

DETERMINATION OF FLUORIDE CONCENTRATION IN GROUND WATER BY ION SELECTIVE ELECTRODE METHOD IN PRODDATUR MUNICIPALITY, YSR KADAPA DISTRICT, ANDHRAPRADESH, INDIA

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ABSTRACT

Fluoride concentration in ground water samples of Proddatur is determined by Ion Selective Electrode method, a total of twenty samples were collected and analysed in the study area. Fluoride ion exhibits unique properties compared to other physico-chemical parameters as its concentration in optimum dose in drinking water is advantageous to health and if the concentration exceeds the limit, affects the health. The lowest and highest fluoride levels observed are 0.469 mg/L and 1.97 mg/L respectively with an average of 1.09 mg/L. Both the minimum and maximum observed levels have slight deviation with minimum (0.5 mg/L) and maximum permissible (1.5 mg/L) limits. The overall concentration levels of fluoride in the study area are within the WHO prescribed limits.

Keywords: Ground water, Fluoride, Proddatur, fluorosis, Ion Selective Electrode.

1. INTRODUCTION

Ground water is used for domestic, industrial water supply and irrigation all over the world, availability of good quality of water will help in development of any nation. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Fresh water occurs as surface water and ground water in this groundwater contributes only 0.6% of the total water resources on the earth. It is major and preferred source of drinking water in rural and urban areas particularly in India.

Fluoride frequently occurs in igneous as well as in metamorphic rocks, especially in alkali rocks, granite, basalt, shale, clays and calcium phosphate rocks are the main sources of

fluoride. Minerals which have the greatest effect on the hydro geochemistry of fluoride are fluorite, apatite, mica, amphiboles, certain clays and villiamite^{1, 2}. Fluoride concentration in natural water depends on various factors such as temperature, pH, solubility of fluoride bearing minerals, anion exchange capacity of aquifer materials (OH for F), nature of geological formation and contact time of water with particular formation.

Among the water quality parameters, fluoride ion exhibits unique properties³. Occurrence of fluoride in groundwater has drawn worldwide attention due to its considerable impact on health⁴. Fluoride based on its concentration level impact on human health, very low doses of fluoride (below 0.5 mg/L) in water promote tooth decay. However, when consumed in

higher doses (above 1.5 mg/L), it leads to dental fluorosis or mottled enamel and excessively high concentration (above 3.0 mg/L) of fluoride may lead to skeletal fluorosis⁵⁻⁷. In general, fluoride content in water between 1.5 and 2.0 mg/l may lead to dental mottling, which is characterized initially by opaque white patches on the teeth and in advanced stages leads to dental fluorosis (teeth display brown to black staining) followed by pitting of teeth surfaces. High manifestations of dental fluorosis are mostly found in children up to the age of 14 years, and skeletal fluorosis⁸ may occur when fluoride concentrations in drinking water exceed 4–8 mg/l.

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. Fluorosis is endemic in 17 states of India. It affects 65 million people including six million children. Severely effected states are Andhra Pradesh, Tamilnadu, Karnataka, Gujarat, Rajasthan, Punjab, Haryana, Bihar and Kerala⁹⁻¹².

The severity of fluorosis depends on the concentration of fluoride in the drinking water, daily intake, continuity and duration of exposure, and climatic conditions so it very necessary to understand the present contamination level, distribution and developing a methodology for safe drinking

water source. The health problems arising as a result of fluoride contamination are more wide spread in India. The problem of excessive fluoride in ground water in India was first reported in 1937 in the state of Andhra Pradesh¹³.

Due to its strong electronegativity, fluoride is attracted to positively charged calcium in teeth and bones. Major health problems caused by fluoride are dental fluorosis, teeth mottling, skeletal fluorosis and deformation of bones in children as well as adults. No effective cure for these diseases. Therefore, it is desirable to drink water having a fluoride concentration less than certain value. Hence, drinking water with more than 1.5 mg/L fluoride concentration needs treatment. In view of this we conduct a study to determine the concentration of fluoride in different locations of Proddatur by Ion Selective Electrode method.

2. EXPERIMENTAL

Study Area

The study area (figure 1c), Proddatur is in the YSR Kadapa district of Andhra Pradesh, India. It is located on the bank of river Penna. Its neighbouring towns include Jammalamadugu, Mydukuru, and Yerraguntla. The latitude and longitude of proddatur are 14°45'00.7"N and 78°32'53.3"E respectively. It has an average elevation of 155 meters. Proddatur is one of the special grade municipalities in Andhra Pradesh; the population in the proddatur is 1, 62, 717, census 2011.

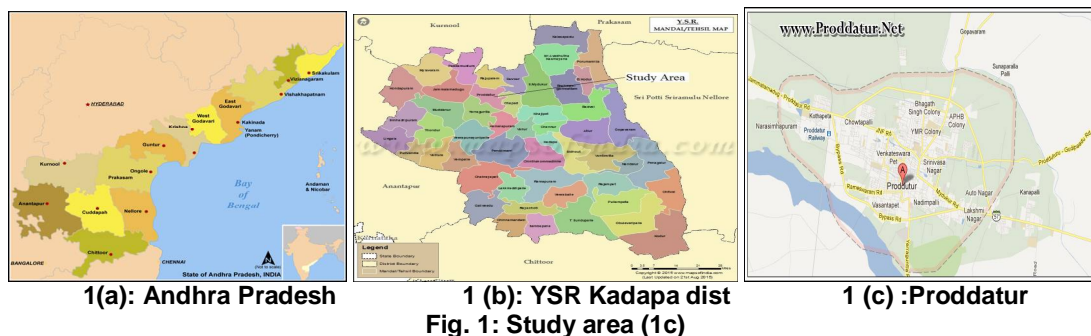


Fig. 1: Study area (1c)

Methodology

Twenty samples of different locations of proddatur were collected in previously washed polyethylene bottles in the month of November, 2015. The samples were collected from bore wells which were extensively used for drinking and other domestic purposes. The ground water samples are analysed by standard method and suggested precautions were taken to avoid contamination.

Fluoride Ion selective electrode Method

Instrument

Ion- Selective meter, Fluoride electrode, Magnetic stirrer.

Reagents

Fluoride Standards of various ranges (0.2-20 ppm) Fluoride Buffer (TISAB- Total Ionic Strength Adjustment Buffer).

Procedure

Sample solutions for calibration of the instruments are prepared from standard

solutions by serial dilution. Instrument is calibrated using standard fluoride solutions before conducting the experiment.

3. RESULTS AND DISCUSSION

Fluoride Sources and Geological Influence

Fluoride incidence in groundwater is mainly a natural phenomenon, influenced basically by the local and regional geological setting and hydro-geological conditions. The chief sources of fluoride in groundwater are the fluoride-

bearing minerals in the rocks and sediments. The important fluorine-bearing minerals are fluorite, apatite, certain amphiboles and micas. The concentration of fluoride in groundwater is limited due to the low solubility of most fluorides. The solubility values of sodium fluoride, magnesium fluoride and calcium fluoride at 18 °C are 42,200 mg/L, 87 mg/L and 15 mg/L respectively. Magnesium fluoride is more soluble than calcium fluoride. Sodium fluoride is very soluble¹⁴.

Table: Fluoride levels in the study area

S.No	Sample Location	Fluoride (mg/L)	S.No	Sample Location	Fluoride (mg/L)
1	Dorasani Palli	1.15	11	Sri Ram Nagar	0.92
2	Sasthri Nagar	0.74	12	Arts College Road	0.469
3	HB Colony	0.596	13	Two town area	1.12
4	AB School area	1.20	14	Netaji Nagar	1.20
5	Industrial Esatate	1.29	15	Guraviah thota	1.27
6	Modampalli	0.915	16	LIC Office ara	1.56
7	One Town area	1.97	17	Devangapeta	0.875
8	Vasanth Peta	1.21	18	Bollavaram	1.23
9	Rameswaram	1.15	19	Amrutnagar	1.32
10	YMR Colony	0.577	20	Srinivasa nagar	1.20

Fluoride in the study area

From the table it is found that the fluoride levels are within the permissible limits except slight deviations. The minimum (0.469 mg/L) and maximum levels (1.97 mg/L) are observed at sample no.7 and 12 respectively. It is also found that both the minimum and maximum levels have slight deviation with lower and upper permissible limits given by WHO.

4. CONCLUSION

The ground water quality of Proddatur is assessed with focus on fluoride levels. A total of twenty samples of different locations were collected from study area and analysed by Ion Selective Electrode method (ISE). From the data it is concluded that the fluoride concentrations of most of the studied locations are within the permissible limits of WHO.

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