International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 10 Issue 1, Jan-Feb 2026 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

An Analysis of Fluoride Concentration in Ground Water of Villages Kherla, Chhakra, Sekhpur, Kherara, Raipur, Math, Kusay, Meri, Phulwara, Khandeep (Rajasthan)

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ABSTRACT

This study evaluates the fluoride concentration in the groundwater of ten selected villages within the Wazeerpur Tehsil of Sawai Madhopur district, Rajasthan. Rajasthan's unique geological landscape, characterized by fluoride-rich minerals and a semi-arid climate, poses a significant risk for endemic fluorosis.

Groundwater samples were collected from tube wells (T/W) and open wells (O/W) across villages including Math, Meri, Phulwara, Kunsay, Raipur, Khandeep, Shekhpur, Kharera, Chhakra, and Kherla. The samples were analyzed following standard protocols and compared against the Bureau of Indian Standards (BIS) IS 10500:2012. Furthermore, the study explores the potential of wheat husk as a sustainable adsorbent for de-fluoridation.

KEYWORDS: *Fluoride Contamination, Groundwater Quality, Rajasthan Geology, Wazeerpur Tehsil, Dental Fluorosis, Skeletal Fluorosis, De-fluoridation, Wheat Husk Adsorbent, BIS Standards (IS 10500:2012), Public Health Risk.*

How to cite this paper: Ganga Shy Meena "An Analysis of Fluoride Concentration in Ground Water of Villages Kherla, Chhakra, Sekhpur, Kherara, Raipur, Math, Kusay, Meri, Phulwara, Khandeep (Rajasthan)" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-10 | Issue-1, February 2026, pp.251-256, URL: www.ijtsrd.com/papers/ijtsrd100050.pdf

IJTSRD100050

1. INTRODUCTION

Drinking water is a major source of fluoride in daily life. Fluoride is also found in food, some Medications, tea, toothpaste. Fluoride in groundwater is a major negative ion found in various forms. After entering the body, About 99% of fluoride gets stored in bones and teeth due to excessive intimacy of calcium. Fluoride ion By displacing the calcium of teeth and bones, it increases fluorosis disease, causing bones to harden and weakened. In the teeth, brittle and deep spots are formed. The process of formation of bone and teeth in children is more affected by this.

Environment and human factors are responsible for the concentration of fluoride in the groundwater contains high amount of fluoride in crystalline and sedimentary rocks In limestone, asbestos, granite, basalt phosphorite, etc., which gradually enters the water. Similarly, fluoride found in pesticides and fertilizers also enter the soil. Groundwater is the main source of drinking water in developing countries. world Health Fluoride has been determined in high amounts in the WHO ;1.0 ppm, SI 10500:2012 : 1.5ppm drinking water standard.

There is a source of drinking water for millions of residents, which increases the results of this contamination, Daily consumption and agriculture is dependent on these water sources, so also moderate levels of fluoride Over time, it is accumulating in harmful concentrations. Where groundwater source is designed to maintain water, Prolonged health is a possible source of risk.

Many affected communities are in rural areas where there is a shortage of safe water option sources and Infrastructure is underdeveloped for advanced water treatment. This dependence on ground water Not only does a significant health threat, but it also disrupts the socio -economic progress of the region. A significant understanding and development of fluoride contamination requires. This detailed introduction to the original effect and possible solutions Fluoride

makes a platform for contamination for which it must be given immediate light. Fluoride contamination under the ground is an important and intensive environmental health crisis. Therefore, it is necessary to throw light on complex factors contributing to its existence.

Fluoride is a naturally found element found in various minerals including fluorite, fluorspar and fluorapatite. It is the 13th most abundant element in the earth's crust and is present in water, soil, plants and animals. While fluoride is necessary for human health, excessive intake can cause serious health problems.

Fluoride contamination has emerged as the biggest contribution in Rajasthan. This issue is the specific geology and dry climate of the region, Chemical processes are also run by industrial activities etc.

Wide desert region in Rajasthan's scenario, ancient rock structures , Due to prolonged natural weathering and erosion process due to naturally rich minerals Fluoride is leaked in ground water.

2. Review Of Literature:-

Ground water is the main source of drinking water and domestic use in rural and town areas of Rajasthan. The quality of groundwater is directly related to human health. due to geological structure and dry climatic conditions in many areas of Rajasthan state, excess fluoride in groundwater has emerged as a serious problem.

in the presented report, the fluoride level in the groundwater of selected villages of Maath, Meri, Phulwara, Kunsai, Raipur Khandid, Shekhpur, Kharera, Chhakra, Kherla of Wazirpur tehsil of Sawai Madhopur district (Rajasthan) has been tested and evaluated. The objective of this study is to assess the drinking water suitability of groundwater and identify health risks caused by fluoride. the fluoride levels in the samples taken from ground water sources of the above villages were found to be 0.21, 1.11, 0.67, 0.50, 2.41, 1.52, 1.38, 1.38, 0.39 and 1.29 mg/litre respectively.

the study shows that the fluoride content in Math, Phulwara, Kunsay, Chhakra villages was found to be within the desirable limits (IS 10500:2012 – 1.0 mg/litre). In Meri, Sekhpur, Kharera, Kherla it is found within the permissible limit (IS10500:2012-1.5 grams/litre). particularly in Raipur and Khandeep, fluoride levels exceeding the permissible limit (1.5 mg/litre) may pose health risks. This shows the need for safe drinking water supply and appropriate treatment measures in the study area.

3. Objectives of the Study:-

The primary objectives of this research are as follows:

- To **quantify the concentration of fluoride** in groundwater samples from ten selected villages in Wazeerpur Tehsil.
- To **assess the suitability** of these water sources for human consumption based on Bureau of Indian Standards (BIS) IS 10500:2012.
- To **identify specific geographical hotspots** (villages) where fluoride levels exceed the permissible limit of 1.5 mg/L.
- To **evaluate the potential of wheat husk** as an eco-friendly and low-cost bio-adsorbent for the removal of fluoride from contaminated water.
- To **raise awareness** regarding the health impacts of fluorosis and suggest mitigation strategies for the local community.

4. Research Methodology:-

Experimental De-fluoridation (Wheat Husk Study)

A unique part of your methodology is the work plan to use **wheat husk** as a bio-adsorbent:

- **Preparation:** Wheat husk is washed, dried, and sometimes chemically treated (with acid or base) to increase its surface area and porosity.
- **Adsorption Process:** Known quantities of contaminated water from Raipur or Khandeep are treated with varying dosages of wheat husk.
- **Mechanism:** The fluoride ions are physically or chemically adsorbed onto the surface of the husk. This is a "Batch Adsorption Study" where factors like contact time, pH, and adsorbent dose are monitored.

Data Interpretation

- **Comparative Analysis:** The results were tabulated and compared against national health safety standards.
- **Statistical Mapping:** High-risk zones were identified (Raipur and Khandeep) where the concentration exceeded 1.5 mg/L.

Mitigation Remedy:

1. Defloridation Technology:

Various methods are used to remove fluoride from drinking water, including active alumina filter reverse osmosis and admission to use. These techniques can effectively reduce fluoride levels, which makes water safe for water consumption

2. Rainwater harvesting:

The collection of rainwater and storage can provide an alternative source of drinking water that is free from fluoride contamination. For complementing groundwater sources, rainwater harvesting systems should be promoted in both rural and urban areas.

3. Public Awareness Campaign:
The public will have to educate the dangers of fluoride and make them aware to promote safe water sources.

Boundaries
The study will not address the interference of ions and particles such as Ca+2, Mg+2, Fe+2 and Ti+2 present in water. Furthermore, structural characterization and morphological studies of the adsorbents used are beyond the scope of the present study .

Work Plan
Municipal – Wazeerpur and 44 Villages of Wazeerpur Tehsil Area is divided into 4 parts, ground water samples will be collected and studied and work will be done on the removal of fluoride using wheat husk.

Method Of Sampling:
Sample Collection
For sampling fluoride concentration in ground water, in Wazeerpur Tehsil, standard ground water sampling protocol will be followed. Here is a basic outline of the process, which will be adjusted according to specific needs and guidelines.

Site Selection/ Study Area
Samples of ground water were taken and analyzed in the first phase from the municipal – the fluoride level in the groundwater of selected villages in the study area - Math, Meri, Phulwara, Kunsai, Raipur Khandid, Shekhpur, Kharera, Chhakra and Kherla has been tested and evaluated. The main source of drinking water is tube wells.

Sampling Equipment Sample Bottles:
Clean, glass bottles will be used for sample collection. Sterilizing Materials: Sample bottles will be cleaned with distilled water to avoid contamination.


Khandeep


Raipur


Sheldipet


Kharera


Chhakia
शुभ


Khela

The borehole/head pump will be flushed for 10-15 minutes to collect fresh ground water samples. Approximately 1 liter of water will be collected in each sample bottle by escaping air bubbles. The bottles will be tightly sealed, marked with the place, date and time of collection and then tested on time.

5. Analysis and Discussion:-

Geological Factors:

The characteristic of Rajasthan's geological texture is the presence of minerals with fluoride within its foundation, especially fluorite, the weathering of these minerals, a natural process, fluoride in groundwater releases the ions. By incorporating different types of rocks, the specific cravings of this region determine the spatial variability of fluoride concentrations. In areas with high concentrations of these minerals, the level of fluoride in their groundwater is essentially higher in areas with high concentrations of minerals.

Effect of Aravalli ranges:

The Aravalli ranges act as an important determinant in the distribution of a major geopolitical characteristic fluoride. The geological structures associated with this category and the surrounding areas are prominent to high concentrations of fluoride from particular. Structural geology of the region, including defects and fractures, facilitates the movement of groundwater and fluoride from rocks.

Dependence on groundwater:

Rajasthan has heavy dependence on groundwater resources for dry and semi -dry climate. This dependence increases the vulnerability of the population for fluoride contamination. The depth and flow pattern of waterlogged plays an important role in determining fluoride concentrations. Long contact with fluoride -rich rocks can display deep hydrolic high levels due to long -term contacts.

Agricultural methods:

The extensive use of phosphate -based fertilizers in agriculture contributes to fluoride contamination. These fertilizers contain fluoride which sits into soil and later in groundwater. The use of fluoride contaminated groundwater for irrigation causes accumulation of fluoride in soil and crops, which can pose a threat to human and animal health, it also has a negative effect on crop yields.

Industrial activities:

Some industries such as aluminium melting and phosphate mining leave fluoride in the environment through their waste products and emissions. It goes into industrial fluoride ground water.

Effect on health:

Consumption of excessive fluoride can lead to fluorosis salt conditions that affect teeth and bones. The health effects of fluoride contamination are particularly serious for children whose developing bodies are more sensitive to the effects of high chloride stars such as –

1. Dental Fluorosis:

Dental fluorosis causes teeth colour to deteriorate and teeth burst, this is the most common among children who consume high levels of fluoride during their teeth growth years. It can also increase the decay and sensitivity of teeth

2. Scental Fluorosis:

Skental fluorosis is a more severe condition, it affects bones and joints, which cause pain in stiffness and distortion in extreme cases. Skeletal fluorosis can result in chronic pain and disability, which severely affects the quality of life of the affected person.

6. Findings:-

Standard adopted:

the quality of fluoride in ground water has been assessed as per Bureau of Indian Standards (BIS) –
IS 10500:2012:
Desirable limit: 1.0 mg/litre
Permissible limit: 1.5 mg/litre

Fluoride Concentration Details:

S. No.	Particular of Source (Village Name)	Sources	pH	T.Alk	T.H.	Cl	No3	Fluoride (F)	TDS
	Max. Permissible Limits as per IS 10500-2012		**6.5-8.5**	**</=600 mg/l**	**</= 600 mg/l**	**</= 1000 mg/l**	**</= 45 mg/l**	**≤ 1.5 mg/L**	**</=2000 mg/l**
1	Math	T/W	7.3	210	190	110	7	0.21 mg/L	520
2	Meri	T/W	7.2	180	130	90	4	1.11 mg/L	417
3	Phulwara	T/W	7.2	150	120	60	3	0.67 mg/L	320
4	Kunsay	T/W	7.4	360	320	270	22	0.50 mg/L	1010
5	Raipur	T/W	7.2	350	170	210	15	2.41 mg/L*	788
6	Khandeep	T/W	7.2	310	200	110	9	1.52 mg/L*	640
7	Shekhpur	T/W	7.2	580	370	440	11	1.38 mg/L	1569
8	Kharera	O/W	7.4	2580	3570	1340	130	1.38 mg/L	9747
9	Chhakra	T/W	7.2	980	1170	990	59	0.39 mg/L	3214
10	Kherla	T/W	7.4	1840	3500	1820	120	1.29 mg/L	7360

*Above permissible limit

7. Conclusions:-

The study concludes that the quality of groundwater is not uniform in the selected villages. Fluoride concentration in Math, Phulwara, Kunse, Chhakra villages is within the desirable limit (IS 10500:2012 – 1.0 mg/litre). In Meri, Sekhpur, Kharera, Kherla it is found within the permissible limit (IS10500:2012-1.5 grams/litre). especially in Raipur and Khandeep, the water quality in these villages is not satisfactory due to fluoride levels exceeding the permissible limit (1.5 mg/litre), the water has been found unfit for drinking due to excess fluoride.

8. Recommendations:-

1. de-fluoridation plants should be set up in high fluoride affected villages.
2. Alternative safe drinking water sources should be available.
3. Rain water harvesting should be encouraged.
4. Ground water quality should be monitored regularly.
5. villagers should be made aware of the ill effects of fluoride

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