



# **STUDY OF FLUORIDE CONTAMINATION IN GROUND WATER OF MANDAWA AREA OF JHUNJHUNU DISTRICT (RAJASTHAN) -THE HERITAGE CITY OF SHEKHAWATI**

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## **ABSTRACT**

Ground water contains various types of pollutants and several other substances, which are dissolved in it. Presence of these elements are useful for human body but in a specific limit. A study of the ground water quality of Mandawa area of Jhunjhunu district was carried out to assess the risk to human health. It was found that ground water of Mandawa area is highly contaminated with fluoride. Most of the ground water samples were found to be highly contaminated with fluoride while few water samples were suitable for human consumption. The result of this study helps in getting awareness of health hazards of contaminated water. Overall, the quality of water is unsatisfactory for drinking purpose in the investigated area.

**Key words:** Ground water, Water contamination, Fluoride, Ion-selective electrode, Fluorosis.

## **INTRODUCTION**

Water is the most important thing for the perpetuation of life on this planet. Water covers about 3/4<sup>th</sup> of the earth's surface, but only 3% of it is suitable for human use. Good quality of water is essential for all the people. WHO has given a set of guideline values for drinking water quality<sup>1</sup>. Ground water is an important source of water supply throughout the world and it is the main source of drinking water in the most of the rural areas. The quality of ground water is continuously changing as a result of nature and human activities. During last decade, this is observed that ground water get polluted drastically because of increased human activities<sup>2,3</sup>. Polluted ground water is the cause for the spread of epidemics and chronic disease in human. Physico-chemical characteristics of ground water of different parts of countries have been studied by many authors<sup>4,5</sup>.

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Fluoride is natural component of the earth crust and also found in many mineral like fluorite, fluoroapatite etc<sup>6-7</sup>. The maximum permissible limit of fluoride in water is 1.5 mg/L by WHO and ICMR<sup>8-9</sup>. Effects of fluoride "Fluorosis" were first introduced by Schott<sup>10</sup> and it is reported in both human and cattle<sup>11-12</sup>. Fluorosis is a most widespread geochemical disease affecting more than 66 million people including children under the age of 14 years<sup>13</sup>. Excess of fluoride causes dental, skeletal and non-skeletal fluorosis through continued use of fluoride contaminated water, air and agriculture products<sup>14</sup>. In Rajasthan state out of 27 districts; 16 districts, have been confirmed as fluoride affected area and have more than permissible limit concentration of fluoride<sup>15-17</sup>. The presence of fluoride in ground water can be attributed to geochemical reasons<sup>18</sup>.

Mandawa is a small town in the Shekhawati region. In Shekhawati region of Rajasthan, the beautiful small town Mandawa, known throughout the state for its Forts and Havelis. Mandawa is situated in the north of Rajasthan, around 190 Km away from Jaipur, the capital of the state. The structure of the palace reminds of the cultural and social importance of this region in the past of the havelis, the most important are the Chokhani, Ladia, Binsidhar Newatia, and Gulab Rai Ladia Haveli. Another haveli, the Binsidhar Newatia Haveli, is known for its curious paintings. The Gulab Rai Ladia Haveli is famous for its erotic images, now mostly defaced.

## **EXPERIMENTAL**

The ground water samples were collected from different tube wells (T.W.) in clean polyethene bottles without any air bubbles. The bottles were rinsed before sampling and tightly sealed after collection and labeled in the field. Reagent used for the present investigations were of A. R. grade. Doubly distilled water was used for preparing all solutions. Many methods have been suggested for the determination of fluoride ion in ground water sample. The calorimetric and electrode method are the most satisfactory methods, used in the present time<sup>19</sup>.

### **Fluoride ion-selective electrode method**

**Principle:** The fluoride ion selective electrode was used with Orion 720 Ion Meter (USA). Ion selective electrode develops emf due to the selected ion which is proportional to its concentration. The ion meter gives direct values of fluoride concentration in water samples.

**Interference:** Addition of an appropriate buffer provides a nearly uniform ionic strength background, adjusts pH and breaks up complexes (notably of Al and Fe).

## Apparatus

- (a) Ion selective meter
- (b) Fluoride electrode
- (c) Magnetic stirrer with PTFE coated stirring bar.

## Reagents

### (a) Fluoride standards

- (i) Stock Fluoride solution : 221 mg anhydrous NaF was dissolved and diluted to 1000 mL.
- (ii) Standard  $F^-$  : Stock solution was diluted 10 times to obtain the solution 1 mL = 0.01 mg  $F^-$

### (b) Fluoride buffer

383 gm ammonium acetate, 211 mL of hydrochloric acid and 19.8 gm of 1,2-cyclohexylene diamine tetra acetic acid (CDTA) were added and diluted to 1000 mL.

## Procedure

- (a) Instrument calibration : Instrument was calibrated at 0.2, 2.0 and 20.0 ppm  $F^-$  concentration.
- (b) Measurements were taken directly on ion meter by taking 10 mL of water sample and 1.0 mL of buffer solution.

Seven representative ground water samples of entire study area were collected and analyzed for fluoride. Source and Sampling point of various water samples are given in Table 1.

**Table 1: Water sampling location**

Source	Sampling points
T.W.	Castle Hotel, Mandawa
T.W.	Singhasan Haveli, A Heritage Hotel, Mandawa
T.W.	Mandawa College, Mandawa

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Source	Sampling points
T.W.	Police Thana, Mandawa
T.W.	National Public Sr. Sec. School, Mandawa
T.W.	Shri Sanatan Dharam Panchayat Sr. Sec. School, Mandawa
T.W.	Shri Yuvak Sabha Bal Mandir, Mandawa

The parameter and standard value in physico-chemical examination of ground water samples are given in Table 2.

**Table 2: Parameter, standard value and unit employed in physico-chemical examination of ground water samples**

Parameter of ground water samples	Standard values as guided by ICMR		Unit
	Desirable limit	Permissible limit	
Fluoride	1.0	1.5	mg/L

## RESULTS AND DISCUSSION

Fluoride concentration of various ground water samples at Mandawa area of Jhunjhunu district of Rajasthan are given in Table 3.

**Table 3: Fluoride concentration of various water samples at Mandawa area of Jhunjhunu district of Rajasthan**

S. No.	Source	Fluoride concentration (mg/L)
1.	T.W.	4.0
2.	T.W.	3.0
3.	T.W.	1.5
4.	T.W.	2.5
5.	T.W.	1.4
6.	T.W.	2.1
7.	T.W.	2.8

According to ICMR, desirable limit of fluoride is 1.0 mg/L and permissible limit is 1.5 mg/L. In the present study, it is observed that the fluoride concentration varied from 1.4 to 4.0 mg/L. On the basis of result obtained, five ground water samples collected were found to have high level of fluoride concentration as compared to ICMR and it may cause diseases due to fluoride. At higher levels, however, staining of teeth enamel (Fluorosis) occurs.

The people of this area is also affected by Dental fluorosis so the more investigation, studies and solutions are required.

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