# Fluoride Contamination Status of Groundwater in Villages of Sanganer Tehshil of District Jaipur (Raj.)

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**Abstract**

A big concern around the globe is fluoride pollution in water, with health threats such as dental and skeletal fluorosis. The problem of groundwater contamination is faced by the Sanganer tehsil. In the current investigation, the determination of fluoride in drinking water in (40 samples of) 20 Villages of Sanganer tehsil with a fluoride content greater than the acceptable level (>1.5 mgl-1) was carried out. Symptoms of skeletal and gut fluorosis were observed in some inhabitant after the survey. The highest concentration of fluoride was found in Mandau village. The samples of water were alkaline with a pH ranging from 7.5 to 10.00 There was a spectrum of electrical conductivity (EC) from 370 µmhoScm-1 to 2350 µmhoScm-1. The overall hardness (TH) ranged between 69 and 560 mgl-1. Chloride ranged from 105.00 mgl-1 to 890.00 mgl-1 and 0.82 to 4.10 mgl-1 fluoride. It was discovered that the alkalinity of all water samples was below the acceptable level. The findings suggested that the quality of villages of Sanganer Tehsil is poor and that it is not suitable for drinking purposes. After treatment it can be used for drinking purposes.

**Keywords**: Fluoride, Sanganer, Ground water, Pollution, Drinking Water

**Introduction**

Groundwater is a highly useful natural resource known to us and the most commonly dispersed. For municipal, industrial and agricultural reasons, it is paramount. Clean and uncontaminated groundwater is therefore pivotal for the region. Groundwater is usually cheaper, more convenient and less vulnerable to contamination as compared to surface water. (Divya Vishnoi et al.,)

Fluoride is a natural beneficial nutrient present in air, water and soil in varying amounts. It improves dental health when ingested in optimal quantities, but excess consumption (> 1.5 mgl-1) can lead to fluorosis, including dental, skeletal and non-skeletal fluorosis, along with secondary neurological complications. (Lineswara, 2003; Rajkumari and Rao, 1985; Shailaja and Jhonson, 2007; Susheela, 1993). The fluoride concentration should be in the range of 1.00 to 1.50 mgl-1 and above the upper level, according to healthy drinking water quality standards; this contributes to adverse effects on the body (WHO, 1984).

Throughout the planet, the threat of fluorosis has increasingly increased. The same problems are also faced by India. Presently, seventeen Indian states have been reported as having excess fluoride in drinking water, including Rajasthan. People from 22 districts (out of 32) are reportedly consuming fluoride in Rajasthan. (Samal and Naik, 1988) greater than permissible limit. Earlier workers (Bishnoi and Arora, 2007; Chinoy et al., 2005; Gangal, 2005; Gupta, 1991; Handa, 1988; Sharma et al., 2005; Stanley et al., 1997; Yadav et al., 2003) reported that fluoride and fluorosis was correlated with high concentration of fluoride ion in drinking water. Typically high fluoride is not found in surface water where high fluoride content can be polluted with groundwater since fluoride rich rocks are the normal source of fluoride. It leaches out the fluoride from these rocks as water percolates through the rocks. Leaching from the earth's crust is also the primary source of fluoride in groundwater. Fluoride ranges from 180 μg g-1 in sandstone and greywache to 800 μg g-1 in granites in different rock forms (Sharma et al., 1990).

More than 90% of the population in our sample region receives drinking water requirements from groundwater sources such as hand pumps and open wells. Realization of the adverse effects in the human body of water-borne fluoride, especially on the teeth and bones and due to the widespread incidence of dental and skeletal fluorosis. In the study area, a survey was conducted. Groundwater samples from 20 villages in the study region were obtained.

## Materials and Methods

### Sample Collection

Groundwater samples were collected (open well / hand pump) from 20 Villages of Sananer Tehsil villages of Rajasthan as shown in Table 1. A total of 40 samples of water samples were collected (2 samples per village) in a pre-cleaned 1 litre polyethylene bottle. In the months of July and August 2016, sampling was conducted randomly. Water samples were taken to the laboratory for examination using traditional physico-chemical parameter techniques.

### Methodology

With the assistance of a selective ion meter (Mettler Toledo MA 235 pH/ ion Analyzer), fluoride concentration was calculated. It followed the normal protocol for assessing the concentration of fluoride (APHA, 2005). The total ionic strength adjustment buffer (TISAB) was used for acceptable

results in order to preserve a sufficient ionic strength and to prevent complex formation. In addition, according to standard methods, physico-chemical parameters such as pH, EC, total hardness, chloride and alkalinity were also estimated as per standard methods (APHA, 2005). The standard values of drinking water according to WHO, USPH and ISI has been mentioned in Table 2.

**Results and Discussion**

Table 1 displays the analytical results of various samples obtained from the study area (20 villages) of Sanganer Tehsil. The result shows that the concentration of fluoride ranges from .80- 4.10 mgl-1 in groundwater samples from twenty villages. Fluoride concentration ranged from 1.25-1.90 mgl-11 in eight villages (Table 1). The concentration of fluoride in one village is very disturbing. The maximum fluoride concentration was reported in Mandua (4.10 mgl-1). 3 villages ranging from 2.00 to 2.10 mgl-1. According to WHO, the allowable limit for fluoride concentration is 1-1.5 ppm (1996). The data showed that maximum Tehsil sanganer villages have a degree of fluoride greater than the allowable limits. The discrepancy in the concentration of fluoride is possibly attributable to the difference in the rocks' chemical parts. As a number ranging from 7.5-10.0.0, pH is expressed. The number is an expression of the concentration of H+ ion in the solution. The value of pH with respect to the study area was found in the range of 7.5 to 10.00. The maximum value of pH was found in sample of Mandua village (10.0) and minimum pH (7.5) was observed from village Harbanspura (Table 1) According to WHO (1996) pH should be between 6.9-9.2. The pH was found to be within the permissible limit accept four villages of the study area. It has been observed that pH brought out positive correlation with fluoride concentration, indicating that higher alkalinity of water promotes leaching of fluoride and thus affects the groundwater. (Teotia et al., 1981; Wodeyar and Sreenivasa, 1996) (Table-2). Fluoride concentration also associated with alkalinity (Trivedi, 1988). Electrical conductivity is a numerical expression of ability of an aqueous solution to carry electrical current. USPH recommended permissible limit for electrical conductivity (EC) is 300 µmhoS cm-1(Table 2). Minimum (670µmhoS cm-1) and maximum (2350 µmhoS cm-1). EC was reported from Layalakabas and Jaichandpura villages respectively (Table 1). By analyzing the results, 98% water samples found to be within the permissible limit. 2% of samples was found to be higher than permissible limit (Table 1). A positive correlation was observed between EC and F as earlier reported by (Devi et al., 2003).

Water hardness is not a particular aspect, but a mixture of cations and anions that is variable and complex. The overall hardness (TH) ranged between 135 and 560 mgl-1. The minimum (135 mgl-1) and maximum (560 mgl-1) were recorded from the villages of Layalakabas and Harbanspura, respectively. (Chart 1). Safe allowable hardness limit recommended by WHO, i.e. 100-500 mgl-11 (Table 2). Hardness of ground water is mostly due to carbonates, bicarbonates, Ca and Mg sulphates and chlorides. To Ca-H. The admission of two villages outside the permissible limits was within the permissible limit. (Chart 1). Hardeness showed a negative association with fluoride in this study. The findings are in line with the decision of (Jain et al., 2005; Trivedi, 1988). This is mostly due to the poor solubility of fluoride (Hem, 1991). The chloride ranged between 105 and 890 mgl-1. The

minimum (105 mgl-1) was reported from the village of Shrirampura and the maximum (890 mgl-1) was reported from the village of Mandua (Table 1). The chloride content in four villages was higher than the acceptable limit (200-600 mgl-1) and lower in 16 villages. Chloride, however, has shown a strong association with fluoride. The alkalinity varied between the minimum (220 mgl-1) in Layalakabas and the maximum (930 mgl-1) in Naurottampura village (Table 1). The alkalinity of near-water samples was found to be below the allowable level (Table 1). The high alkalinity level gives the water an unpleasant taste. This showed a strong association with pH, F, EC and Cl-. The findings are in line with the results of the analysis (Jain et al, 2005).The data show that, with high levels of fluoride and alkalinity, the groundwater of Sanganer Tehsil has degraded slightly, which is a significant danger to human health. Most of the parameters were either greater than or below the allowable limit. It was therefore concluded that the ingestion of fluoride mainly by groundwater led to the production of dental and skeletal fluorosis. The drinking water in the villages of Sanagner Tehsil is therefore not potable.Continuous monitoring of physico-chemical parameters should be conducted to preserve groundwater quality and can only be used for cooking and drinking after prior care. The authors strongly recommended that some urgent steps to defluoridate drinking water should be taken, e.g. Technique of Nalgonda, established by the National Institute of Environmental Engineering Research. Some other preventive majors include vitamin C consumption in large quantities in rich food products, consuming more milk, and eating calcium-rich vegetables such as leafy vegetables. The main sources of fluoride ingestion are prevented if any of the signs of fluorosis are observed

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Table-1: Showing chemical quality of groundwater of Villages of Sanganer Tehsil.

| S. No. | Name of village | pH | F | EC | TH | $Cl^-$ | ALKALINITY |
|---|---|---|---|---|---|---|---|
| | | | (ppm) | µmhos/cm | (mg/L) | (mg/L) | (mg/L) |
| 1 | Mohanpura | 9.9 | 2.00 | 756 | 158 | 695 | 700 |
| 2 | Lyala ka bas | 8.3 | 1.75 | 290 | 69 | 300 | 220 |
| 3 | Jhanyee | 8.1 | 1.25 | 918 | 205 | 190 | 610 |
| 4 | Khatwara | 7.8 | 1.00 | 1138 | 190 | 110 | 480 |
| 5 | Peepla Bharat singh | 8.3 | 1.80 | 1125 | 165 | 150 | 635 |
| 6 | Mandau | 10.0 | 4.10 | 734 | 89 | 890 | 690 |
| 7 | Chak Harbanshpura | 8.1 | 1.40 | 1265 | 145 | 195 | 655 |
| 8 | Harbanshpura | 7.5 | 1.20 | 1500 | 90 | 290 | 540 |
| 9 | Jaichandpura | 7.8 | 0.89 | 2350 | 550 | 385 | 349 |
| 10 | Shri Rampura | 8.4 | 1.50 | 1320 | 210 | 105 | 610 |
| 11 | Chimanpura | 8.25 | 0.94 | 1455 | 435 | 168 | 510 |
| 12 | Shri Ramgopalpura | 7.9 | 0.82 | 1800 | 540 | 555 | 465 |
| 13 | Keshopura | 8.1 | 0.90 | 2165 | 410 | 438 | 430 |
| 14 | Bhankrota Kalan | 8.2 | 1.67 | 918 | 410 | 350 | 710 |
| 15 | Asarpura | 9.7 | 2.10 | 690 | 210 | 745 | 650 |
| 16 | Ganpatpura chakno.2 | 9.8 | 2.00 | 295 | 390 | 790 | 760 |
| 17 | Mangyawas | 7.9 | 1.20 | 1830 | 285 | 180 | 840 |
| 18 | Singarpura | 8.4 | 1.78 | 1890 | 385 | 185 | 930 |
| 19 | Narrotampura | 8.6 | 1.90 | 1745 | 180 | 110 | 715 |
| 20 | Ramsinghpura | 8.0 | 1.10 | 1950 | 195 | 230 | 290 |

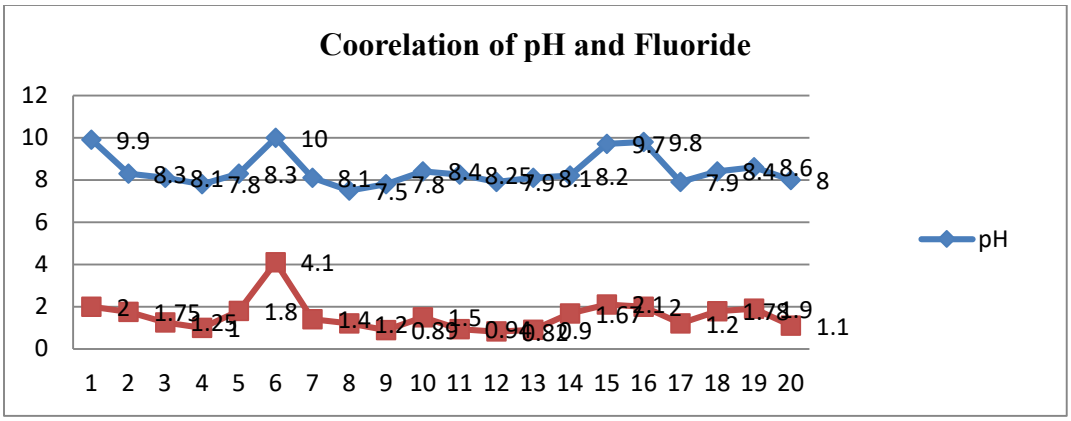


Fig - 1: shwoing coorelation of pH and Fluoride (F-ppm) of twenty villages of Sanganer Tehsil

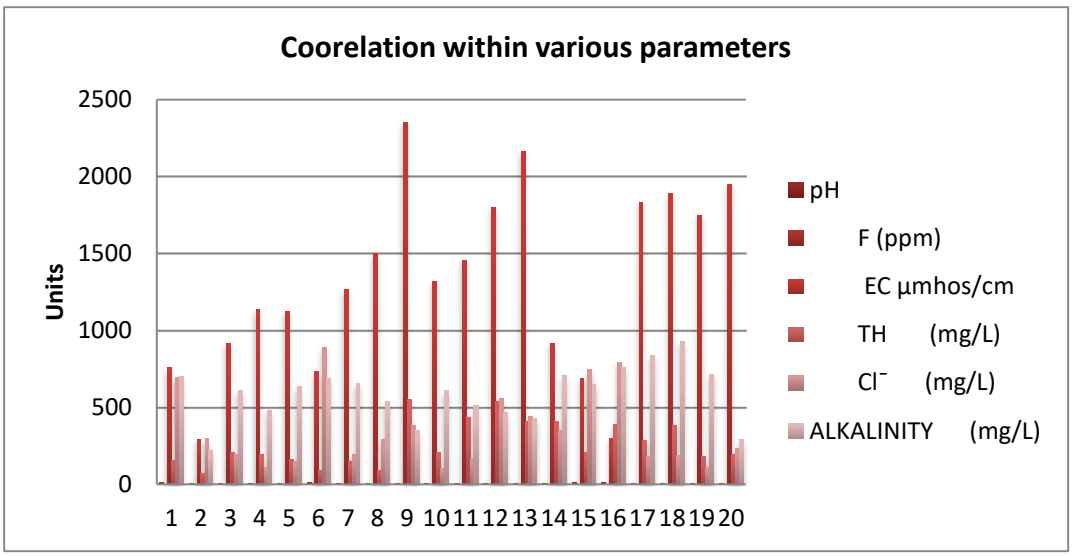


Fig - : shwoing coorelation of all parameters of twenty villages of Sanganer Tehsil

**Table-2: Indian Standards for Drinking Water**

| Parameters | USEPA | WHO | ISI | ICMR | CPCB |
|---|---|---|---|---|---|
| pH (mg/l) | 6.5-8.5 | 6.5-8.5 | 6.5-8.5 | 6.5-9.2 | 6.5-8.5 |
| Turbidity NTU | - | - | 10 | 25 | 10 |
| Conductivity (mg/l) | - | - | - | - | 2000 |
| Alkalinity (mg/l) | - | - | - | - | 600 |
| Total hardness (mg/l) | - | 500 | 300 | 600 | 600 |
| Iron *mg/l) | - | 0.1 | 0.3 | 1.0 | 1.0 |
| Chlorides (mg/l) | 250 | 200 | 250 | 1000 | 1000 |
| Nitrate (mg/l) | - | - | 45 | 100 | 100 |
| Sulfate (mg/l) | - | - | 150 | 400 | 400 |
| Residual (mg/l) free Chlorine | - | - | 0.2 | - | - |
| Calcium (mg/l) | - | 75 | 75 | 200 | 200 |
| Magnesium (mg/l) | - | 50 | 30 | - | 100 |
| Copper (mg/l) | 1.3 | 1.0 | 0.05 | 1.5 | 1.5 |
| Fluoride (mg/l) | 4.0 | 1.5 | 0.6-1.2 | 1.5 | 1.5 |
| Mercury (mg/l) | 0.002 | 0.001 | 0.001 | 0.001 | No relaxation |
| Cadmium (mg/l) | 0.005 | 0.005 | 0.01 | 0.01 | No relaxation |
| Selenium (mg/l) | 0.05 | 0.01 | - | - | No relaxation |
| Arsenic (mg/l) | 0.05 | 0.05 | 0.05 | 0.05 | No relaxation |
| Lead (mg/l) | - | 0.05 | 0.10 | 0.05 | No relaxation |
| Zinc (mg/l) | - | 5.0 | 5.0 | 0.10 | 15.0 |
| Chromium (mg/l) | 0.1 | - | 0.05 | - | No relaxation |
| *E. coli* (MPN/100 ml) | - | - | - | - | No relaxation |