Study of Physico-chemical Parameters of Drinking Water of Bhopal city with Reference to Health Impacts

H.C. KATARIA*, MANISHA GUPTA, MUKESH KUMAR, SANDHYA KUSHWAHA, SHERWATI KASHYAP, SONAL TRIVEDI, RANI BHADORIYA and NAVAL KISHORE BANDEWAR

Department of Chemistry, Government Geetanjali Girls PG College, Berasia Road, Bhopal - 462 038 (India).

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ABSTRACT

Safe drinking water is the primary need of time most of the people depends upon groundwater sources that have problems of hardness, calcium, Nitrate, Phosphate, fluoride, D.O., B.O.D., COD and heavy metals copper and Zinc and excess of MPN count, Different samples has collected in pre and post monsoon seasons during 2008-09. Different parameters of water has been analyzed and evaluated to the suitability of drinking water for human consumption and public hygiene scenario and health impacts. Some of the parameters are observed within the prescribed limits of 15 : 10500 while others are beyond the limits of WHO and ISI.

Key words: Physic-chemical parameters, Drinking water, Bhopal city, Health impacts.

INTRODUCTION

Water is the most essential commodity for all living creatures. Organisms can not survive without water. Water is one of the most essential constituents of the human environments. Man needs it, in the first place for his physiological existence. It is used for many purposes e.g. industrial water supply, irrigation, drinking, propagation of fish and other aquatic systems and generation of fish and hydro-powers. Water is the source of energy and governs the evolution and functions of the universe on the earth. Water, the most vital necessity of life, is in abundance 97.3% of the world's water i.e. 1.45 billion cubic Kms, Ocean water is salty and cannot be used for agricultural, domestic and industrial purposes. Only 13x10⁶ cubic Kilometers water is available in the form of stream, lakes, wells and tube wells i.e. 0.6%, 8.5x10¹⁵ m³ is groundwater, occurs in the depth of 80-135 m below the ground surface as water levels decreasing day-by-day. The run-off water has large number of substances e.g. silt, organic impurities.

The global environment is changing continuously due to unfavourable alteration of surroundings, wholly as a by product of man's actions, through direct or indirect effects of changes in energy pattern, radiation levels, chemical and physical constitution of organisms. These changes may affect man directly or through his supplies of water and of agricultural and other biological products, the most common types of pollution and pollutants discharged, encountered in domestic and industrial waste waters, along with their possible effects on the water resources are discussed. Chemicals are a major source of water contamination⁸ that introduced during water movement through geological materials, manufactured chemicals may cause problems.

Fertilizers and pesticides are major contributors to water pollution, Nitrates from fertilizers are a common chemical pollutant of water. Heavy metals, sulphates, nitrates, chlorides, phosphates, carbonates, ammonia, pesticides, phenols, soaps, detergents are the common chemical pollutants. There are a number of pathogenic micro-organisms which cause water borne disease in man.

Among the metals the severe pollutants are lead, cadmium, arsenic, copper, zinc, manganese, iron, and calcium.

MATERIAL AND METHODS

Bhopal, the capital of Madhya Pradesh, is the largest state of India witnessed the world's worst industrial disaster i.e. leakage of MIC gas form Union Carbide factory on 3rd Dec 1984. Bhopal is situated on 23°16'N Latitude and 77° 25' E longitude and is located on "hard pink red sand stone of Vindhyan region at 503m above the mean sea level (MSL) according to meteorological Deptt. of India, There are Three Seasons Monsoon (June to Sept.), Winter (October to February) and Summer (March to mid June) of the year.

Due to increasing trend of fast urbanization, industrialization there are fair chances of environmental and water pollution. Throughout the world, interest in the quality of ground water which is degraded by human activities, over exploitation, over pumping and percolation of effluents, sewage from factories and due to geological changes, it becomes very important to assess the groundwater quality of Berasia Road, Bhopal. The present district of Bhopal was carved out from Sehore district in 1972 with population of 10,63,662 (1991) Census and about 15 lac at present, out of this about 1.5 lac population is living presently in Berasia Road area of Bhopal.

Methods

About 10 sampling stations have been chosen for this present study area during 2009-10.

Sampling Stations

- 1. Near Sagar Instt. of Technology
- 2. Institute of Aeronautics
- 3. Jatkhedi

- 4. Jhirinia
- 5. Essar Petrol Pump
- 6. Sonkachha Poultry Farm
- 7. Mama Ka Dhaba
- 8. Doraha
- 9. Sadabahar Dhaba
- 10. Shyampur Kurawar

Samples for analysis with standard procedure in accordance with standard method of American Public Health Association APHA (1988) and National Env. Engineering Research Instt. (NEERI) (1986) Nagpur. The instruments has used in the limit of precise accuracy and chemicals used of G.R. Grade. Temperature, pH, TDS has measured. The T-H, Ca-H, Mg-H has measured titrimetrically by using EDTA, Chloride by Mohr's Argentrometric titration and K_2CrO_4 as indicator, D.O. by Winkler's method, Total alkalinity has determined by titrimetric methods using phenophthalein and methyl orange indicators. Nitrate, sulphate and phosphate measured by spectrophotometer.

RESULTS AND DISCUSSION

The results of the study has summarised in Table -1

Temperature

Temperature is one of the most essential parameters in water. It has significant impact on growth and activity of ecological life and is greatly affects the solubility of oxygen in water. The temperature of Borewell's water has found to be in the range of 22°-29°C. pH value is the best indicator of presence of acid or alkali in water samples. pH in the present study at BW, to BW₉ varied from 6.4-7.3. The acceptable limit prescribed by drinking water standard is 6.5 – 8.5 EC and free CO₂ varied from 296-723 μ mhos/em and 6.0-7.7 ppm respectively at different sampling stations.

Chloride

Chlorides are common constituents of all natural waters. Higher value of it imparts a salty taste to water, making it unacceptable for human consumption. As per ISI the desirable limit of chloride for drinking water is 250 mg/l and the permissible limit is 1000 mg/l. The chloride value in this study varied from 78.4-132 ppm. Total alkalinity is the quantitative capacity of an aqueous media to react with H⁺ ions. Desirable limit is 200 mg/l and maximum permissible limit 600 mg/l. In the present study it varied from 128-230 ppm.

Total hardness of water is caused by the presence of Ca & Mg salts. Hardness of BW1-BW9 samples varies from 70.4-154, Ca-H 46.2-114 & Mg-H 24.2-44 ppm respectively. Desirable limit of T-H for drinking water is 300 mg/l & permissible limit in the absence of alternate source is 600 mg/l. So, all the water samples have values within the permissible limits.

D.O., B.O.D. and C.O.D. in the presence study ranges from 1.28-1.98, 2.06-3.24 and 28.4-88.4 ppm respectively. Lower value of these parameters recorded at BW₁, BW₃, BW₂, BW₉ and BW₅ and BW₆ while higher values at BW₉, BW₅ and BW₃ respectively. The findings are similar with those of Kataria (1990, 1995, 2000) and Kataria <u>et al.</u> (2006), (2008) and (2010).

Nitrate, sulphate, phosphate and fluoride has ranged in the present study from 3.8-17.4, 34.8-92.4, 0.80-2.1 and 0.08-1.24 ppm respectively. The concentration of different forms of nitrogen gives a useful indication of the level of micro-nutrients in the water and hence their ability to support plant growth. The prescribed limit of by WHO is 50 mg/l for domestic water. The presence of sulphate has less effect on the taste of water compared to the presence of chloride. The desirable limit of sulphate in drinking water prescribed by ICMR is 200-400 mg/l. The high concentration of

Table 1: Analysis of borewell's water of Gandhinagar, Narsinghgarh Road, Bhopal During 2009-10

Parameters	Unit	BW ₁	\mathbf{BW}_{2}	$\mathbf{BW}_{_3}$	\mathbf{BW}_{4}	\mathbf{BW}_{5}	\mathbf{BW}_{6}	BW ₇	\mathbf{BW}_{8}	BW,
Temperature	°C	26.8	26.0	23.2	22*	28.2	28.8	29**	26	27.2
pH	-	6.5	6.9	6.4*No	$O_{3}^{-}6.5$	6.9	7.1	7.0	7.2*	7.3**
Electr. Cond.	mhos/ cm	490	532	482	480	540	412	304	296*	723**
Free CO ₂	ppm	6.0*	6.4	7.2	7.0	7.7**	6.4	6.2	6.0	5.8
Chloride	ppm	104.2	116.4	102.8	98.6	78.4*	126.2	128	132**	130.4
Total Alkalinity	ppm	152	160	142	136	148	212	230**	128*	134
Total hardness	"	74.6	70.4*	124	138.4	142	154**	146	138	142
Ca-H	"	50.4	46.2*	86	102.0	100	110**	103	102	108
Mg-H	"	24.2*	24.2	38	36.4	42	44**	43	36	34
D.O.	ppm	1.28*	1.64	1.48	1.54	1.64	1.72	1.8	1.92	1.98**
B.O.D.	"	2.8	2.24	2.36	2.68	3.24**	2.72	2.5	2.74	2.06*
C.O.D.	"	64.2	66.8	88.4**	82.8	28.4*	36.4	32	52.8	80.4
Nitrate	ppm	4.4	3.8*	8.0	5.6	12.3	14.2	13	17.4**	9.4
Sulphate	"	42.8	56.2	40.0	42.4	34*.6	78.2	84	86.4	92.4**
Phosphate	"	0.80*	0.90	1.2	1.4	2.0	2.1**	1.8	1.60	1.8
Fluoride	"	1.04	1.20	0.08*	0.05	1.0	1.1	1.2	1.4	1.24**
Copper	"	0.010*	0.018	0.030	0.06	0.064	0.07	0.08**	0.05	0.60
Zinc	"	0.030*	0.04	0.032	0.02	0.03	0.08	1.2**	0.06	0.052
M.P.N.	No/100ml	48	44.2	18.2	16.4*	54**	32		19.4	20.8

*Minimum

** Maximum values

BW1 = Near Sagar Instt. of Technology

BW₍₃₎ Jatkhedi

BW₍₄₎ Jhirinia

BW₆ = Sankachha Poultry form

BW₂ = Inst. of Aeronautics

 $BW_7 = Near Mama Ka Dhaba$

BW₉ = Sadabahar Dhaba

BW₅ = Essar Petrol Pump

BW[°] Doraha

sulphate may induce <u>diarrhea</u> and intestinal disorders. Phosphate in water occurs in the form of orthophosphate, polyphosphate in water occurs in the form of orthophosphate, polyphosphate and organic phosphate. Excess amount of sulphate in water has cathartic effect of human health. The findings are similar with Bindhu and Selvamohan (2009) fluoride is essential for human beings as a trace element and higher concentration of this element causes toxic effects. Concentration of fluoride between 0.6-1.0 mg/l in potable water protects tooth decay and enhances bone development (Kundu et al., 2001).

Copper and Zinc found in the range of 0.010-0.08, 0.030-1.2 ppm respectively and MPN 16.4-54 No/100ml.

In the present study most of the parameters are found within the prescribed limits of IS : 10500 e.g. pH, EC, Chloride, alkalinity, T-H, Ca-H, Mg-H, D.O., C.O.D. White some are beyond the limits free CO_2 , BOD, Nitrate, Fluoride, and MPN.

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