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# Groundwater Quality: with Focus on Fluoride Concentration in Rural Parts of Bagalkot District, Karnataka and Defluroidation Studies

Naveenkumar[1] Subhashchandra Police Patil[2] Dr Veena S. Soraganvi[3]
1. M.Tech Scholar, Department of civil, Basaveshwar Engineering College Bagalkot, India.
2. M.Tech Scholar, Department of civil, Basaveshwar Engineering College Bagalkot, India.
3. Professor, Department of civil, Basaveshwar Engineering College Bagalkot, India.
E-mail Id: naveendg45@yahoo.com

**Abstract**
Water is an essential natural resource for sustenance's of life and environment that we have always thought to be available in abundance and free gift of nature. However chemical composition of surface or subsurface water is one of the prime factors on which the suitability of water for domestic, industrial and agriculture purpose depends. In North Karnataka region especially Bijapur, Bagalkot and Gadag districts are dry and drought prone areas. Dependability of ground water for drinking and irrigation is more. Fluoride is one of the main problems associated with the quality of ground water in the area resulting into dental and skeletal Fluorosis. Generally higher proportions of dissolved constituents are found in ground water than in surface water because of greater interaction of ground water with various materials in geologic strata. Therefore in this study Groundwater quality studies of Bagalkot district with focus on Fluoride is carried out. Defluoridation by fixed bed adsorption using mixed bed containing zeolite, Alumina and Bone ash in equal proportion in a column is performed. The method is simple and economical and removes 50-60% of Fluoride. Therefore the method can be used where the Fluoride content up to 3-3.5 mg/L and fluoride affected area are shown in maps.
**Keywords:** Fluoride Defluoridation Zeolite Adsorption

## 1. INTRODUCTION

Groundwater is one of the most valuable natural resource and therefore its protection and management is vital for human evolution, socio-economic development and ecological diversity. Groundwater chemistry is a largely function of mineral composition of the aquifer through which it flows. Fluoride is naturally beneficial nutrient found in varying concentration in air, water and soil. According to safe drinking water quality standards, the concentration of Fluoride should be in the range of 1.00 – 1.5 mg /L and beyond the upper level it leads to harmful effect on the body. The treatment of fluorosis has been rapidly increasing throughout the world. India is also confronting the same problem. Presently 17 Indian states have been identified as having excess Fluoride in drinking water. Fluorosis was correlated with high concentration of Fluoride ion in drinking water. Usually the surface water does not contain high Fluoride where as groundwater may be contaminated with high Fluoride content because the usual source of Fluoride is Fluoride rich rocks. When water percolates through rocks it leaches out the Fluoride from these rocks. The Fluoride content of groundwater varies greatly depending on the geological settling and types of rocks. The most common fluorine bearing minerals are fluorite, apatite and micas. Therefore Fluorides problems tend to occur in place where this mineral are most abundant in the host rock. Although Fluoride can be ingested through drinking water, some food items and beverages as well as cosmetics, may contain high concentration of Fluorides. However, the most important route of intake of Fluoride has been identified to be the drinking water.

### 1.2 Study area

Bagalkot is a newly formed district in November 1997 by bi-furcating Bijapur district. Bagalkot town is the district headquarters. The district is located in the northern part of the state of Karnataka. The district is rich in resources like limestone, pink granite, copper and iron ore and dolomite and geographical location of the study area is15º49' and 16º46' N latitude, 74º58' and 76º20' E longitude.


**Fig 1: Study area**

## 2. Methodology

Extensive field work has to be carried out for the collection of groundwater samples from Bagalkot district. A preliminary survey of the Bagalkot district was performed to identify public water supply borewell and other borewells being used for drinking water and samples of borewell are collected and analyzed in laboratory. Fluoride test is analysed by Orion ion selective Electrode method. For defluoridation purpose glass column, allumina and tricalcium phosphate are used. And experiment is carried out by adsorption method.

**Preparation of Impregnated Zeolite Bed**

Zeolite (80mesh) 2kg washed with water, then impregnated (Doaped) with Calcium Phosphate (bone ash) 100gm, and Alumina ($Al_2O_3$) 100gm properly mixed using polythene bag and tilting for an hour. Then aerated to blow off extra bone ash and alumina, and dried in a hot air oven for 3 hour. This is placed in the column to perform experiments. Prepared impregnated Zeolite bed is shown in Figure 2.

**Column Experiment**

Column grade material (2kg) filled in a column of size 60cm height and 6cm diameter tapped with rubber cork to ensure proper packing. The column experiment is performed for initial Fluoride concentration of 5mg/L, 10mg/L and 15mg/L. The continuous flow at the top is given and contact time is varied by adjusting knob at the bottom of the column. Samples collected at the different times (5m, 10m, 15m) are plotted.

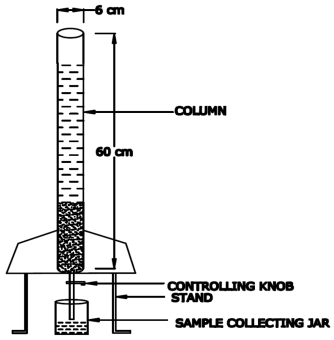



**Fig 2: impregnated Zeolite bed**

## 3. Results and Discussion

### 3.1 Fluoride

In Bagalkot district there are 6 taluks. In each taluk Fluoride affected borewells are identified and samples are collected for physico-chemical analysis. Total 287 samples are collected and analyzed and result of each taluk wise details are sowed.

| Sl.No | Taluk | No of Village | Potable | Non Potable | Fluoride(>1.5mg/L) |
|---|---|---|---|---|---|
| 1 | Bagalkot | 62 | 29 | 33 | 28 |
| 2 | Hunagund | 69 | 27 | 42 | 30 |
| 3 | Badami | 41 | 14 | 27 | 18 |
| 4 | Bilagi | 38 | 24 | 14 | 11 |
| 5 | Jamkhandi | 43 | 20 | 23 | 13 |
| 6 | Mudhol | 34 | 12 | 22 | 10 |

**Bagalkot Taluk**


**Fig 3: Map Showing Fluoride Affected Areas of Bagalkot Taluk**

**Hungund Taluk**


**Fig 4: Map Showing Fluoride Affected Areas of Hungund Taluk**

**Badami Taluk**

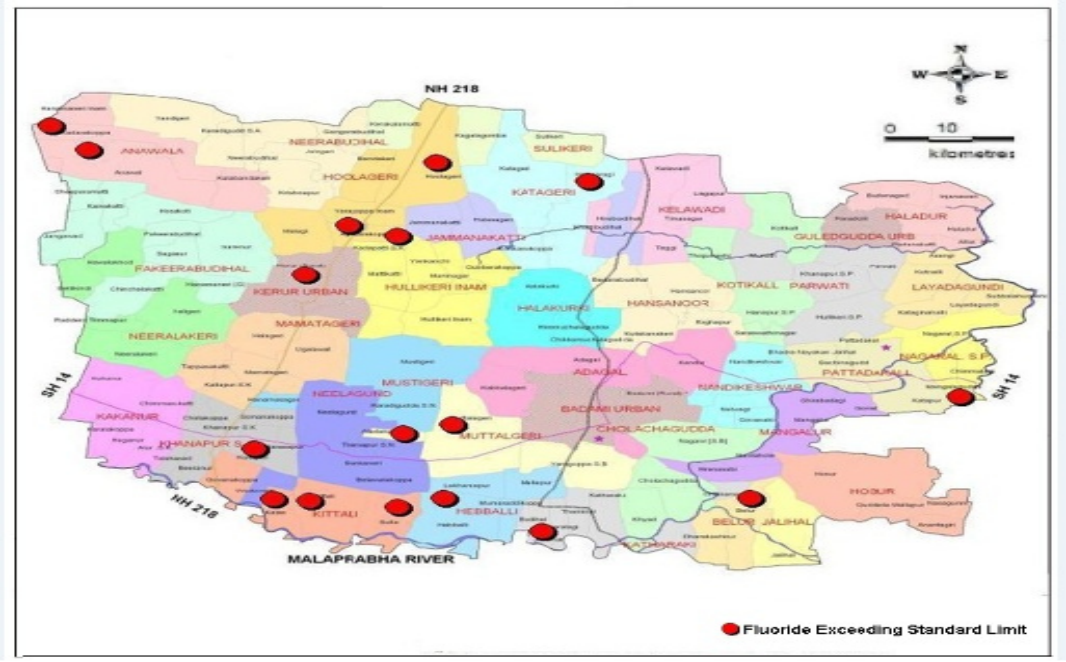



**Fig 5: Map Showing Fluoride Affected Areas of Badami Taluk**

**Bilagi Taluk**


**Fig6: Map Showing Fluoride Affected Areas of Bilagi Taluk**

**Jamakhandi Taluk**


**Fig7: Map showing Fluoride Affected Areas of Jamakhandi Taluk**

**Mudhol Taluk**

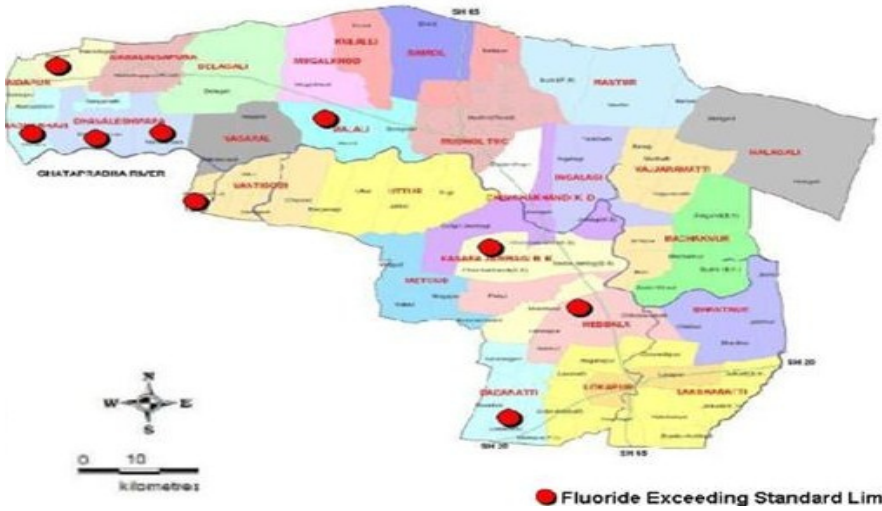



**Fig 8: Map showing Fluoride Affected Areas of Mudhol taluk**

**3.2 Defluoridation**

**Table 1 Results of Column experiment for initial concentration of 5mg/L**

| Sl no | Time in minutes | Final concentration (C) mg/L | Removal ($C_o$-C) mg/L | % Removal $\frac{Co-C}{Co}\times100$ | $\frac{C}{Co}$ |
|---|---|---|---|---|---|
| 1 | 3.2 | 2.2 | 2.8 | 56 | 0.44 |
| 2 | 4.28 | 2.1 | 2.9 | 58 | 0.42 |
| 3 | 4.38 | 2.0 | 3.0 | 60 | 0.40 |
| 4 | 7.1 | 1.98 | 3.02 | 60.4 | 0.39 |
| 5 | 8.26 | 1.9 | 3.1 | 62 | 0.38 |
| 6 | 11.44 | 1.9 | 3.1 | 62 | 0.38 |
| 7 | 13.28 | 1.9 | 3.1 | 62 | 0.38 |
| 8 | 16.26 | 1.895 | 3.105 | 62.1 | 0.379 |
| 9 | 20.6 | 1.885 | 3.115 | 62.3 | 0.377 |

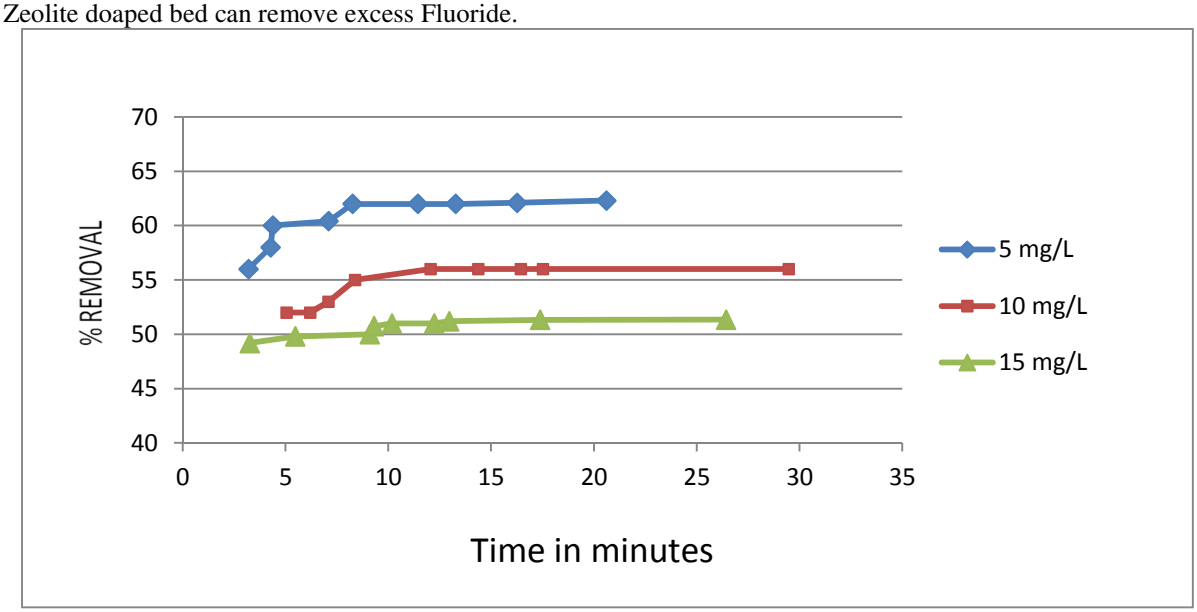
**Table 2 Results of column experiment for initial concentration of 10mg/L**

| Sl no | Time in minutes | Final concentration (C) mg/L | Removal ( $C_o$-C) Mg/L | % Removal $\frac{Co-C}{Co}\times100$ | $\frac{C}{Co}$ |
|---|---|---|---|---|---|
| 1 | 5.05 | 4.8 | 5.2 | 52 | 0.48 |
| 2 | 6.2 | 4.8 | 5.2 | 52 | 0.48 |
| 3 | 6.37 | 4.7 | 5.3 | 53 | 0.47 |
| 4 | 8.39 | 4.5 | 5.5 | 55 | 0.45 |
| 5 | 12.06 | 4.4 | 5.6 | 56 | 0.44 |
| 6 | 14.38 | 4.4 | 5.6 | 56 | 0.44 |
| 7 | 16.45 | 4.4 | 5.6 | 56 | 0.44 |
| 8 | 17.53 | 4.4 | 5.6 | 56 | 0.44 |
| 9 | 29.48 | 4.4 | 5.6 | 56 | 0.44 |

**Table 3 Results of column experiment for initial concentration of 15mg/L**

| Sl no | Time in minutes | Final concentration (C) mg/L | Removal ( $C_o$-C) mg/L | %Removal $\frac{Co-C}{Co}\times100$ | $\frac{C}{Co}$ |
|---|---|---|---|---|---|
| 1 | 3.26 | 7.62 | 7.38 | 49.2 | 0.508 |
| 2 | 5.47 | 7.53 | 7.47 | 49.8 | 0.502 |
| 3 | 9.11 | 7.5 | 7.5 | 50 | 0.50 |
| 4 | 9.31 | 7.39 | 7.61 | 50.74 | 0.492 |
| 5 | 10.17 | 7.35 | 7.65 | 51 | 0.49 |
| 6 | 12.23 | 7.35 | 7.65 | 51 | 0.49 |
| 7 | 12.97 | 7.32 | 7.68 | 51.2 | 0.488 |
| 8 | 17.39 | 7.30 | 7.7 | 51.33 | 0.486 |
| 9 | 26.42 | 7.297 | 7.703 | 51.35 | 0.486 |

In this study it is observed that with the increase in retention time of Fluoride solution with Zeolite doaped bed can remove excess Fluoride.




## 4. Conclusions

Water samples are collected from 287 bore wells out of that 161 borewell water is unfit for drinking purpose due to high content of various minerals and out of that 113 are unfit due to high Fluoride concentration. In Bilkerur (Bagalkot taluk) maximum Fluoride content of 4.1mg/L is observed. Defluoridation has been performed by Adsorption method using mixed bed containing Zeolite, Alumina and Bone ash. The method is reliable for removal of 50-60% Fluoride. The Defluoridation method can be adopted for Fluoride content upto 3.5 mg/L. For samples of higher Fluoride concentration than 3.5 mg/L fixed bed column analyzed in series can be adopted as per requirement.

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