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PHYSICO-CHEMICAL ANALYSIS OF GROUND WATER SAMPLES OF FIROZABAD DISTRICT, U.P. (INDIA)

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ABSTRACT

Ground water is one of the most useful water sources. Contamination of such water source is a big problem creating health hazards. The dyeing units at small scale levels in the glass city of U.P. are ever increasing. The effluents from dying units play a vital role in toxicating the ground water quality.

In the present study, we have collected groundwater samples from different places of Firozabad district (U.P.) India. These samples have been analysed on the basis of various qualitative parameters. Estimation of physicochemical parameters was carried out. This study was aimed to assess the suitability of the ground water for the domestic and agricultural purposes. The results obtained in the present investigation show that the concentration of fluoride, electrical conductivity and total dissolved solids (TDS) were in excess where as nitrate and chloride were found in large amounts in some of the drinking water sources. In the period of present course, the fluoride amount was noticed in very high range which may cause health hazards for human being. The main aim of the present communication is to highlight the pollution load in the selected study area.

Key words: Firozabad, Domestic health, Pollution, Ground water, Dyeing units.

INTRODUCTION

Fresh water has become a scarce commodity due to over exploitation and pollution of water. Increasing population and its necessities have lead to the deterioration of surface and sub surface water. Ground water is the major source of drinking water in both urban and rural areas. Till recently, it has been considered a reason for dependable source of uncontaminated water. Groundwater crisis is not the result of natural factors. It has been caused by human actions[1]. Fluorosis due to drinking water has been reported in thousands of

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villages in A.P., Western M.P, U.P., Gujarat and Rajasthan. Due to fluorosis in animals and human beings, which effect dental and skeleton tissues. It is characterized by back pain in lumber and cervical region, rigidity and stiffeners of spine and `chest limitation of movement of joints with the amskylosis of spine, hips and knees, crotalaria genuvalgwn and wind swept deformities of leg, inability to walk and crippling[2].

It is evident that many parts of the industrial area in India are colonized are in very close vicinity of the industries and are using groundwater for drinking, cleaning and bathing purposes[3]. Metals are considered toxic and when they enter the body more than the prescribed limit they start causing harm. In the same way many physicochemical parameters play an important role in determining the quality of water[4].

EXPERIMENTAL

The quality test survey of the ground water was conducted in the post rainy season 2008. Eight water samples were collected from the different places of Firozabad district. The water samples were collected during the noon hours between 12.00 to 4.00 pm for which air tight stopper two liter capacity polythene bottles were used and samples were brought to the laboratory for the analysis of temperature, pH, DO, BOD, TDS, alkalinity and heavy metals. Analysis was done using the potable water analysis kit at the sampling site[5]. The vital parameters of samples are noticeable larger then the limits recommended by WHO[6-7] and IS.

Physico-chemical analysis

The collected samples were analyzed for major physical and chemical water quality parameters like pH**,** electrical conductivity (EC), total dissolved solids (TDS), total hardness (TH), Ca^{2+}, Mg^{2+} as per the method assessment of ground water quality described in "Standard methods". pH was measured using a pH meter(Model No. 324, Systronic Make). Electrical conductivity was measured using a conductivity meter (Model No.304, Systronic Make). The chloride, total hardness and total alkalinity were estimated by the standard methods of water and waste water[6-10]. Examination of water and wastewater were done by American Public Health Association (APHA)[11]. The parameters present in the water sample can be calculated by using various methods[12-13]. Nitrate was determined by ion selective electrode method.

RESULTS AND DISCUSSION

Total 8 water samples of ground water of Firozabad district were collected in clean polythene bottles and brought to the laboratory. The samples were chemically preserved by

the addition of 3-5 mL concentrated HNO_3 per liter of the sample. The temperature, pH, conductivity and dissolved solids of the water samples were determined on the spot using a thermometer; pH-meter, conductometer and TDS meter. Various standard methods (APHA-AWWA-WPCF, 1995; HMSO, 1986)[11] were used for the determination of other parameters. Total alkalinity was determined by visual titration method using methyl orange and phenolphthalein as indicator. Total hardness and calcium were measured by EDTA titrimetric method using EBT (Eriochrom Black-T) indicator respectively. Chloride was determined by Argentometric method using potassium chromate indicator. The chemical data were complied further.

Temperature

Temperature of all the water samples were noticed in the range of 27.0^{o}C. The temperature of water generally depends on the atmospheric condition.

pH

The pH values fluctuated between 8.10 to 9.30 (Table 1). The limit of pH value for drinking water is specified as 6.50 to 8.50, in the present study the pH shows alkaline trend.

Total hardness

Total hardness varied from 141 to 389 mg/L in all ground water samples the total hardness values exceeded the permissible limit.

TDS

The TDS of the water samples ranged from 141 to 389 mg/L. The I.S. standard for dissolved solid is up to 500 mg/L and the maximum permissible quantity is 2000 mg//L (WHO: 1995).

Chloride

The chloride concentrations ranged from 85.4 to 320.5 mg/L in the sample of water. If the water with high chloride is used for concentration purpose and high chloride content in groundwater can be attribute to label of ground water drainage system and bad maintenance of environment around the sources.

Sulphate

Sulphate was found in the range from 139 to 330 mg/L. The sulphate content in water is important in industrial supplies. High concentration of sulphate in water can cause malfunctioning of the elementary casual and shows cathartic effect on human beings.

Fluoride

Fluoride content of groundwater sample of the study areas ranges from 0.46 to 1.10 ppm. Maximum permissible limit is 1.0 ppm (WHO,). Small concentration of fluoride in drinking water has beneficial effect on human body. However concentration of fluoride below 0.5 ppm causes dental caries and higher concentration beyond 1.5 ppm causes dental and skeletal fluorides.

Electrical conductivity

Electrical conductivity is useful to evaluate the purity of water. Maximum electrical conductivity is recorded in G1 (1.70 μmhos/cm) and the minimum EC at G2 (1.28 μmhos/cm).

D.O. and B.O.D

Range of DO is 7.5 mg/L to 10.4 mg/L and BOD is 5.3 mg/L to 13 mg/L. Depletion of dissolved oxygen in water supplies can encourage microbial reduction of nitrate to nitrite and sulphate to sulphide giving odour problem. DO determine the quality of drinking water.

Cobalt and Zinc

The high values of heavy metals and physicochemical parameters have severe health consequence and these are discussed independently below. Among the studied metals listed in Table 1, cobalt and zinc are essential metals and they are required for the body. Cobalt is essential as a component of vitamin B12 required for production of red blood cells and prevention of pernicious anemia. Zinc is a nutritionally essential metal and its deficiency results in severe health consequences[4]. In the present study, result shows that the concentrations of cobalt, zinc are within desirable limits in all the samples so it is not going to cause ill effects on the nearby population. But these metals become toxic when they exceed the normal range. The normal range in adult male for cobalt is 0.11-0.45 μg/L and for zinc it is 70-120 μg/L[14].

Lead and Mercury

Other heavy metals studied in the present study are lead, mercury. These elements are not at all required by the body so it may cause harmful effects if there concentration increases in the body above the prescribed limit. In the present study lead, mercury were found in some groundwater and it may effect the population consuming this groundwater. The normal ranges prescribed for adult for lead in whole blood is < 25 μg/L. The normal

range for mercury in whole blood is 0.6-59 μg/L[14]. Acute effects of lead are inattention, hallucinations; delusions, poor memory and irritability. Lead absorption in children may affect their development and also results in bone stores of lead. It is associated with behavioral effects, nephropathy and plumbism. Primary target organs of mercury toxicity are nervous system and kidneys. Exposure to elemental mercury is associated with both sensory and motor nerve conduction abnormalities. Mercury poisoning is also associated with erythrism, eye disease, skin disease (erythematic, itching, papules and pustules).

The data revealed that there were considerable variations in the examined samples from different sources with respect to their chemical characteristics. The results indicate that the quality of water considerably varies from location to location. The results of the physico-chemical analysis are tabulated in Table 1.

Table 1

Metal type	Desir-able limit	G1 RKT (ow)	G2 Sastri nagar (BW)	G3 Jain nagar (BW)	G4 Suhag nagar (BW)	G5 Kotala chungi (BW)	G6 Barika-hagla (BW)	G7 Ghanta ghar (BW)	G8 Nai basti (BW)
pH	6.5-8.5	8.40	8.6	8.1	7.9	8.2	8.0	9.30	9.00
Total hardness [mg/L]	300	169	179	141	281	389	151	201	200
TDS [mg/L]	500	251	269	409	321	331	369	310	485
Chloride [mg/L]	250	207	95.4	91.2	112.0	320.5	309.5	114.0	115.2
Sulphate [mg/L]	200	330	274	256	140	139	150	330	330
Nitrate [mg/L]	45	17.1	17.4	21.0	45.5	12.2	14.3	20.9	15.6
Fluoride [mg/L]	1.0	0.24	0.46	0.24	3.1	1.9	4.0	3.40	1.1
DO [mg/L]	> 5	8.0	8.8	7.8	9.5	5.8	10.4	9.9	7.5
COD [mg/L]	(10)**	9.0	10.0	10	5.3	8	13	7.8	6.5
Conductivity, (μmohs/cm)	1.400**	1.70	1.28	0.57	1.485	1.7	0.578	0.31	0.37

Cont…

Metal type	Desir-able limit	G1 RKT (ow)	G2 Sastri nagar (BW)	G3 Jain nagar (BW)	G4 Suhag nagar (BW)	G5 Kotala chungi (BW)	G6 Barika-hagla (BW)	G7 Ghanta ghar (BW)	G8 Nai basti (BW)
Lead	50	53.2	49.8	25.6	45.5	38.6	10.4	15.4	21.2
Zinc	5000	800.6	500.6	899.7	1500	2012	2321	2584	2012
Mercury	1.0	1.1	0.9	0.8	0.9	0.8	1.3	0.5	0.7
Cobalt	-	0.03	0.04	0.05	0.03	0.04	0.06	0.04	0.04

Desirable limits as per IS: 10500 **WHO standard value

CONCLUSION

The groundwater of the studied area Firozabad district has been found to be unfit for drinking because fluoride has been detected in major samples above desirable limit. Lead, mercury, chloride and sulphate has also been detected in few samples (Table 1). It is suggested that the people in this area should drink only treated water and subsequent review and checking of water should be taken care. The industry should discharge there effluent water only after proper treatment. Blood, urine, hair are the most accessible tissues in which an exposure or dose should be measured as they are sometimes referred to as indicator tissue.

REFERENCES

1. A. Kumar, Water Pollution, Nisha Enterprises, New Delhi, 1-331 (2004).
2. S. P. S. Teotia and M. Teotia, Endemic Skeletal Fluorosis-Clinical and Radiological Variant, Fluoride, **21**, 39 (1988).
3. S. Prajapati and R. V. Singh, Ground Water Analysis of Jaipur City During Monsoon Season 2004, Indian J. Environ. Sci., **10(2)**, 155 (2006).
4. Curtis D. Klaassen, Casarett & Doull's Toxicology, The Basic Science of Poisons, 5th International Edition, Mc Graw Hill, Health profession division, USA, 691721 (1996).
5. Wequar Ahmad Siddiqi and Javed Hassan, Current World Environment, **1(2)**, 145 (2006).
6. S. Nagarajan, M. Swaminathan and P. L. Sabarathinam, Poll. Res., **12(4)**, 245-250 (1993).
7. World Health Organization, Guidelines for drinking water quality-I, Recommendations Geneva, WHO, 2nd Ed., (1993).

8. M. K. Patel, K. Mohanty, T. N. Tiwary and T. K. Patel, Indian J. Env. Prot., **14(5)**, 373-379 (1994).

9. S. K. Mittal and N. Verma, Indian J. Env. Prot., **17(6)**, 426-429 (1970).

10. W. Fresenius, E. K. Quentin and W. Schneider, Water Analysis in a Practical Guide to Physio-chemical and Micro-Biological Water Examination and Quality assurance, Springier Verlag, 804 (1988).

11. APHA, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, **2-4**, 29-179 (1995).

12. M. Meybeck, Rev. Geol. Dyn. Geogr. Phys., **21**, 215-246 (1997).

13. N. Manivasakam, Physical Chemical Examination of Water, Sewage and Industrial Effluents 3rd Ed, Pragati Prakashan, Meeret, India, **13** (1996).

14. Norbert W. Tietz, Clinical Guide to Laboratory Tests, A division of Harcourt Brace and Company, The Curtis Center, Independence Square West, Philadelphia, Pennsylvania, **3**, 19106 (2000).

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