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Analytical Study of Fluoride Ion in Drinking Water around Ambikapur, Sarguja District, Chhattisgarh, India

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Abstract:- Although fluoride was once considered an essential nutrient, the U.S. National Research Council has since removed this designation due to the lack of studies showing it is essential for human growth, though still considering fluoride a "beneficial element" due to its positive impact on oral health. The U.S. specifies the optimal level of fluoride to range from 0.7 to 1.2 mg/L (milligrams per liter, equivalent to parts per million). A 2000 systematic review found that water fluoridation was statistically associated with a decreased proportion of children with cavities (the median of mean decreases was 14.6%, the range −5 to 64%), and with a decrease in decayed, missing, and filled primary teeth (the median of mean decreases was 2.25 teeth, the range 0.5–4.4 teeth), which is roughly equivalent to preventing 40% of cavities.Fluoride's adverse effects depend on total fluoride dosage from all sources. At the commonly recommended dosage, the only clear adverse effect is dental fluorosis, which can alter the appearance of children's teeth during tooth development; this is mostly mild and is unlikely to represent any real effect on aesthetic appearance or on public health. The critical period of exposure is between ages one and four years, with the risk ending around age eight. Fluorosis can be prevented by monitoring all sources of fluoride, with fluoridated water directly or indirectly responsible for an estimated 40% of risk and other sources, notably toothpaste, responsible for the remaining 60%.

Keywords:- Fluoridation, dosage, fluorosis, aesthetic, consumption.

I. INTRODUCTION

Safe drinking water is essential to humans and other life forms. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation. There is a clear correlation between access to safe water and GDP per capita. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A recent report (November 2009) suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%.Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation. Approximately 70% of the fresh water used by humans goes to agriculture .Water is the chemical substance with chemical formula H_2O: one molecule of water has two hydrogen atoms covalently bonded to a single oxygen atom.Water appears in nature in all three common states of matter and may take many different forms on Earth: water vapor and clouds in the sky; seawater and icebergs in the polar oceans; glaciers and rivers in the mountains; and the liquid in aquifers in the ground.At high temperatures and pressures, such as in the interior of giant planets, it is argued that water exists as ionic water in which the molecules break down into a soup of hydrogen and oxygen ions, and at even higher pressures as superionic water in which the oxygen crystallises but the hydrogen ions float around freely within the oxygen lattice. Fluoride's effects depend on the total daily intake of fluoride from all sources. About 70–90% of ingested fluoride is absorbed into the blood, where it distributes throughout the body. In infants 80–90% of absorbed fluoride is retained, with the rest excreted, mostly via urine; in adults about 60% is retained. About 99% of retained fluoride is stored in bone, teeth, and other calcium-rich areas, where excess quantities can cause fluorosis. Drinking water is typically the largest source of fluoride. In many industrialized countries swallowed toothpaste is the main source of fluoride exposure in unfluoridated communities. Other sources include dental products other than toothpaste; air pollution from fluoride-containing coal or from phosphate fertilizers; trona, used to tenderize meat in Tanzania; and tea leaves, particularly the tea bricks favored in parts of China. High fluoride levels have been found in other foods, including barley, cassava, corn, rice, taro, yams, and fish protein concentrate. The U.S. Institute of Medicine has established Dietary Reference Intakes for fluoride: Adequate Intake values range from 0.01 mg/day for infants aged 6 months or less, to 4 mg/day for men aged 19 years and up; and the Tolerable Upper Intake Level is 0.10 mg/kg/day for infants and children through age 8 years, and 10 mg/day thereafter.

II. OBJECTIVES OF THE PRESENT WORK

The quality of water is of vital concern for mankind since it is directly linked with human welfare. It is matter of history that faecal pollution of drinking water caused water Bourne diseases which wiped out entire population of cities. The aim of this study was to determine the amount of fluoride in drinking water of Five villages of Ambikapur of Sarguja dist. Polluted water is the culprit in all such cases. The major sources of water pollution are domestic waste from urban and rural areas, and industrial wastes which are discharged in to natural water bodies.For this Physico-chemical analysis of drinking water samples will be taken from different Five villages of block Premnagar and awares to avoid all problem which come from more fluoride.

Because presence of large amount of fluoride is associated with---

Dental and skeletal fluorosis and inadequate amount with dental carries.
U S public health services has stated that fluoride makes the bone more brittle.
Mottling of teeth disease causes permanent damage to the enamel.
Skeletal fluorosis followed by pain and stiffless of the joints.
Osteoporosis found children below age of 10 years also affected.
In female faces infertility problem.

III. INTRODUCTION OF SELECTED AREA

Ambikapur with an area of 16034.4 Sq.kms with 54 percent of tribal population is one of the under developed districts in Chhattisgarh. About 36% of area encompasses reserved and protected forest land. Ambikapur is the district headquarters. The total population of the district is 1970661 (2001) census, out of which 93.03 % is rural population. The net irrigated area is 31968 ha. out of which 6077ha. (19 percent only) is irrigated by ground water

Sarguja district is a great table land of numerous hills and plateau.The two important Physiographic features of the district are the Mainpat plateau and the Jamirpat plateau.The former is 28.8 km long and 12.8 km wide and rises to a maximum height of 1152.45 metres. It forms the southern boundary with Raigarh district. The Jamirpat is about 3km wide. It forms the eastern boundary of Sarguja with Jharkhand State. The maximum elevation of Jamirpat is 1219.2 metres. The principal rivers of the district are the Kanhar, the Rihand, the Morna, the Mahan, the Geur, the Geger, the Neur, and the Gej. There are two distinct drainage system in the district. One is northernly and the other is southernly.

The district has subtropical climate characterised by hot summer and monsoon rainfall followed by dry and cold winter season. The normal rainfall of the district is 1600.9 mm. The annual temperature varies from 39.6°C to 43°C in summer and 8.6° to 23.9°8C in winter.

IV. HYDROGEOLOGY

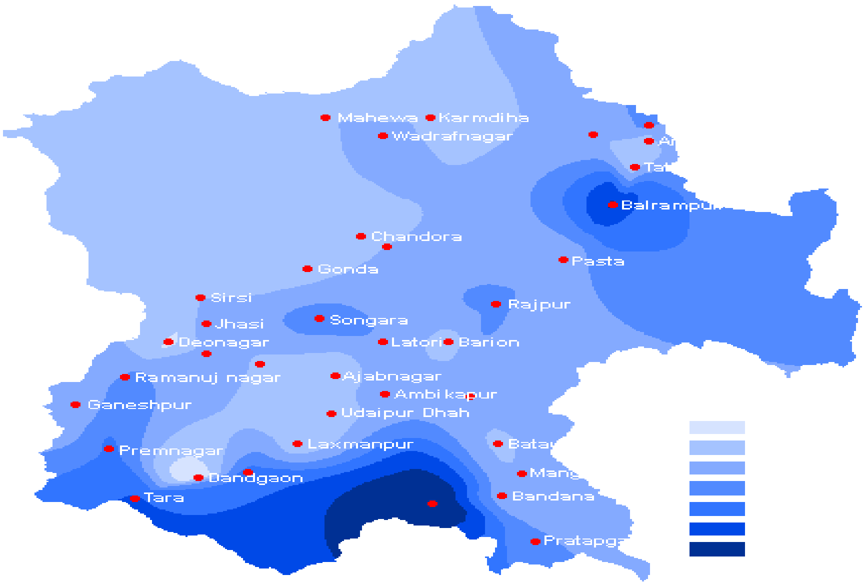
The major geological formations in the district are rocks belonging to Archean, Gondwanas, Lametas and Deccan trap group of rocks overlain by sub Recent to Recent alluvial sediments. Ground water occurs under phreatic and semi confined to confined conditions in the inter grannular pore spaces in the shallow weathered rocks and in the fractured system at deeper levels respectively. The ground water levels in the phreatic aquifer varies from 3.66 to 16.5 mbgl and from 1.59 to 10.37 mbgl during pre monsoon and post monsoon period respectivly. Long term trend analysis of ground water level in the district reveals that 13.15% of the wells in pre monsoon and none of the wells in post monsoon period show a significant (20 cm/year) falling trend.

Under the exploration programme, the Central Ground Water Board (CGWB) has drilled 30 exploratory in the Sarguja district to assess the aquifer system and their potential. The data from these boreholes has indicated that the aquifers vary from few metres to 70 mbgl. Tube wells in Gondwanas range from 27 to 76 mbgl. with discharge between 5 to 3 m^3/hr.The ground water in the district is mainly developed by dug wells for domestic and irrigation purposes. The dug cum bore wells are also used for irrigation. These structures tap ground water down to a depth of 6 to 20 mbgl. The borewells fitted with hand pumps are used for the rural drinking water supply requirements of the village community.

V. QUALITY

The quality of ground water in the district is generally suitable for both drinking and irrigation and is within the permissible limits as per Indian Standards.

Water Table Condition
Decadal (1995-2005) Average of Pre-monsoon (May) Water Level in m



VI. GROUND WATER RESOURCES

Ground water resource figures presented below are as per the estimations carried out jointly by CGWB,Govt. of India and Ground Water Survey Circle, Govt. of Chhattisgarh. The figures pertain to the year 2004.All the blocks in the district have been categorised as safe from ground water development point of view.

Annual Available Ground Water Resources (ha m)	**154455**
Allocation for Domestic Use in the year 2025 (ha m)	**7302**
Gross Draft for Irrigation (ha m)	**26326**
Balance Ground Water Availability for Future Irrigation (ha m)	**120827**
Stage of Ground Water Development (%)	**20.05**
Additional Area that can be Brought Under Irrigation (ha) (assuming 90% stage of development and crop water requirement of 0.7 m)	**73550 (4.3 % of the geographical area)**

VII. MATERIAL & METHOD

Samples were collected and analysed as per procedure laid down in the standard methods for examination of water and waste water of American public Health Association (APHA) compsite sampling method was adopted for collection of samples of water from five location of village Sample for chemical analysis were collected in polyethylene container's. Samples collected for metal contents were acitified (1.0 ml HNO_3 per liter samples). Some of the parameter like P^H Temperature, conductivity, dissolve oxygen T.D.S. were analysed on site using portable water analysis kit. The other parameter were analysed at laboratory.

Method: SPADNS SPECTROPHOTOMETRIC

Apparatus

a. Distillation apparatus: 1L round bottom long neck, borosilicate glass boiling flask, thermometer adapter, connecting tube and an efficient condenser, with thermometer adapter and a thermometer reading up to 200oC, the apparatus is shown in the Figure.

Alternative types of distillation apparatus may be used.

b. Spectrophotometer for use at 570nm. It must provide a light path of at least 1 cm or a spectrophotometer with a greenish yellow filter (550 to 580nm).

Reagents

a. Sulphuric acid, H2SO4, conc., reagent grade

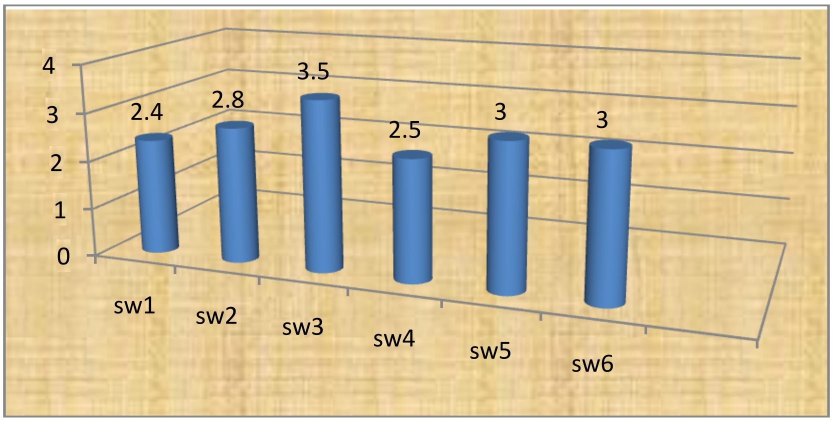
b. Silver sulphate, Ag2SO4, crystals, reagent grade

c. Stock fluoride solution. Dissolve 221.0mg anhydrous sodium fluoride, NaF, in distilled water and dilute to 1000 mL; 1 mL = 100μg Fd.
Standard fluoride solution. Dilute 100 mL stock fluoride solution to 1000 mL with distilled water; 1 mL = 10μg Fe.
SPADNS solution: Dissolve 958mg SPADNS, sodium 2 - (parasulphophenylazo)-1,8 - dihydroxy-3,6-naphthalenedisulphonate, in distilled water and dilute to 500 mL; protect from light - stable for 1 year.
f. Zirconyl-acid reagent: Dissolve 133mg zirconyl chloride octahydrate, ZrOCl2.8H2O, in about 25 mL distilled water, add 350 mL conc HCl and dilute to 500 mL.
g. Mixed acid zirconyl-SPADNS reagent: Mix equal volumes of SPADNS solution and zirconyl-acid reagent - stable for 2 years.
h. Reference solution: Add 10 mL SPADNS solution to 100 mL distilled water. Dilute 7 mLconc HCl to 10 mL with distilled water and add to SPADNS solution - stable for 1 year. Set the instrument to zero with this solution.
i. Sodium arsenite solution: Dissolve 5g NaAsO2 and dilute to 1L with distilled water

Procedure
a. Distillation: Distillation is necessary for samples containing high concentration of dissolved solids, see Table. Proceed to step d if distillation is not required. To 400 Ml distilled water in the distillation flask, with magnetic stirrer operating, add 200 mL conc. H2SO4 and a few glass beads. Connect the apparatus as shown in the figure and heat to Laboratory Manual ID: 1.11 Version: 2 Page: 2/3
180 ^{o}C. Prevent overheating by stopping heating when temperature reaches 178^{o}C.
Discard distillate.
b. Cool the acid mixture remaining in the flask to 80oC and add 300 mL sample. With stirrer operating, distil until the temperature reaches 180oC (again stop heating at 178oC to prevent overheating), turn off heat; retain the distillate for analysis.
c. Add $AgSO_4$ to the distilling flask at the rate of 5mg/mg Cl- to avoid Cl- interference.H2SO4 solution in the flask can be used repeatedly until contaminant from samples accumulates to such an extent that recovery is affected. This can be ascertained by distilling a known standard and determining recovery.
d. Standard Curve Preparation: Take the following volumes of standard fluoride solution and dilute to 50 mL with distilled water and note down the temperature:
Standard F-solution, mL 0 0.1 0.2 0.5 1.0 2.0 3.0 5.0 7.0
μg F- 0 1.0 2.0 5.0 10.0 20.0 30.0 50.0 70.0
e. Pipette 10.00 mL of mixed acid-zirconyl-SPADNS reagent to each standard and mix well. Avoid contamination. Set photometer to zero absorbance with the reference solution and obtain absorbance readings of standards (at 570nm). Plot a curve of mg F- versus absorbance. Prepare a new standard curve whenever a fresh reagent or a different standard temperature is used.

Result & Disscussion
Village I – Baraul
A Total number of six samples were collected and tested for their fluoride concentration . Three samples represent surface water collected from river/nallah and represented as s1-sw_1, s2-sw_2,s3-sw_3 while the remaining samples were collected from under-ground water / tube wells s4-sw_4, s5-sw_5,s6-sw_6 .All the six samples were colourless . odourless, and free from solid suspension. The result of absorbance have been compiled below for the se samples:-
Table I- Fluoride Concentration of water samples in village Baraul

samples	Fluoride in mg/l
s1-sw_1	2.40
s1-sw_2	2.80
s1-sw_3	3.50
s1-sw_4	2.50
s1-sw_5	3.0
s1-sw_6	3.0

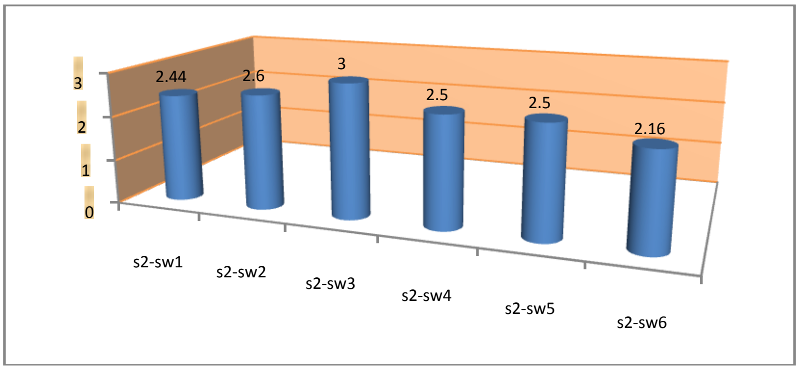


Village II Ramtirath

A Total number of six samples were collected and tested for their fluoride concentration . Three samples represent surface water collected from river/nallah and represented as s1-$sw_{1,}$ s2-sw_2,s3-sw_3 while the remaining samples were collected from under-ground water / tube wells s4-$sw_{4,}$ s5-sw_5,s6-sw_6 .All the six samples were colourless . odourless, and free from solid suspension. The result of absorbance have been compiled below for these samples:-

Table II- Fluoride Concentration of water samples in village Ramtirath

samples	Fluoride in mg/l
S2-sw_1	2.44
S2-sw_2	2.60
S2-sw_3	3.0
S2-sw_4	2.50
S2-sw_5	2.50
S2-sw_6	2.16



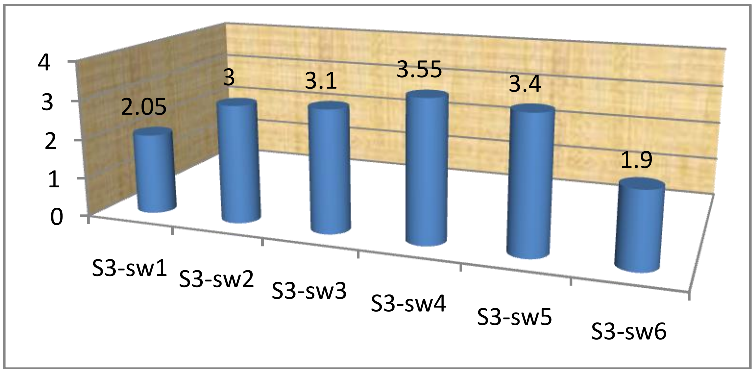
Water samples

Village III- BANAPATTI

A Total number of six samples were collected and tested for their fluoride concentration . Three samples represent surface water collected from river/nallah and represented as s3-$sw_{1,}$ s3-sw_2,s3-sw_3 while the remaining samples were collected from under-ground water / tube wells s3-$sw_{4,}$ s3-sw_5,s3-sw_6 .All the six samples were colourless . odourless, and free from solid suspension. The result of absorbance have been compiled below for these samples:-

Table III- Fluoride Concentration of water samples in village BANAPATTI

samples	Fluoride in mg/l
S3-sw_1	2.05
S3-sw_2	3.00
S3-sw_3	3.10
S3-sw_4	3.55
S3-sw_5	3.40
S3-sw_6	1.90



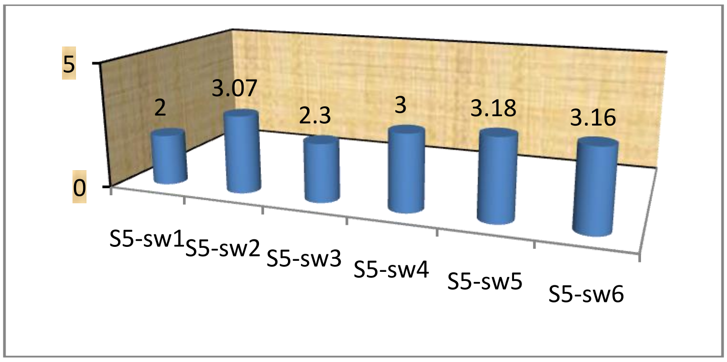
WATER SAMPLES

Village IV- BARWAHI

A Total number of six samples were collected and tested for their fluoride concentration . Three samples represent surface water collected from river/nallah and represented as s5-sw_1, s5-sw_2,s5-sw_3 while the remaining samples were collected from under-ground water / tube wells s5-sw_4, s5-sw_5,s5-sw_6 .All the six samples were colourless . odourless, and free from solid suspension. The result of absorbance have been compiled below for these samples:-

Table IV- Fluoride Concentration of water samples in village BARWAHI

samples	Fluoride in mg/l
S5-sw_1	3.16
S5-sw_2	3.18
S5-sw_3	2.50
S5-sw_4	3.0
S5-sw_5	3.50
S5-sw_6	3.20



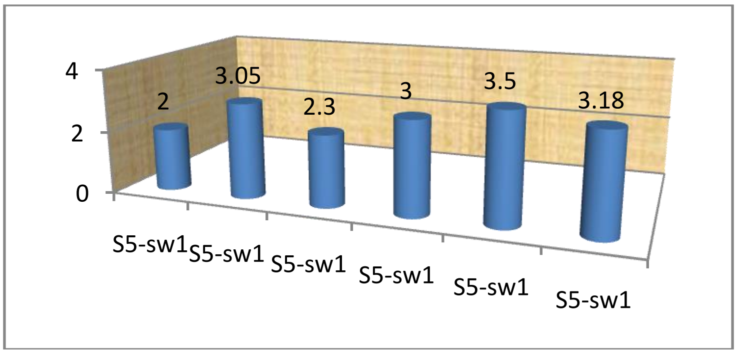
Water samples

Village VI- FATEHPUR

A Total number of six samples were collected and tested for their fluoride concentration . Three samples represent surface water collected from river/nallah and represented as s1-sw_1, s2-sw_2,s3-sw_3 while the remaining samples were collected from under-ground water / tube wells s4-sw_4, s5-sw_5,s6-sw_6 .All the six samples were colourless . odourless, and free from solid suspension. The result of absorbance have been compiled below for these samples:-

Table VI- Fluoride Concentration of water samples in village Fatehpur

samples	Fluoride in mg/l
S6-sw_1	2.0
S6-sw_2	3.05
S6-sw_3	2.30
S6-sw_4	3.0
S6-sw_5	3.50
S6-sw_6	3.18



Water samples

Result of analyses of Water from Five villages of Surajpur dist. Of Premnagar Block are recorded in table 1,2,3,4 and 5. In all the five villages each have six sampling station (three were collected from the surface and three samples were collected from the tube well) of village- BARAUL fluoride was recorded in the range of 2.40,2.80, 3.50, 2.50, 3.0 and 3.0 mg/l . maximum permissible limit for fluoride as world Health organization (WHO) is 1.5 mg/l. all six samples fluoride found excess of their permissible limit .

Water samples analyses of Five villages of Surajpur dist. Of Premnagar Block are recorded in table 1,2,3,4 and 5. In all the five villages each have six sampling station (three were collected from the surface and three samples were collected from the tube well) of village- BANAPATTI fluoride was recorded in the range of 2.44,2.44, 3.0, 2.50, 2.50, and 2.16 mg/l . maximum permissible limit for fluoride as Indian standard (IS) is 0.6 to 1.2 mg/l. all six samples fluoride found excess of their permissible limit .

Mximum permissible limit for fluoride as NEERI manual (1991) is 1.0 mg/l. Water from Five villages of Surajpur dist. Of Premnagar Block are recorded in table 1,2,3,4 and 5. In all the five villages each have six sampling station (three were collected from the surface and three samples were collected from the tube well) of village- BARWAHI fluoride was recorded in the range of 2.05, 3.00, 3.10, 3.55, 3.40 and 1.90 mg/l. all six samples fluoride found excess of their permissible limit .

The concentration of fluoride from Five villages are recorded in table . In all the five villages each have six sampling station (three were collected from the surface and three samples were collected from the tube well) of village- DHODHAGAON fluoride was recorded in the range of 3.16, 3.18, 2.50, 3.0, 3.50 and 3.20 mg/l. all six samples fluoride found excess of their permissible limit .Maximum permissible limit for fluoride as NEERI manual (1991) is 1.0 mg/l and maximum permissible limit for fluoride as world Health organization (WHO) is 1.5 mg/l.

The concentration of fluoride from Five villages are recorded in table . three were collected from the surface and three samples were collected from the tube well of village- FATEHPUR fluoride was recorded in the range of 2.0, 3.07, 2.30, 3.0, 3.50 and 3.18 mg/l. all six samples fluoride found excess of their permissible limit .Maximum permissible limit for fluoride as NEERI manual (1991) is 1.0 mg/l and maximum permissible limit for fluoride as world Health organization (WHO) is 1.5 mg/l.

VIII. CONCLUSION

The preset study has been made to evaluate the Fluoride concentration of water samples collected from the five villages of Ambikapur of Sarguja Dist, Chhattisgarh. Each village have made six sampling satation .These samples were analysed for study of fluoride and their effect in surrounding area. Fluoride in naturally occurring in water can be above or below from recommended levels. Both the excess and deficiency of fluoride in water produces adverse effects on the health. Maximum acceptable limit for fluoride as world Health organization (1985) is 1.5 mg/l. In present study the fluoride concentration of water samples of all Five villages were found over the permissible limit. Therefore, there was harmful effect of fluoride were found in all villages

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