Jr. of Industrial Pollution Control 22 (2)(2006) pp 277-284 © Enviromedia Printed in India. All rights reserved

STATUS OF IRON AND FLUORIDE POLLUTION IN SOME PARTS OF DISTRICT UNNAO, U.P., INDIA

MAMTA GOYAL* AND DURGA NATH DHAR**

*Department of Chemistry, Babu Banarasi Das National Institute of Technology and Management, Lucknow, India **Retired Prof., Dept. of Chemistry, I.I.T., Kanpur, India

Key words : Status of iron, Fluoride, Ground water.

ABSTRACT

Ground water is one of the important sources for drinking water and is also used for other purposes. With the explosion in human population, the demand for ground water is on the increase. The suitability of ground water for potable purposes is judged, from the health standpoint, on the types of minerals dissolved in it. We report herein that the ground water sources in some parts of district Unnao in U.P. contain iron and fluoride ions in quantities which are outside the permissible limits laid down by the Bureau of Indian standards.

INTRODUCTION

Water, the most vital resource for all kinds of life on this planet, is also the resource, adversely affected both quantitatively and qualitatively by all kind of human activities on land, in air or in water.

Though the pollution of water as a result of human activities is a phenomenon as old as hills, the increasing industrialization, urbanization and developmental activities and consequent pollution of water has brought a veritable water crisis. The industries continue to be one of most significant causes of pollution of aquatic ecosystem due to adverse kind of wastes produced by them (Trivedy and Goel, 1986).

More than seventy five percent of global population depends for their drinking water requirement on ground water resource. Both ground and

^{*}Author for correspondence: 5/7 Vikas Nagar, Lucknow- 226 022 (U.P.)

surface water potential constitute about 0.6 percent of the total global water resources. Owing to its feasibility and utility in comparison to oceanic and glacial water of this usable amount, ground water component is 97% and surface water 3% respectively.

Monitoring of ground water is necessary in order to know the water quality status, which is cyclically replenished every year from rainfall and other source of recharge.

We have carried out our research studies for some part of the district Unnao, located in U.P. Unnao lies between 26°50′ and 27°00′ (North latitude) and 80°03′ and 81°03′ (East longitude) and is included in the 'Survey of India, Troposheet no. 63A, B and F.It is covered in the North by Hardoi districts, and in the East by Raebareli and Lucknow Districts. The Ganges river located in the West separates it from the district of Kanpur and Fatehpur. Geographically it falls in the central region of the State of Uttar Pradesh. The Unnao district is divided into 4 Tehsils, 16 Development blocks and total geographical area is 4,562 square Kilometers.

METHODOLOGY

Any scientific and technical effort to keep the ground water free from ecological imbalance would require knowledge of the concentration levels of different parameters. Thus for the selection of sampling sites of part Unnao district, the authors undertook preliminary survey to identify the suitable locations. The sampling sites were selected keeping in the view of the location of tanneries, industries etc.Since these constitute the source for effluents. A total of 20 sampling locations were selected. The details about these sampling stations designated as U-1 to U-20 are briefly discussed below, these are also depicted clearly in the map (Fig.1).

Sampling

The ground water is a part of the dynamic system and its chemical composition differs and varies on changing the sampling sites laterally and vertically. The grab samples were collected in pre-cleaned,good chemical resistant plastic bottles. Two water sample bottles were collected from each sampling sites. One bottle was preserved with concentrated Nitric acid on the site immediately after collection,for trace metal analysis. Sampling frequency was twice in a year viz. pre-monsoon (during June) and post –monsoon(during November 2002).

Experimental

pH and Electric conductivity (EC) measurement were conducted at the site itself, with the help of recalibrated portable pH and EC meters. Trace elements, viz., Ca, Mg, Na, K, Fe and Cr were determined by Atomic Absorption Spectrophotometer (AAS) (Perkin-Elmer).

CO₃⁻², HCO₃⁻ and Cl⁻ were analysed by titration methods, while Nitrate, Sulphate and Fluoride were determined by UV-Visible Spectrophotometer (Chemito).Standard procedures were followed for sampling and analysis of the ground water (APHA, 18th Ed. 1989.) The analytical results obtained are

Sampling villa	ages (Block a	nd Tahsil lis	st) of Unna	o district
1 0			/	

S.No.	Sample No.	Village	Block	Tehsil
1.	U-1	Kewana	Nawabganj	Hasanganj
2.	U-2	Pindari	Nawabganj	Hasanganj
3.	U-3	Taura	Bichhia	Kwajgirpur
4.	U-4	Targaon	Bichhia	Kwajgirpur
5.	U-5	Jargaon	Bichhia	Kwajgirpur
6.	U-6	Murrazanagar	Bichhia	Kwajgirpur
7.	U-7	Gaura Kotherawa	Nawabganj	Hasanganj
8.	U-8	Sheikhpur	Nawabganj	Hasanganj
9.	U-9	Janukha	Bichhia	Kwajgirpur
10.	U-10	Husainnagar	Bichhia	Kwajgirpur
11.	U-11	Makoor	Nawabganj	Hasanganj
12.	U-12	Newrana	Bichhia	Kwajgirpur
13.	U-13	Shivpur	Bichhia	Kwajgirpur
14.	U-14	Badarka Harbans	Karan	Kwajgirpur
15.	U-15	Singhroshi	Karan	Kwajgirpur
16.	U-16	Amarsas	Karan	Kwajgirpur
17.	U-17	Bethar	Karan	Kwajgirpur
18.	U-18	Ghurkhet	Bichhia	Kwajgirpur
19.	U-19	Godwa Vishunpur	Bichhia	Kwajgipur
20.	U-20	Kusehri	Nawabgang	Hasangang

given in Table 1 and Table 2.

RESULT AND DISCUSSION

Analytical data of water samples collected during pre-monsoon and post-monsoon 2002 are collected in table1and table 2 . From results obtained it is apparent that the water of top aquifer tapped in the dugwells, varies in quality with respect to distance. The average depth of dugwells, private tubewells etc.ranges from 8 meter below ground level (bgl) to 90 meter bgl.

Throughout the study period, water was found to remain in the alkaline range and varied from 7.41 at location no. U-3 during post- monsoon 2002 to 9.0 at location no. U-9 during pre-monsoon 2002.On comparing pre - and post- monsoon period data. It was observed that , there is general decreases in pH values from pre-and post- monsoon seasons, which may be due to dilution effect after recharge during monsoon period. EC values varied from 208 μ / cm. at location no.U-7 during post-monsoon 2002.to 4038 μ /cm. at location no.U-19 during pre-monsoon.Again there is a decreases in EC values from pre-monsoon to post-monsoon and may be attributed to the dilution effect cause by the monsoon.

According to conductivity and sodicity classification (CS Classification) proposed by United State Salinity Laboratory(USSL), some quality of water is not found suitable for irrigation purpose as these water fall in C3 category. During post-monsoon period location U-2,U-11, U-16, U-17, U-19, i.e. conductivity more than 2250μ /cm. Following are the locations where EC was found to be high than the C3 category. During pre-monsoon location no.



Fig. 1 The variation of p^{H} of ground water at different locations in the Unnao district during pre- and post-monsoon period.



Fig. 2 The variation of electrical conductivity of Ground water in different locations of Unnao district, during pre- and post- monsoon period.

U-2,U-11,U-16,U-17,and U-19.(see List of sampling locations). Water of this quality if used for irrigation, there will be accumulation of salt content in soil, making it saline or sodic.

Nitrate ions concentration was found to be well within the prescribed limit of 45mg/L in drinking water as specified by IS:10500 standard, except at location no.U-16, where it ranges from 84 to 53.28 mg/L during pre- to post-monsoon period. The high concentration of nitrate ions produces methoglobomania or blue baby disease especially in children. District Unnao is having a bad reputation due to the high fluoride ions contents in ground water. Result show that concentration of fluoride ions in ground water ranges from 0.8to 2.3mg/L.during pre-monsoon season, out of 20 sample collected,7 sample contained fluoride more than 1.5mg/L limit as prescribed by IS:10500 standards. However the desirable limit of fluoride ions in water is from 0.6-1.2mg/L. when the available data were analysed from the standpoint of



Fig. 3 The variation of fluoride ion concentration in the Ground water at different locations in the Unnao district during pre- and post-monsoon period.



Fig. 4 The variation of fluoride ion concentration in the Ground water at different locations in the Unnao district during pre- and post-monsoon period.

safe level of fluoride ions in water, the following conclusion was apparent, viz, the fluoride ions content, in 15 samples, was found to be more than the prescribed safe limit of 1.2mg\L.

In other words it meant that 75% of the water, in some part of Unnao, is unfit for human consumption. During post-monsoon season, only 4 samples contain fluoride more than 1.5mg\L (Fig. 3).

Fluoride ions, present in the drinking water, target calcium phosphate – the constituent of bones in the body. Thus, if the concentration of fluoride ions is in excess of 1.0mg/L. it results in molting and produces stains on the teeth. It also causes softening of bones, especially of the spinal chord, due to which the person concerned is not able to assume an erect posture while standing.

All kinds of water including ground water have appreciable quantities of Iron. In ground water most of the iron remains in ferrous state due to general lack of oxygen. The concentration of iron fluctuates from 0.28mg/L at location

Table-1

Analytical water qu	iality analysis of	water samples of distric	t Unnao (Post-monsoon)
---------------------	--------------------	--------------------------	------------------------

S.N.	pН	EC	CO_3^-	HCO ₃	Cl	SO_4^-	NO_3^{-}	F-	Ca++	Mg^{++}	Na+	Κ	+
Fe ⁺⁺													
1.	7.53	1440		629	107	36	3.86	1.68	65	66.72	98	32.51	1.36
2.	8.39	2863	52	590	502	102	3.03	1.26	126	89.88	322	39	1.22
3.	7.41	876		420	36	30	7.32	1.38	42.4	40	66	10.92	0.86
4.	7.61	398		210	180	6	2.06	1.28	21.6	21.48	23.92	6.63	0.32
5.	7.95	708		187	18	4.8	5.28	1.04	47.4	34.08	38.2	9.36	0.69
6.	8.28	613		129	72	9.2	1.02	0.93	35	26.16	49.45	7.3	1.19
7.	8.26	208		58	18	5.2	0.86	0.37	14.4	11.8	9.2	4.29	0.28
8.	8.49	928	26	420	72	9.12	8.16	1.56	49.2	39	68.8	12.48	1.28
9.	8.63	438	26	170	18	11.04	5.28	1.24	21	15.48	41.4	7	1.01
10.	8.43	558	26	210	36	8.16	1.28	1.47	27	29.64	36	9.06	0.86
11.	8.57	2612	52	839	323	61	0.56	1.22	127	93.8	247	63.11	2.9
12.	8.46	2109	58	892	143	29.76	7.32	1.49	111	86.4	156.6	54.9	3.2
13.	8.09	1553		629	143	62.02	7.09	1.26	75.2	57.3	114.8	76	1.9
14.	7.77	468		236	18	5.76	11	1.08	23.8	27.2	24.8	4.68	0.6
15.	8.02	1090		525	72	17.76	7.26	1.09	55	46.4	61.8	47.6	1.2
16.	7.96	3542		1154	538	130.5	53.28	1.13	139.4	111.6	363.4	81.2	2.3
17.	7.53	3602		1364	430	92	1.8	0.72	174.4	133.3	311	78.4	1.3
18.	8.39	1483	520	590	72	52.6	2.3	1.89	81.8	69.8	90.6	36.4	1.8
19.	7.63	3749		538	138	2.4	0.62	157.2	126	396	88.4	2.6	1.6
20.	7.93	1208		72	22.8	2.6	1.96	72.4	58.9	74.06	56.4	2	4

1.4

Note: The concentration of Anions & Cations are expressed in mg/l.

Table-2

Analytical water quality analysis of water samples of district Unnao (Pre -monsoon)

S.N.	pН	EC	CO_3^-	HCO3-	Cl	SO_4^-	NO_3^-	F-	Ca++	Mg ⁺⁺	Na ⁺	Κ	+
Fe ⁺⁺													
1.	7.86	1574		288.5	266.6	164.6	1.81	1.81	28.1	17.6	269	14.8	1.61
2.	8.5	3100	39.6	533.8	519.4	274.5	8.03	1.4	12.3	30.4	61.9	51.09	1.32
3.	7.44	924		79.4	78.45	275.8	15.32	1.53	87.23	29	26	49.14	0.92
4.	7.81	417		33.55	63.19	86.27	6.81	1.46	33	23	7.5	7.41	0.31
5.	8.1	745		123.8	153.4	55.6	11.26	1.34	19	22	96	8.58	0.78
6.	8.34	653	19.8	128.1	95.49	47.46	4.26	1.01	24	25	60.95	12.19	1.26
7.	8.36	216	99	33.55	29.8	23.55	3.26	0.39	17.5	12	4.5	2.76	0.36
8.	8.67	943	19.8	18.56	188.2	23.61	18	2.03	8	0.6	215	4.29	1.49
9.	9	457	39.6	49.41	72.06	18.16	15.26	1.36	2.9	12.12	69.4	12.48	1.38
10.	8.5	605	19.8	129.3	60.7	65.46	6.84	1.62	7.3	18.4	93.8	15.99	1.11
11.	8.83	2800	39.6	600.2	440.9	209.3	4.28	1.31	65.6	84.81	379	43.68	3.21
12.	8.63	2250	19.8	476.4	367.8	171.9	22.32	1.66	36.4	20.9	370	43.29	3.45
13.	8.21	1612		452.6	213.7	125.8	21	1.35	34.47	350	245	31.98	2.1
14.	7.98	486		87.23	55.02	86.88	32.4	1.13	35.84	18	22.5	13.26	0.81
15.	8.31	1110		175.1	117.5	231.8	12.4	1.26	46	64	58.4	24.57	1.49
16.	8.4	3775	54.0	202	506	198	84	1.3	161	188	309	3.8	2.9
17.	7.81	3936		549	988	186	1.9	0.9	193	212	289	11.6	1.9
18.	8.61	1630	116	493	134	64	2.9	2.3	69	84	193	6.3	2.1
19.	7.9	4.38		549	1132	2.4	2.6	0.8	233	256	338	8.3	3.4
20	8.1	1200		555	136	2.8	2.8	1.58	186	253	278	7	3

1.7

Note: The concentration of Anions & Cations are expressed in mg/L.



Fig. 1 Ground water sampling locations dist. Unnao

no.U-7 during post- monsoon season to 3.4mg/L at location no.U-19 during pre-monsoon season. The desirable limit prescribed by the Bureau of Indian standards is 0.3mg/L. Excess iron may cause vomiting, constipation etc.

CONCLUSION

The study area forms a part of central Ganges plain and is underlain by the pile of quaternary unconsolidated sediments. Qualitatively the shallow ground water in most part of study area of Unnao district falls under C3 category based on USSL classification, indicating high salinity. This water can

282

be used for semi tolerant soil under good drainage practices. However, for drinking purposes most of the phreatic samples of ground water analysed were not found suitable owing to the high fluoride and Iron concentration, which were outside the prescribed limits, especially in location numbers. U1,U3,U8,U10,U12,U18 and U20.

REFERENCES

- Ground Water Monitoring, U.P. 1999. Alkaline land reclamation project europeon economic commission (EEC) district, Ecoman Laboratories Pvt. Ltd. Document No.11, U.P. Sodic land Reclaimation Project(UPSLRP). *Ground water Monitoring*(*GWM*). 04 -11.
- Khare, K. and Agrawal, C. 1998. Ground water quality of Unnao district Uttar Pradesh, S.T.M No-79 (GWD) 19,Ground Water Department, U.P.Lucknow.
- Rai, D. 1999. Fluoride pollutiion of ground water in U.P. and its sustainable remedial measures for domestic water supply. *Technical Volume*, *IWWA* (Indian Water Work Association) pp 31-35.
- Srivastav, A.K. 1988. Hydrogeology and ground water resource potential of Unnao district, Uttar Pradesh, Central Ground Water Board.
- Status of Ground Water Pollution in U.P. 2000. Report published by Central Ground Water Board (CGWB), Northern region, March.
- Trivedy, R.K. and Goel, P.K. 1986. *Chemical and Biological Methods for Water Pollution Studies.*, Enviromedia, Karad.