	(near)Renuka cenema hall	86	5.8	147	142	139	16	.1026	28	24
20	New court	52	5.7	259	177	149	17	.0979	30	26
21	(near) Railway station	46	5.7	267	181	125	42	.1026	25	16
22	Sripuria	55	5.9	443	301	198	30	.1026	39	27
23	Tamulbari	56	5.9	564	381	225	105	.1495	45	28
24	Sripuria 7 No gate	26	5.5	282	167	320	15	.0983	54	45
25	Congress colony	112	6.1	123	106	139	15	.1641	26	18
26	Sripuria chariali	45	5.4	362	215	303	17	.1134	43	47
27	Raja ali road	65	5.8	290	173	358	41	.2061	40	63
28	Syama palli	112	6.1	123	73	126	15	.1787	12	23
29	Millan palli	65	5.8	909	541	464	140	.1741	84	62
30	Dihingia gaon	65	6.0	210	154	130	25	.1021	26	19

RESULTS AND DISCUSSION

The analytical data of the collected 30 water samples are shown in table-1. From the observations, the ground water of the study area was found to be acidic in nature. The pH range was found 5.4 to 6.3. Usually pH has no direct impact on consumers but the permissible range ascertained by WHO are 6.5 – 8.5. Water with lower pH is corrosive in nature while, for effective disinfection with chlorine the pH should preferably be less than 8. The range of chloride in all the water samples was found 13-140 mg/L, which is quite below the permissible limit 250 mg/L. Excess chloride in water increases the corrosion of metal, which can lead to increased concentration of metals in the water. In all the water samples fluoride concentrations were found lower than the permissible range 0.6 – 1.2 mg/L. The observed range of the fluoride level in the study area was found 0.0912 mg/L to 0.2283 mg/L. Low level of fluoride in the study area might be due to the absence of fluoride bearing minerals in the region. No cases of dental or skeletal Fluorosis were observed in the study area.

CONCLUSION

From the fluoride level found in ground water samples of the study area it can be concluded that there is the possibility of occurring dental caries among the children. However, this being the preliminary studies, more elaborate studies should be taken up to established the fluoride content of this region.

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