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Contamination of fluoride in ground water in and around Sehore city (M.P.) with special reference to human health

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ABSTRACT

Hydrogeochemical investigation have been carried out in and around Sehore city to see the extent of fluoride contamination in ground water of the study area. Fifty six ground water samples were collected on a grid pattern (Survey of India Toposheet), which covering shallow deep aquifers, It is observed that fluoride concentration level ranges from as low at Patni and Khokri villages (0.20 mg/l) to as high as Ramkheri, Mahoriya, Kauriya, Phutibawari, Pipliyamiran, Barkheri, Hasnabad, Jahangirapura, Ugarkhera, (6.89, 6.99, 1.92, 2.08, 3.95, 2.00, 5.96, 4.53, 2.05 mg) respectively. In this light, study has been conducted to evaluate the impact of excess content of fluoride on the human health of the area people.

Key words: Ground water, fluoride concentration, Hydrogeochemical investigation.

INTRODUCTION

Fluorosis is a global problem and is caused by consumption of excess amount of fluoride in drinking water. Out of 32 state of India seventeen state are affected with dental, skelton and non-skelton fluorosis. The amount of fluoride concentration in water varies from 1.0 to 4.80 mg/l. Deleterious effect and dreadful disease in human beings are caused by fluoride. On the other face fluorides are known to be beneficial when it is present within a range of 0.5-1.5 mg/l. But, when it is exceeds the limit of 1.5 mg/l (Kotoiah and Kaumara swamy, 1994) it may cause fluorosis-dental, skelton and non skelton fluorosis may be caused due to high concentration of fluoride in drinking water (Sushila 1991 and 1999).

The area of present investigation is a part of Malwa Plateau region. The area of study is bounded by latitude 23°5'-23°15' as per Survey of India Toposheet no. 55A/16 and 55E/4 which covering an area of 576 sq. km. The receiving average rain fall of 1211 mm, the temperature varies from 5.8° C and relative humidity between 62% to 71%.

Methodology

Fifty six groundwater samples were collected on a grid network pattern (Survey of India Toposheet 2.5' × 2.5' Fig. 1) from different locations, which covers about 56 villages so as to represent the full view of the study area. The water monsoon seasons, from different sources, viz tubewell, handpump and open wells. Samples were transported to the laboratory as for as possible and analysed for conventional parameters indicative of physico-chemical quality viz P^H Electrical Potassium (K), Calcium (Ca), Magnesium (Mg), Carbonate (CO_3), Bi-Carbonate (HCO_3), Chloride (Cl), Nitrate (NO_3), Sulphate (SO_4), Flouride (F). The Flouride levels were detected by using ion selective electrode.

All samples were analysed by standard methods (IS-1992, Neeri 1988 and APHA 2000), for drinking purpose WHO (1985) BIS (2003) IS (1992) standard are followed.

RESULTS AND DISCUSSION

The result of the present study summarized in table 1. The desirable and permissible values of water Quality parameters as per BIS standards are given table 2.

The P^H values of water samples were found in the range of 6.9 to 9.5, except one sample Hasnabad village, rest are within the rang as per IS-10500 standard. This shows all the sources was alkaline in nature.

Electrical Conductivity (EC) values very from 210 to 1843. The alkalinity is the important parameter in the distribution of flouride. The alkalinity values varies from 32 to 186 the maximum alkalinity is observed at Jatkheri village.

The total hardness of the area varies from 42 to 1320. The Calcium content of groundwater of the area ranges from 42 mg/l to 1140 mg/l. Out of 56 samples 13 samples are beyond the permissible limit. The concentration of sodium in the study area ranges from 36 to 236 mg/l. The major source of sodium is due to weathering of plagioclase feldspar. The concentration varies from 22 to 675 mg/l in the study area. Sulphate concentration in the study area varies from 10 to 48.8 mg/l.

Nitrate is effective for plant nutrient and moderately toxic and is considered important for its adverse effect on health. Nitrate concentration is very from 1.77 to 6.30 mg/l. Flouride is more common in ground water then surface water beyond the permissible limit may caused decease Known as Fluorosis. The fluoride level in the are of study ranges from 0.20 to 6.99 mg/l.

Out of 56 samples 9 villages Ramkheri, Mahoriya, Kauriya, Phutibawari, Pipliyamiran, Barkheri, Hasnabad, Jahangirapura, Ugarkhera,

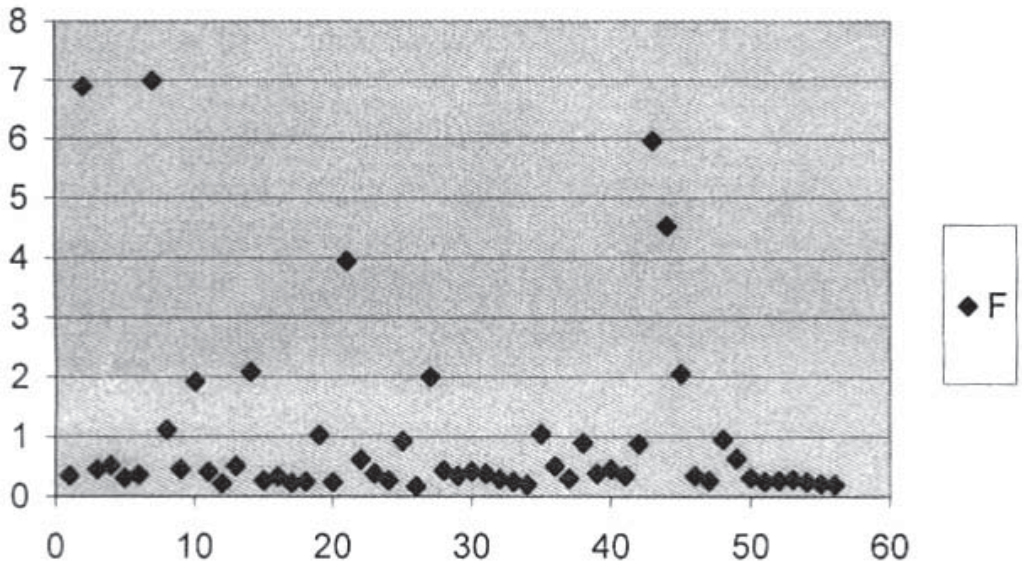

Fig. 1: Fluoride Concentration Level in ground water

Table 1: Post Monsoon Sub surface water quality analysis data 2006

S. No.	Village name	pH	EC	TDS	Na	K	Ca	Mg	T-H	CO_3	HCO_3	Cl	F	NO_3	SO_4
1.	Lasuliya Khas	7.0	537	338	144	2.42	188	140	328	Nil	78	60	0.35	50	12.8
2.	Ram Kheri	8.3	1441	906	98	1.16	96	48	144	Nil	162	675	6.89	10	22.6
3.	Bisamkhara	7.2	530	332	62	0.44	260	52	312	Nil	90	90	0.45	25	16.2
4.	Muskara	7.6	946	594	86	0.68	320	160	480	Nil	60	125	0.52	50	44.4
5.	Kachanaria	7.6	675	486	76	0.56	290	170	460	Nil	80	100	0.31	75	38.6
6.	Sangrampur	7.1	764	484	44	1.24	484	60	544	Nil	132	95	0.36	75	14.8
7.	Mahoriya	8.0	668	414	64	1.84	60	44	104	Nil	44	235	6.99	50	18.2
8.	Bhatoni	7.8	1213	764	120	0.44	340	112	452	Nil	120	275	1.11	75	26.8
9.	Baktal	7.6	1435	932	104	0.52	780	44	824	Nil	24	400	0.45	10	32.2
10.	Kauriya	7.9	663	472	38	0.76	120	72	192	Nil	38	100	1.92	10	48.2
11.	Phunmogra	7.5	884	574	46	1.38	488	52	540	Nil	142	135	0.41	135	10.06
12.	Rapheiqgang	7.6	1023	664	126	1.72	456	56	512	Nil	80	160	0.22	234	18.4
13.	Bijori	7.9	430	266	68	0.54	122	46	168	Nil	124	60	0.51	29.2	16.8
14.	Phutibawari	7.8	501	310	76	0.66	86	10	96	Nil	34	65	2.08	17.2	22.8
15.	Mugispur	7.9	542	340	88	0.78	210	110	320	Nil	158	50	0.27	65.0	18.2
16.	Sarangakheri	7.0	459	288	116	4.42	288	44	332	Nil	36	20	0.33	34.8	22.8
17.	Sehore	7.6	1199	778	90	1.02	560	148	708	Nil	78	250	0.23	73.0	12.06
18.	Bariyakheri	7.8	652	410	68	0.86	292	76	368	Nil	44	100	0.25	34.8	36.2
19.	Chanderi	7.9	431	266	262	0.78	80	40	120	Nil	32	115	1.03	8.42	10.6
20.	Thunakalam	7.2	210	128	172	2.26	114	54	168	Nil	138	25	0.24	2.24	34.2
21.	Pipliyamiran	8.0	300	194	44	3.08	40	32	72	Nil	66	70	3.95	2.39	28.6
22.	Nayakhera	8.1	254	164	68	2.48	28	12	40	Nil	58	70	0.62	1.77	12.8
23.	Phanda	7.0	597	388	88	1.56	198	50	248	Nil	42	60	0.38	30.04	24.2
24.	Pipliyadhakar	6.9	555	360	124	0.56	260	76	336	Nil	162	40	0.27	31.02	42.06
25.	Dubri	7.0	540	348	212	0.84	180	40	220	Nil	12	100	0.93	25.5	10.08
26.	Khajuri	7.0	550	356	58	2.66	296	64	360	Nil	88	25	0.17	48.5	20.4
27.	Barkheri	7.9	281	182	96	1.48	98	42	140	Nil	58	50	2.00	2.12	28.2
28.	Jatkheri	7.6	1040	676	68	1.86	288	92	380	Nil	186	325	0.43	39.9	18.6
29.	Barwakheri	7.1	250	338	32	1.24	298	74	372	Nil	44	55	0.35	26.7	24.2

Table 1 Cont.....

30.	Sonda	7.8	881	572	176	0.76	416	164	580	Nil	68	80	0.42	28.2	12.4
31.	Udpura	6.9	869	564	162	5.44	488	64	552	Nil	32	135	0.38	78.4	18.8
32.	Narisngkhera	7.5	458	296	88	2.22	260	60	320	Nil	42	40	0.29	18.1	38.4
33.	Durgapura	7.4	453	294	62	6.42	186	34	220	Nil	112	45	0.25	38.6	26.2
34.	Khokri	6.8	2114	1248	38	1.12	1140	180	1320	Nil	78	525	0.20	630	12.6
35.	Jatakhera	7.2	550	340	148	0.98	176	44	220	Nil	64	165	1.04	14.4	40.4
36.	Satpipliya	7.0	1383	856	112	0.90	604	188	792	Nil	48	590	0.50	11.3	38.8
37.	Bhaunukheri	6.9	1295	792	98	4.24	598	122	720	Nil	22	385	0.30	115	54.2
38.	Gurbhela	8.0	361	222	56	3.18	58	14	72	Nil	74	125	0.89	3.12	12.8
39.	Mograram	7.0	617	382	68	2.16	260	112	372	Nil	138	50	0.38	5104	48.8
40.	Lasuriyaram	7.6	1249	774	44	0.88	498	102	600	Nil	172	285	0.45	170	22.2
41.	Kankarkhera	7.2	1240	768	54	0.925	484	136	620	Nil	124	570	0.35	52.8	36.2
42.	Jahangirpura	7.0	1843	1142	172	0.42	496	64	560	Nil	168	385	0.88	69.9	22.4
43.	Hasnabad	9.5	474	292	140	2.48	60	20	80	CO3	152	225	5.96	7.89	28.6
44.	Jahangirpura	8.3	810	502	32	3.12	78	34	112	Nil	66	275	4.53	50.6	32.4
45.	Ujarkhera	8.2	450	292	168	4.48	40	20	60	Nil	88	190	2.05	2.10	12.4
46.	Dhaboti	7.6	576	374	42	1.26	120	84	204	Nil	142	150	0.35	25.7	28.6
47.	Barkheri	7.2	876	568	96	2.48	380	108	488	Nil	76	165	0.26	81.8	18.2
48.	Titoriya	7.0	404	262	112	0.84	46	14	60	Nil	180	110	0.95	2.60	14.6
49.	Bamuliya	7.5	552	358	146	0.66	260	80	340	Nil	32	50	0.63	16.9	38.6
50.	Heerapur	7.0	998	648	32	0.56	410	110	520	Nil	46	215	0.31	118	44.2
51.	Dhabla	7.2	656	406	64	1.08	250	120	400	Nil	92	55	0.25	28.7	32.6
52.	Bhojnagar	7.4	600	390	236	2.24	280	80	360	Nil	116	45	0.26	27.5	48.2
53.	Uljhawan	7.0	570	368	162	0.98	200	140	340	Nil	120	35	0.28	29.9	22.4
54.	Kolanaskhurd	7.2	558	362	78	0.66	198	178	376	Nil	130	30	0.24	46.2	12.6
55.	Bilkisganj	7.0	886	574	36	0.54	458	142	600	Nil	64	150	0.21	58.8	36.2
56.	Patni	7.0	1622	1004	44	1.18	504	156	660	Nil	58	425	0.20	260	44.8

Note: All values are in mg/l except p^H and EC.

Table 2: Desirable and permissible values of important water quality parameters

Parameter	pH	TDS	TH	Ca^{2+}	Mg^{2+}	Cl^{-}	Alkalinity	NO_3^{-}	F^{-}	SO_4^{2-}
Desirable value	6.5-8.5	500	300	75	30	250	200	45	1	200
Permissible value	6.5-8.5	2000	600	300	100	1000	600	45	1.5	400

* IS - 10500 : 1991, Edition 2.2, Indian Standard Drinking water- Specifications (first revision), 2003, BIS, New Delhi

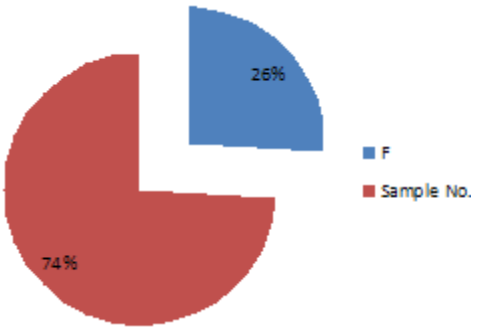

Fig. 2: Distribution of fluoride concentration in groundwater (%)

(6.89, 6.99, 1.92, 2.08, 3.95, 2.00, 5.96, 4.53, 2.05 mg/l) having high concentration of flouride level as compared to standard laid down by IS, BIS, WHO, this people are suffering form skelton and dental fluorosis from the table 1 and Fig. 1. It is clear that the flouride concentration in the study area is not uniform due to variations in the presence and accessibility of flouride bearing minerals to water and the weathering and leaching process (Sahu and Karim 1989).

CONCLUSIONS

It can be observed that the groundwater quality of the study area on few places acceptable as per IS 10500 standard table 2.

As special attention of flouride level in groundwater about 9 villages were not meeting the water standard. It comes about 26% of the study area Fig. 2.

The Excess flouride concentration in the study area may be attributed to the geological formation and rapid groundwater depletion. It is high time that an affordable solution to minimize the flouride contamination for maintaining the good health of the affected area people.

In this light it is further suggested that an immediate Need to defluoride the water system either by community or by domestic defluoridation techniques.

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REFERENCES

1. APHA. Satandard methods for examination of water and waste water. American Public Health Association 20th Edition Washington (2000).
2. BIS, IS - 10500; 1991, Edition 2.2, Indian Standard drinking water specifications (First Revision) BIS New Delhi.
3. WHO, Health criteria and other supporting Information, Guidelines for drinking water quality, 2 CBS publication.
4. Kotaih and Kuamra Swami in, Environmental engineering manual first edition. Anand (Gujrat) India 27 (1994).
5. National Environmental Engineering Research Institute (NEERI) Nagpur, Course Manual Text book 4th edition (1988).
6. Susheela, A.K., Technical information for training cum awareness camp for doctors. Public Health and Engineering other officers, All India Institute of medical sciences, New Delhi (1991).
7. Indian Standard - 100500 (1992).
8. Sahu N.K. and Karim, M.A., J. Geological Society India **33**: 450-456 (1989).