

To Assess the Concentration of Fluoride from Bore Well Drinking Water in Yavatmal District, Maharashtra, India.

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Abstract:

The standard value for Fluoride ion concentration in the drinking water is proposed to be 0.5 mg/L to 1.5 mg/L. For the present study, 10 villages (35 locations) were selected from the study area, where Borewell (tube well) water is used for drinking and domestic purposes. After studying some physico-chemical parameters, the first step of optimization was achieved and the results have been presented. Some of the water bodies were found to contain somewhat high fluoride concentration, high electrical conductance, total hardness and some inorganic salts. Hence the use of these water bodies is unsuitable for drinking purpose. The maximum fluoride concentration was found to be in the range of 2.5 mg/L to 4.0 mg/L.

Keywords: Fluoride, Drinking water, Physico-chemical parameters, Bore well, Yavatmal district.

Introduction:

Atmospheric pollution, contaminants in fertilizers or geological conditions can contribute to large extent for fluoride ions in water. Small concentration of fluoride in drinking water has beneficial effect on human body if taken in controlled quantity of less than 1.5mg/L, so as to prevent dental caries [1]. However its bioavailability depends upon the pH and other characteristics of soil [2]. Water gets contaminated mostly due to high contents of weatherable minerals. Fluorides are readily absorbed by plants, especially from more acidic soil. Fluoride concentration of >10mg/L were found toxic to plants.

Dental and bone fluorosis and skeletal abnormalities are the result of excessive intake of fluoride from water with high concentration fluoride. Long term investigations of excessive fluoride have chronic effect on the kidneys. The fluoride concentration in surface water generally does not exceed 1.5mg/L. However, extremely high concentration of fluoride in Yavatmal district has been found to be 14.2mg/L. Earlier studies show that the excessive fluoride content of water can be reduced to desired level by various water treatment methods.

Special types of rocks like; lime stones, coal, iron ores, dolomite, chromites etc. are found spread in the soil of Yavatmal district.

Materials and Methods:

For analysis purpose, water samples were collected in prewashed 2 liter polythene cans/bottles, well rinsed thrice with water sample to be analyzed. Colour and Temperature was noted immediately after collection of sample. They were brought to the laboratory and used for the determination of pH, electrical conductance and dissolved oxygen within 6 hours of collection. Other physico-chemical parameters were analyzed as per APHA [4] and ICMR. The concentration of Na, K has been determined by using flame photometer. Analysis of Calcium and Magnesium were done by complexometric titration method (solutions were prepared using conductivity water). Fluoride was analyzed using an ion selective electrode method [4].

Result and Discussion:

People from areas where due the shortage of surface drinking water is the problem, use bore well water for drinking purposes. The drinking water problem is mostly faced by the village people as the water supply facilities are not developed there. The physico-chemical attributes including temperature, pH, turbidity, electrical conductance, DO, total hardness, acidity, total alkalinity, total dissolved solids(TDS),

chloride, sulphate, fluoride, calcium, magnesium and iron concentration were investigated during 2016-17. 10 villages were randomly selected from various villages of Digras, Darwha, Aarni, Ghatanji and Babhulgaon talukas, where Bore-well (tube well) water is used for drinking and domestic purposes. Water samples from various bore wells of the village were collected for the study. Data of the physico-chemical qualities of the Bore well water from the selected locations is tabulated in the table1. The quantities given are the average value of the samples from one village.

It could be seen from the observations that the highest fluoride content in the Bore well water was recorded 4.0 mg/L. Most of the samples were found with fluoride content ranging from 2.5 mg/L to 4.0 mg/L, which is higher than the highest permitted level 1.5 mg/L. The concentration of fluoride ions in the water depends upon several factors such as fluoride concentration in the rocks from which water is percolated. The observation table show the highest value of temperature 31°C and lowest value of 24°C.

The pH value of the water samples were found in the range of 6.1 to 7.2. This represents that some of the water samples are acidic in nature. This could be harmful for the human health because the permissible level of pH in the drinking water is 6.5 to 8.5 [5].

The turbidity values of the water samples ranged from 8.3 NTU to 11.2 NTU. The permissible level is 10 NTU.

Electrical Conductance has the permissible level of 200 µmho per cm. The water samples from the study area showed higher value of electrical conductance than this permissible level. The values recorded were in the range of 263 µmho per cm to 345 µmho per cm. This indicates high concentration of dissolved ionic substances.

All the water bodies had the dissolved oxygen (DO) level higher than 5 mg/L.

Hardness of water as calcium and magnesium carbonate and bicarbonates is the measure of high concentration of dissolved salts from geological strata. The WHO has fixed the level of 500 mg/L, as a tolerant limit of hardness. It was observed that seven villages have the hardness of water samples more than this permissible level.

Alkalinity is also mainly due to carbonates and bicarbonates. High alkalinity values are indicative of eutrophic nature of the water body. The alkalinity values of studied water samples were near to the permissible level, 600 mg/L. The acidity of water samples was within the permissible level.

Most of the water samples were having high level of TDS, ranging from 247 mg/L to 342 mg/L. The permissible level is 250 mg/L. Water with high TDS is unsatisfactory for drinking, bathing and washing as well.

Table 1: Physico-chemical parameter attribution values of different 10 villages under study.

	Village									
	V-1	V-2	V-3	V-4	V-5	V-6	V-7	V-8	V-9	V-10
Temperature (°C)	27.0	26.0	29.2	24.8	25.3	31.0	30.7	29.4	24.0	27.5
pH	6.7	7.2	6.8	7.1	7.2	7.1	6.4	6.1	6.5	6.8
Turbidity (NTU)	9.3	9.7	8.3	8.8	10.4	11.2	9.9	10.8	9.7	9.4
Conductance (µmho/cm)	311	263	285	294	321	345	274	330	296	319
DO (mg/L)	5.05	4.89	4.93	5.04	5.10	5.07	5.20	5.16	5.03	5.10
Total Hardness (mg/L)	493	607	585	592	612	634	621	573	485	397
Acidity (mg/L)	52	54	47	42	57	48	49	44	47	41
Alkalinity (mg/L)	585	593	590	603	573	581	598	601	588	595
TDS (mg/L)	274	278	342	326	337	339	269	327	247	272
Chloride (mg/L)	32.2	28.9	29.4	31.6	31.8	32.1	30.7	30.2	29.7	31.3
Sulphate (mg/L)	149	147	151	146	152	144	148	150	151	149

Fluoride (mg/L)	2.4	1.4	1.3	2.5	3.7	3.9	2.6	1.5	4.0	3.2
Calcium (mg/L)	30.1	29.8	28.7	28.4	30.6	29.6	28.2	28.6	30.4	29.2
Magnesium (mg/L)	6.37	6.72	6.57	7.12	7.43	7.27	6.39	5.81	5.79	7.06
Iron (mg/L)	1.93	2.32	2.19	2.27	2.39	1.87	2.11	2.06	2.17	2.20

*Values given are the average of various locations of a village.

High concentration of chloride was recorded during the study in most of the water samples. This may be due to presence of many of the soluble salts in the soil. Concentration of sulphate and calcium was found in the expected level.

The heavy metals like iron and magnesium were found to be higher than those prescribed by ISI-1983 [7] and WHO-1971. They are toxic and affect normal metabolic functions even when present in small amounts and are responsible for permanent disorders of the organs like kidney.

Conclusion:

The Bore well water reservoirs of the study region are contaminated especially with fluoride, Total hardness, TDS, Chloride. It leads to several health problems in population of the Yavatmal district, tribal district.

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