International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 08 | August - 2022 Impact Factor: 7.185 ISSN: 2582-3930

# Study and Analysis of Fluoride Contamination in Drinking Water with different Stages

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**ABSTRACT -** Drinking water is the biggest contributor to daily fluoride intake. The dissolution of fluorine-containing rock minerals is a natural source of fluorides in groundwater, while the use of phosphate fertilizers, sewage sludge, or pesticides is the artificial source of fluoride in groundwater and surface water. Fluoride concentrations that exceed the standards cause fluorosis of the teeth and skeleton. Fluoride toxicity can also cause non-skeletal conditions such as joint aches and pains, non-ulcer dyspepsia, polyuria (a tendency to urinate frequently), polydipsia (excessive urgency), muscle weakness, fatigue, and anemia with low hemoglobin levels.

**Keywords-** Groundwater, Fluoride, Dental Fluorosis.

## 1. INTRODUCTION

Various types of cheap and effective adsorption media such as clay, industrial solid waste such as red clay, use of soil bleaching, used catalysts and fly ash, activated alumina, carbonaceous materials, bone coal, natural zeolite and synthetics, etc. A review focusing on the sources of fluorine in drinking water, their health effects, and various control measures. Water is an essential resource for all life on this planet. Water covers more than 71% of the Earth's surface and is a very important natural resource for people. The earth is full of natural resources needed for human development. Day by day the increasing demand has led to the development of new methods of water quality assessment and management. Water is the primary means of human ingestion of fluoride. Fluoride in drinking water can be beneficial or harmful to health, depending on its concentration [1]. The presence of fluoride in drinking water within the permissible limits is useful in the calcification of tooth enamel. According to the World Health Organization (WHO), the maximum acceptable concentration of fluoride is 1.5 mg/L, the acceptable limit in South Africa is 0.75 mg/L, while the permissible limit for fluoride in drinking water in India is 1 mg/L.

Concentrations exceeding these parameters showed dental and skeletal fluorosis, as well as endocrine, thyroid and liver damage. Fluoride stimulates bone formation and small concentrations have beneficial effects on teeth, hardening enamel and reducing the incidence of caries. Mc Donagh et al. describe in detail the role of fluoride in the prevention of fluorosis [2]. At low levels (less than 2 ppm) soluble fluoride in drinking water can cause enamel staining during tooth formation, but at higher levels other toxic effects can be seen. Severe symptoms lead to death when fluoride doses reach 250-450 ppm. It turns out that the IQ of children in areas with a high concentration of fluoride (3.15 ppm of fluoride in drinking water) is much lower.

Ingested fluorides are rapidly absorbed in the gastrointestinal tract, 35-48% are retained in the body, mainly in skeletal and calcified tissues, the rest is largely excreted in the urine. Chronic ingestion of fluoride-rich feed and water in endemic areas leads to the development of fluorosis in animals, for example. Tooth discoloration, difficulty chewing, bone lesions, lameness, weakness and death. In addition to the health effects, dental fluorosis can have social and psychological consequences [3]. There has been an escalation in daily fluoride intake across the overall human food and beverage chain, with the potential for this escalation to continue in the future. Soft drinks contain large amounts of fluoride. Beer brewed in places with high levels of fluoride in water can contribute significantly to your daily fluoride intake, and sweetened iced teas contain significant amounts of fluoride [4].

One serving of chicken fingers will provide about half of the child's safe upper limit of fluoride. Children's intake of fluoride from juices and flavored drinks can be a significant factor in the development of fluorosis. Pura and Dai report that a large number of the population in India is severely affected by fluorosis. More than 15 states are affected by endemic fluorosis in India. This article states that different fluoride concentrations affect human health [5].

## 2. SOURCES OF FLUORIDE AND HEALTH EFFECTS OF FLUORIDE

Dental fluorosis, characterized by discolored, misshapen, macular, or chalky teeth, is a clear indication of excessive fluoride exposure during childhood, when teeth were developing. These effects do not appear if the teeth have fully grown before exposure to excessive fluoride. Therefore, the fact that an adult does not show signs of dental fluorosis does not necessarily mean that their fluoride intake is within safe limits.

Chronic excessive fluoride intake can lead to severe and permanent deformities of the bones and joints called skeletal fluorosis. Early symptoms include intermittent pain and joint stiffness: headaches, stomach aches, and muscle weakness can also be warning signs. The next stage is osteosclerosis (hardening and calcification of the bones) and finally damage to the spine, major joints, muscles and nervous system. Whether it is related to the teeth or the skeleton, fluorosis is irreversible and there is no cure. The only treatment is prevention, and keeping fluoride intake within safe limits. Research conducted by various researchers over the past five to six years has proven that the persistent effect and accumulation of fluorides not only cause damage to the human skeleton and teeth, but also lead to changes in DNA structure, paralysis, cancer, etc.

## 3. FLUORIDE CONCENTRATION IN DRINKING WATER SOURCES

Fluoride concentrations ranged between 0.2-13.5 mg/L in all studied water sources. Concentrations vary from place to place with sources, the general spatial variance is broad-spectrum and varied. It is notable that fluoride concentrations in groundwater sources are very high compared to surface water sources, and this appears to be due to the dynamic nature of the groundwater system that is influenced and controlled by the geology and structural composition of the area.

## 4. SAMPLE COLLECTION AND ANALYSIS

Water samples were collected in polyethylene bottles, which were vigorously washed with detergent and rinsed with distilled water. As a precaution, all sample bottles were again vigorously washed with water to be tested. These samples were analyzed within 24 hours of their collection in the field laboratories. A fluoride ion meter (Model 290A) was used to analyze fluoride concentrations in water samples. The obtained results show wide spatial variation in the values of all analyzed parameters. It indicates the diversity in geochemistry in the region. Parameters such as fluoride concentrations were above the prescribed limit of 1.5 mg/L. The drinking water sources are from ground and surface waters in most villages. It was observed that the concentration of fluoride and calcium has an inverse relationship in the occurrence in both surface water and groundwater surface in the region.

## 5. FLUORIDE ION SELECTIVE ELECTRODE METHOD

- Instrument Ion- Selective meter, Fluoride electrode, Magnetic stirrer.
- Reagents Fluoride Standards of various ranges (0.2-20 ppm).
- Procedure Samples of solutions for calibration instruments were prepared from the standard.

The instrument is calibrated with standard fluoride solutions prior to performing the experiment. The occurrence of fluoride in groundwater is mainly a natural phenomenon, mainly affected by local and regional geological conditions and hydro-geological conditions.

## 6. METHODOLOGY

The potentiometric method is based on potentiometrics that measure the electromotive force of a galvanic element. Direct voltammetry determinations are almost always made using ion-selective electrodes (ISEs), which are capable of making rapid and selective measurements of analyte concentration.

An ion-selective electrode is sensitive to analyte concentration due to the properties of the ion-selective membrane that provides the interface between the ion-selective electrode and the sample solution. The ability of the ion-selective membrane to conduct current depends to some extent on the presence of the analyte in solutions on both sides of the membrane. The mechanism of this dependence varies, but generally depends on some reaction of the analyte at the membrane surface. The analysis was performed using a fluoride ion meter (Model 290A) equipped with a WTW R 500 reference electrode and the F 500 as an ion-selective electrode. In Figure 1 the reference electrode and an ion selective electrode are schematically shown, where 1 indicate the filling opening for the bridge electrolyte, fluid level of the bridge electrolyte, 3 the inner junction that must be covered with bridge electrolyte and 4 the junction earth indicating the minimum immersion depth.

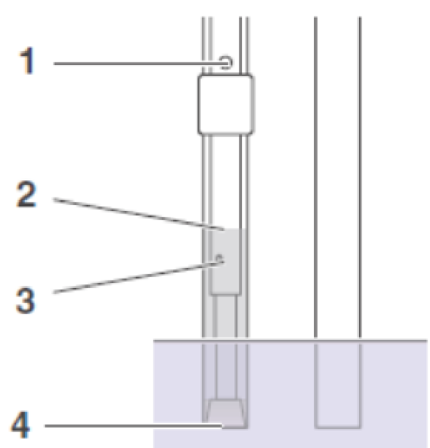


**Figure 1 Schematic representation of reference and an ion-selective electrode.**

1 Indicate the filling opening for the bridge electrolyte,

2 Fluid level of the bridge electrolyte,

3 The inner junction which must be covered with bridge electrolyte

4 The ground junction.

For measurements with the F 500 fluoride electrode, a reference electrode is required. In our investigation, R 500 was used as a reference electrode. The two electrodes together form a double rod combination electrode. The ion-selective electrodes were stored in dilute aqueous standard solution. We are founded the measuring range for fluorine electrode is 1.0-3.0 mg $L^{-1}$.

**7. RESULT AND DISCUSSION**

The details of the contamination level in groundwater before filtration shown in Figure 2. Details of the contamination level and fluoride concentrations (mg $L^{-1}$) in groundwater after filtration (First stages as without mixing of the solution agents) shown in Figure 3. Details of the contamination level and fluoride concentrations (mg $L^{-1}$) in groundwater after filtration (Second stages as with mixing of the solution agents) shown in Figure 4. Details of the contamination level and fluoride concentrations (mg $L^{-1}$) in groundwater after filtration (Third stages as with mixing of the solution agents) shown in Figure 5.

**Table 1 Details of the contamination level in groundwater before filtration.**

| Sl.No. | Name of Lakes | Minimum | Maximum | Average |
|---|---|---|---|---|
| 1 | Adhartal Lake (L1) | 0.2 | 18.6 | 9.4 |
| 2 | Madhotal Lake (L2) | 0.4 | 11.2 | 5.8 |
| 3 | Ranital Lake (L3) | 0.6 | 15.6 | 8.1 |

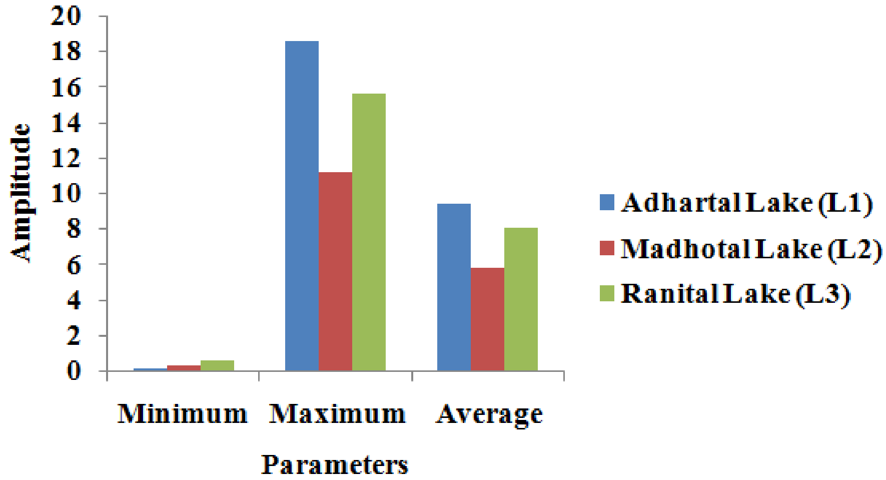


**Figure 2 Details of the contamination level in groundwater before filtration.**

**Table 2 Details of the contamination level and fluoride concentrations (mg $L^{-1}$) in groundwater after filtration (First stages).**

| Sl.No. | Name of Lakes | Minimum | Maximum | Average | Fluoride concentration (mg $L^{-1}$) |
|---|---|---|---|---|---|
| 1 | Adhartal Lake (L1) | 0.2 | 9.4 | 9.2 | < 0.5 |
| 2 | Madhotal Lake (L2) | 0.4 | 5.2 | 4.8 | 0.5-1.5 |
| 3 | Ranital Lake (L3) | 0.6 | 8.5 | 7.9 | 1.5-3.0 |

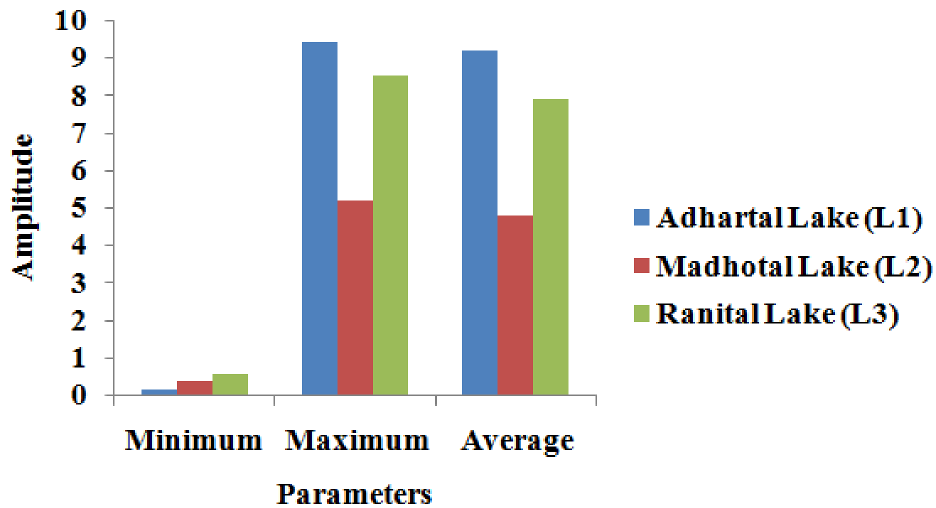

**Figure 3 Details of the contamination level and fluoride concentrations (mg L$^{-1}$) in groundwater after filtration (First stages).**

**Table 3 Details of the contamination level and fluoride concentrations (mg L$^{-1}$) in groundwater after filtration (Second stages).**

| Sl.No. | Name of Lakes | Minimum | Maximum | Average | Fluoride concentration (mg L$^{-1}$) |
|---|---|---|---|---|---|
| 1 | Adhartal Lake (L1) | 0.2 | 9.3 | 9.1 | < 0.5 |
| 2 | Madhotal Lake (L2) | 0.4 | 5.0 | 4.6 | 0.5-1.5 |
| 3 | Ranital Lake (L3) | 0.6 | 7.8 | 7.2 | 1.5-3.0 |

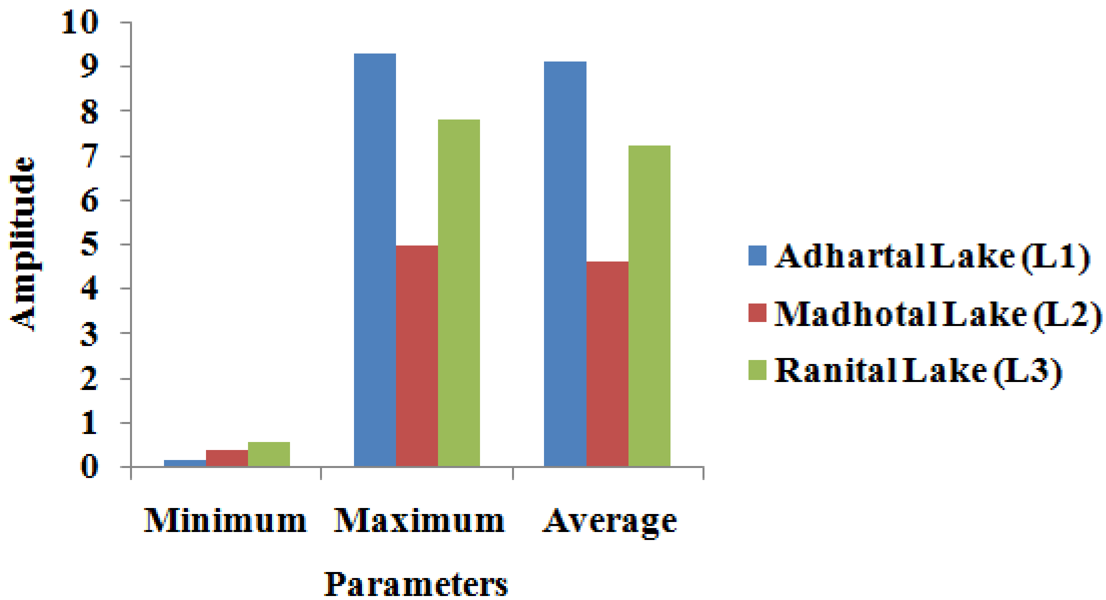


**Figure 4 Details of the contamination level and fluoride concentrations (mg L$^{-1}$) in groundwater after filtration (Second stages).**

**Table 4 Details of the contamination level and fluoride concentrations (mg L$^{-1}$) in groundwater after filtration (Third stages).**

| Sl.No. | Name of Lakes | Minimum | Maximum | Average | Fluoride concentration (mg L$^{-1}$) |
|---|---|---|---|---|---|
| 1 | Adhartal Lake (L1) | 0.2 | 9.3 | 9.1 | < 0.5 |
| 2 | Madhotal Lake (L2) | 0.4 | 5.0 | 4.6 | 0.5-1.5 |
| 3 | Ranital Lake (L3) | 0.6 | 7.8 | 7.2 | 1.5-3.0 |

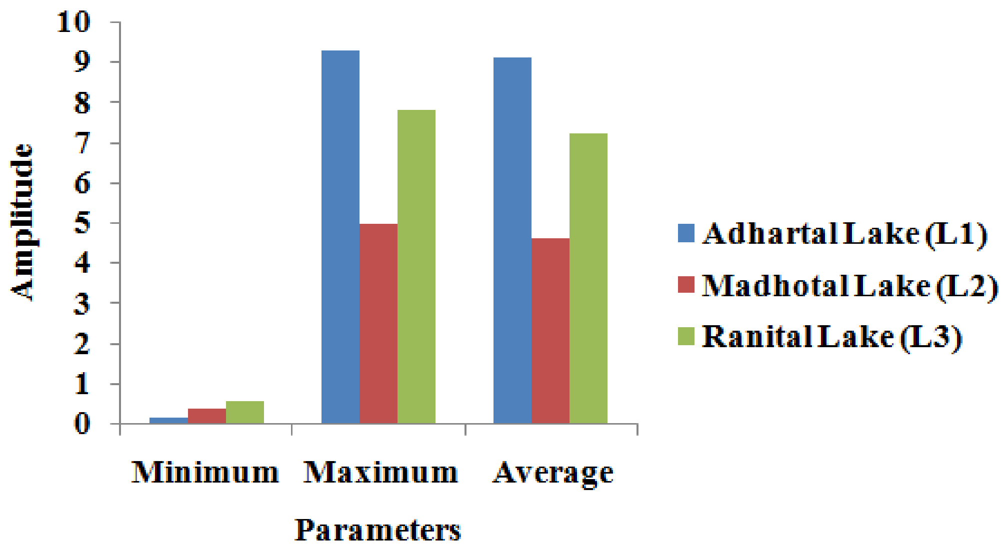


**Figure 5 Details of the contamination level and fluoride concentrations (mg L$^{-1}$) in groundwater after filtration (Third stages).**

**8. CONCLUSION**

Rock minerals and waste disposal contribute to groundwater pollution with fluoride. Researchers looked at different concentrations of fluoride for different diseases. To mitigate fluoride contamination in the affected area, provision of safe, low-fluoride water from alternative sources should be verified as a first choice; otherwise, various methods developed for water defluoridation can be used to avoid fluoride contamination. Groundwater in a particular area must be thoroughly studied before it is used for domestic purposes, and thus a suitable method for its treatment can be chosen. It is obtained the fluoride concentrations (mg L$^{-1}$) in groundwater after filtration (Second stages) has a minimum difference using $ZnCl_2$ and $H2O_2$ solution, which is shown in Table 3 and Figure 4.

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