

## Fluoride Distribution in Groundwaters of Banera Tehsil in Bhilwara District, Rajasthan

J. HUSSAIN\*, K.C. SHARMA† and I. HUSSAIN‡

*Department of Environmental Studies, M.D.S. University, Ajmer-305 009, India*

*E-mail: drhussainj@rediffmail.com, ikbalindia@yahoo.com*

Fluoride concentration of ground water samples from 79 villages of Banera tehsil of Bhilwara district of Rajasthan was determined. In the tehsil 48 villages (61%) were found to have fluoride concentration more than 1.5 mg/L which is the maximum desirable limit of drinking water standard IS:10500, 1999. 59% inhabitants of these villages have the possibility of fluorosis. 2% Population of the tehsil living in 3 villages intakes more than 5.0 mg/L fluoride with each litre of drinking water. In these villages there is the maximum possibility of dental and skeletal fluorosis. The maximum fluoride concentration in the tehsil is recorded 13.0 mg/L in the groundwater of Kamalpura village.

**Key Words:** Fluoride, Groundwater, Fluorosis affected zones, Bhilwara, Rajasthan.

### INTRODUCTION

Fluoride is one of the important factors in water quality management due to its adverse health effects. The higher concentration of fluoride is dangerous to health; even a little concentration of fluoride in drinking water results in dental caries. Excess concentration of fluoride leads to dental and skeletal fluorosis along with secondary neurological complications. The fluoride accumulates in the bones and teeth as fluorapatite  $[\text{Ca}_{10}\text{F}_2(\text{PO}_4)_6]$ , a harder and less easily diseased material<sup>1</sup>. This causes the bones to become brittle and teeth to become porotic. Loss of weight, anorexia, anemia, wasting and cachexia are among the common findings in chronic fluoride poisoning. Fluoride causes respiratory failure, fall in blood pressure and general paralysis. Continuous ingestion of non-fatal dose of fluorides causes permanent inhibition of growth. Fluoride ions inhibit a variety of enzymes often by forming complexes with  $\text{Mg}^{2+}$  ions or by forming "fluoro-phosphate" complexes with magnesium or other metal ions<sup>2</sup>.

Fluorosis continues to remain a serious health problem in India and in several parts of the world. Endemic fluorosis in India is largely of hydrogeo-chemical origin<sup>3</sup>. Therefore, the survey of fluoride level in drinking water may help in the identification and reporting of areas sensitive to endemic fluorosis. In this paper, fluoride level of groundwater from 79 villages of Banera Tehsil of Bhilwara district is reported.

†Vice Chancellor, M.D.S. University, Ajmer-305 009, India.

‡Public Health Engineering Department (PHED) Laboratory, Bhilwara-311 001, India.

## EXPERIMENTAL

Groundwater samples of 79 villages located in Banera tehsil of Bhilwara district were collected in pre-cleaned polythene bottles with necessary precautions<sup>4</sup>. The samples were brought to the laboratory and fluoride concentration was determined by potentiometry (ISE) method<sup>5</sup>.

## RESULTS AND DISCUSSION

Fluoride concentration in groundwater of 79 villages of Banera tehsil was examined. All the villages were cauterized according to the following concentration range (Table-1):

1. Category I: Fluoride concentration below 1.0 mg/L
2. Category II: Fluoride concentration between 1.0 and 1.5 mg/L
3. Category III: Fluoride concentration between 1.5 and 3.0 mg/L
4. Category IV: Fluoride concentration between 3.0 and 5.0 mg/L
5. Category V: Fluoride concentration above 5.0 mg/L

TABLE-1  
FLUORIDE DISTRIBUTION IN BANERA TEHSIL

Category I (below 1 mg/L)	Category II (1-1.5 mg/L)	Category III (1.5-3.0 mg/L)	Category IV (3.0-5.0 mg/L)	Category V (above 5 mg/L)
Amali (0.6),	Baira (1.2),	Babrana (2.2),	Bheempura (3.6),	Ganesh Pura (5.1),
Chamanpura (0.7),	Banera (1.4),	Baldrakha (1.8),	Dolatpura (3.5),	Kamalpura (13),
Chateri Khera (0.6),	Danta Nilawari (1.3)	Balesaria (1.6),	Gharta (3.9),	Surajpur (8)
Kankolia (0.9),	Dhamnia (1.1),	Bamnia (2.9),	Hati Pura (3.6),	
Kasoria (0.9),	Gopal pura (1.5),	Baran (2.9),	Jalia Khera (4.5),	
Lapiya (0.7),	Jasoria (1.1),	Baskalai (1.9),	Lamba (4.2),	
Megharas (0.6),	Jhantal (1.1),	Dabla (2.6),	Lambia Kalan (4.3),	
Raisingh Pura (0.9),	Jorawarpura (1.3),	Dodwania ka khera (3),	Modiya Ka Khera (4.8),	
Rakhsi (0.5),	Kajlodia (1.4),	Doladata (1.8),	Nimbahera Kalan (3.3),	
Ranigpura (0.8),	Kee!puria (1.2)	Doodla (1.6),	Nola Ka Kherc (3.1),	
Sobagpura (0.4)	Khedlia (1.2),	Gor Ka Khera (1.6),	Rooppura (3.1)	
	Kishanpuria (1.4),	Jaswantpura (1.6),	Sadas (3.9),	
	Kotri (1.1),	Kalansas (3),	Sardar Nagar (3.6),	
	Kunwar (1.3),	Kalyan Pura (1.6)	Sardarpura (3.8)	
	Mandi (1.2),	Kheri (1.9),		
	Salaria Kalan (1.4),	Kodlai (1.6),		
	Somyas (1.3),	Kundia Kalan (1.9),		
	Sultan Garh (1.1),	Kundia Khurd (2),		
	Ugas (1.1),	Lambia Kurd (2.2),		
	Upreda (1.1)	Lasaria (1.9),		
		Laxmi pura (2.8),		
		Lothiyas (2),		
		Mahua Kurd (1.8),		
		Munsi (1.9),		
		Musha (1.6),		
		Nanodia (2.9)		
		Nimbahera Kurd (1.6),		
		Raila (1.6)		
		Rupaheli Khurd (1.6),		
		Samalpu (1.6),		
		Vijaypur (2)		

In Banera tehsil, fluoride concentration ranges from 0.4 to 13.0 mg/L. The minimum concentration was recorded in one village (Sobagpura) and the maximum was recorded in village Kamalpura. In the Bhilwara tehsil 11 villages (14%) fall in category I. In these villages fluoride concentration is below 1.0 mg/L which is the maximum desirable limit of standard for drinking water recommended by the Bureau of Indian Standards<sup>6</sup> (BIS) in IS: 10500, 1991. There is no possibility of fluorosis in these villages. Fluoride is beneficial, when present in this limit, for calcification of dental enamel, especially for the children below 10 year age. Once fluoride is incorporated into the teeth, it reduces the solubility of the enamel under acidic conditions and thereby provides protection against dental caries.

20 villages (25%) of the tehsil have fluoride concentration between 1.0-1.5 mg/l (Category II). 1.5 mg/l is the maximum permissible limit of standard<sup>6</sup> for drinking water (IS: 10500; 1991). In 28% population (Fig. 1) in tehsil living in these villages the per day fluoride intake through drinking water is more than 4 mg/D hence 1<sup>st</sup> and 2<sup>nd</sup> degree dental fluorosis may be visible in local residential.

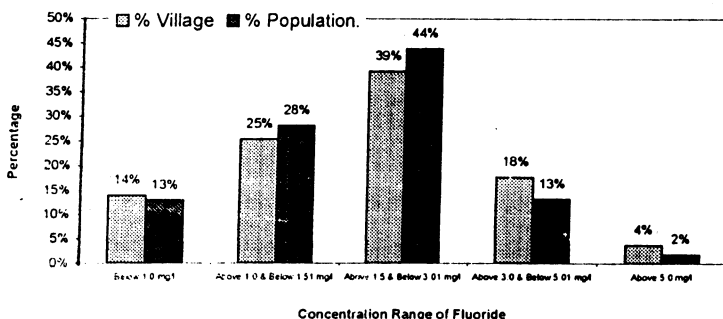


Fig. 1. Percentage distribution of villages and population in various concentration ranges

In 31 villages (39%), the fluoride is between 1.5 and 3.0 mg/L (Category III). This concentration is above the maximum permissible limit as recommended by BIS. These villages contribute 44% population of this tehsil (Fig. 1). Dental fluorosis may be a common visible sign of exposure to excessive fluoride in these villages. At this concentration level, teeth lose their shiny appearance and chalky black, gray or white patches develop on them (known as mottled enamel)<sup>7</sup>. In some consumers, the pre-stage of skeletal fluorosis may occur after 45 yrs of age.

In 14 villages (18%), fluoride concentration in groundwater is above 3.0 mg/L and below 5.0 mg/L. The per-day intake of fluoride in these villages is very high. 13% population of the tehsil (Fig. 1) may have all degrees of dental fluorosis (mild, moderate, moderately severe, severe fluorosis) including skeletal fluorosis after 30 yrs of age in local residents, but the probability of second stage skeletal fluorosis after 45 yrs of age may be common<sup>10</sup>.

Only 3 villages (4%), Surajpura, Kamalpura and Ganeshpura, fall in category V; these villages contribute 2% population of Banera tehsil (Fig. 2). In these

villages fluoride concentration is above 5.0 mg/L; at such a high concentration level all types of fluorosis may occur; however, the final degree of dental fluorosis is the visible sign of over-exposure to fluoride. The second clinical stage (in which pain in bones becomes constant and some of the ligaments begin to calcify) may be common in the local residents. In some villagers advanced skeletal fluorosis (in which the extremities become weak and moving of joints is difficult) may be found<sup>11</sup>. At this concentration, the vertebrae partially fuse together, crippling the patient. This stage of fluorosis is also called "crippling skeletal fluorosis". According to some studies a high dose of fluoride is actually toxic to man causing pathological exchanges including hemorrhagic gastroenteritis, acute toxic nephritis and high degree of injury to the liver and heart muscles<sup>12</sup>. McGown and Suttie<sup>13</sup>, in 1977, reported significant increase in plasma epinephrine and hyperglycaemia induced by fluorides. Fluorosis is accompanied by adverse effect on the other systems and organs of the body, namely, liver, kidney, muscles, heart, lungs, blood and the hormonal functions<sup>14-18</sup>. The kidney is the principal organ through which maximum concentration of fluoride is excreted. High fluoride causes impaired kidney functions.

The present studies have shown occurrences of high fluoride content in the groundwater of several villages of Banera tehsil. The villages, which do not have alternate water sources, should be provided with defluoridation plants to eliminate the problem. The reports on village-wise distribution of fluoride in drinking water may help in implementation of health and water supply schemes by the central and state government.

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URL <http://www.bioenergetics.de>