

# Fluoride Ion in Ground Water of Delhi a Review on the Status and Solution to the Problem

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**Abstract**—About 52% of Delhi population use ground water for drinking and other purposes. Due to contamination of fluoride ion in ground water dental and skeletal fluorosis along with many other problems are commonly face by people. This paper present reviews on the concentration of fluoride ion in various areas of Delhi and proposes suitable technical and non-technical defluoridation remedies for the problem.

**Keywords:** -Ground water, dental skeletal, fluorosis, defluoridation

## Introduction

Water is essential for sustainability of life. Water contains various ions like  $\text{Ca}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{SO}_4^{2-}$ ,  $\text{CO}_3^{2-}$ ,  $\text{F}^-$ , and  $\text{HCO}_3^-$  etc. Out of these entire ions fluoride ion has both beneficial and harmful effect on human health (1). Small amount of fluoride ion is essential for bones and for the formation of dental enamel in animals and humans (2)(3)(4). If it is taken in excess amount, it causes various health impacts. The maximum permissible limit of fluoride in water is 1.5 mg/L as per WHO standards (5). 52% of Delhi lives in slums without basic services (The Hindu article 66507). These people basically use ground water for their daily purposes. The ground water is major source of fluoride ion. The objective of this study was to inquire the presence of fluoride ion concentration in ground water at various places of Delhi and study the mitigation along with management strategies to this problem.

## Description of study area

Delhi is National Capital territory of India. It is connected to the Yamuna-Ganga river system and the Punjab region. It borders the Indian states of Haryana on the north, west and south and Uttar Pradesh (UP) to the east. Delhi lies in the latitude 28.38 N and longitude 77.12 E. the location of Delhi is on the western end of the Gangetic plain, which is drained by River Yamuna. The third largest city of India. It is 16.3 million populated out of this 9 million people use ground water for drinking purpose.

## Permissible limit of fluoride in drinking water

Name of organisation	Desirable limit (mg/L)
Bureau of Indian Standards (BIS)	0.6-1.2
Indian Council of Medical Research (ICMR)	1.0
The Committee on Public Health Engineering Manual and Code of Practice, Government of India	1.0
World Health Organization (International Standards for Drinking Water)	1.5

## Sources of fluoride ion

Various sources of fluoride entering the body are drinking water, food, industrial exposure, drugs and cosmetics etc. However, drinking water is considered as the major contribution to fluoride entering the human body.

## Drinking Water:

The major source of fluoride in the groundwater is fluoride bearing rocks from which it get weathered and/or leached out and contaminates the water. Fluorides occur in three forms, namely, fluorspar or calcium fluoride ( $\text{CaF}_2$ ), apatite or rock phosphate [ $\text{Ca}_3\text{F}(\text{PO}_4)_3$ ] and cryolite ( $\text{Na}_3\text{AlF}_6$ ). Concentration of fluorides is five times higher in granite than in basalt rock areas. Similarly, shale has a higher concentration than sandstone and limestone. Alkaline rocks contain the highest percentage of fluoride (1200 to 8500 mg/kg).

## Food Items:

Besides water, food items especially agricultural crops are heavily contaminated with fluoride as they are grown in the areas where the earth's crust is loaded with fluoride bearing rocks.

**Industrial Exposure:**

Various industries involving the manufacture of phosphate fertilizers, aluminium extraction, fluorinated hydrocarbons (refrigerants, aerosol propellants etc.), fluorinated plastics (polytetrafluoroethylene etc.), petroleum refining and hydrogen fluoride manufacturing units are mainly responsible for airborne fluoride. Fluoride dust and fumes pollute the environment; inhaling dust and fumes is as dangerous as consuming fluoride containing food, water or drugs. Not only the industrial workers are affected but the people living in the vicinity of such industries may also get affected.

**Drug and Cosmetics:**

The sodium fluoride containing drugs for Osteoporosis, Osteosclerosis and dental caries are in use for many years. The prolonged use of these drugs may cause fluorosis. Additionally, the toothpastes and mouth-rinses also contain higher fluoride concentration.

**Health impact of taking excess of fluoride ion****Dental**

High fluoride intake can cause dental problem which can alter the appearance of children's teeth during tooth development. Fluoridation to 1 mg/L is estimated to cause fluorosis in one of every six people (range 4-21 years).

**Kidney**

Excess intake may induce nephrotoxicity i.e. kidney injury.

**Bones**

It can cause skeletal fluorosis. Sometimes it may lead to bone deformities. Toxic levels of fluoride have been associated with a weakening of bones and an increase in hip and wrist fracture.

**Other problem**

Beside above mentioned problems, it is also leads to muscle fibre degeneration, low haemoglobin levels, deformities in RBCs, excessive thirst, headache, skin rashes, nervousness, neurological manifestation, depression, gastro intestinal problem, urinary tract infection, nausea, abdomen pain, malfunctioning of brain, digestive system, respiratory system, central system, reproductive system etc. It is not only affect the human health and animals but also adversely affect the growth of crop.

**Current status of fluoride ion in various areas of Delhi**

Name of the area	Range of fluoride concentration (mg/L)
Maharani Enclave	1.10 – 12.59
Mohan Garden	1.10-2.21
Deepak Vihar	1.10-8.75
Palam Extension	1.10-8.24
Om Vihar	1.58-6.25
Sureksha Vihar	1.10-4.48

Hastal Village	1.10-12.89
Dwarka	0.22-4.64
Nangloi	1.7-13.6
Sagarpur	3.4-24.6
Najafgarh	0.12-12.5
Palam Village	1.2-32.5
Vivek Vihar	0.24-.083
Gandhi Nagar	0.23-0.85
Preet Vihar	0.23-0.80
Alipur	1.5-6.10

(6) (7)

**Solution to the problem**

Fluorosis was considered to be an irreversible disease till recent study. All is found that it can only be prevented cannot be cured. There are two types of solution to this problem.

**Nontechnical methods**

The children should take more milk. Consumption of tea should be reduced to minimum as it also adds to the fluoride intake. People are advised not to use groundwater for drinking and cooking purposes. Instead the awareness among people should be made about the harmful effect of using fluorinated water .(8)

**Technical methods**

A number of technical methods are reported for removal of excess fluoride ion from polluted water like reverse osmosis(9), adsorption by activated alumina, activated carbon ,activated alumina coated silica gel ,calcite, activated saw dust, activated coconut shell carbon ,activated fly ash, groundnut shell, coffee husk ,rice husk, magnesia, serpentine, tri calcium phosphate ,bone charcoal ,activated soil sorbent ,carbon deluoron-1, defluoron-2 etc.(10)

Ion exchange method, Donnandialysis, electro dialysis, nanofiltration ,electrocoagulation are some more methods reported in literature.

**Conclusion**

The presence of fluoride ion concentration in ground water exceeds permissible value almost all over Delhi. This is mostly due to geomorphology of the ground water. It is observed that fluoride concentration varies from one place to another. This may be due to fluctuation in water table at various sites. So technical as well as non-technical technique can be implemented to manage effect of fluoride ion on health.

**Acknowledgement**

We are thankful to university of Delhi for providing financial assistance .we express our sincere thanks to principal of Daulat Ram College for providing working facilities and encouragement for doing this work.

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