Original Research Paper

Assessment of Drinking Water Quality in Bangalore South Central Zone, Karnataka, India

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ABSTRACT

Water of good drinking quality is of basic importance to human physiology, and man's continued existence depends very much on its availability. The concentrations of most of the investigated parameters in the drinking water samples from Bangalore south central zone were within the permissible limits of drinking water quality standards and guidelines. The samples S1, S4, S10, S12 and S15 have electrical conductivity above the limit.

INTRODUCTION

Water is essential for survival of any form of life. On an average, a human being consumes about 2 litres of water every day. Moreover, water has become an essential commodity for the development of industries and agriculture. Owing to increasing industrialization on one hand and exploding population on the other, the demand for water supply has been increasing tremendously. Sewage, industrial wastes and a wide array of synthetic chemicals also pollute this limited quantity of water (Anandhaparameswari et al. 2007).

Surface and ground waters are the only major sources of water to meet out the entire requirement. They get contaminated in many ways. Once the groundwater is contaminated, it may remain in an unusual or even in hazardous condition for decades or even centuries. It is difficult to distinguish the origin of many water quality problems. Natural quality reflects the type and amount of soluble and insoluble substances with which the water has come in contact. Thus, the quality as well as the quantity of clean water supply is of vital significance for the welfare of mankind. It is, therefore, necessary that the quality of water should be monitored at regular intervals. Therefore, in the present study, an attempt has been made to evaluate physico-chemical characteristics of drinking water source in Bangalore city.

MATERIALS AND METHODS

Study area: Bangalore is located in the south-eastern part of India at 12.97° N latitude and 77.56° E longitude. The city is in the heart of Mysore Plateau, a region of Deccan Plateau. Its average elevation from the sea level is 920 m with an uneven landscape of hills and valleys to the south and relatively more level plateau towards the north. The topology of Bangalore is flat except for a central ridge running south of the city.

A total of 15 samples were collected within the radius of 5 km (Table 1). The sampling and analysis was carried out following the standard methods of APHA (2005). Various physico-chemical parameters like pH, electrical conductivity, TDS, total alkalinity, total hardness, chlorides, etc. were analysed and compared with the drinking water standards prescribed by the BIS, ICMR and WHO (Table 2).

RESULTS AND DISCUSSION

The results of the analysis of drinking water samples are given in Table 3.

pH: The pH of the water samples ranged from 7.2 to 8.2. The recommended value for pH for drinking purposes is between 6.5 and 8.5. In the present study, all the water samples analysed were within the permissible limit. However, higher values of pH hasten the scale formation in water heaters and reduce the germicidal potential of chlorine.

Electrical conductivity (EC): The value of electrical conductivity varied from 1064 to 2850 µmhos/cm. The excessive limit is prescribed as 1400 µmhos/cm. Only the samples S1, S4, S10, S12 and S15 have electrical conductivity below the excessive limit. The higher values of electrical conductivity in these samples clearly indicate that the water from these sources is not fit for human consumption. The higher electrical conductivity values may be due to the natural concentration of ionized substances present in water and due to higher total dissolved solids in the study area.

Table 1: Sampling points.

Sampling No.	Location	Sampling No.	Location
S1	Koramangala KSRP Quarters, Bangalore	S8	Old Madivala (Mr. Satish's house), Bangalore
S2	Koramangala Jakkasandra Public Borewell water	S9	J.P.Nagar (House), Bangalore
S3	Koramangala 5th Block, a food mess	S10	J.P.Nagar, Ist Phase, House near Dental College
S4	Adugodi Police Quarters, Bangalore	S11	J.P.Nagar, Ist Phase at Jhoshika Montessari
S5	B.T.M Layout Behind the Balaji Hotel, Bangalore	S12	MES, School, Jayanagar 4th Block, Bangalore
S6	Tavarekere Madduramma Village near BTM, Bangalore	S13	Byrasandra (house)
S7	Tavarekere Madduramma Village near BTM, Bangalore	S14	Jayanagar 3rd Block (house)
		S15	Krishnappa Garden (house)

Table 2: Standards for drinking water quality.

Sl. No.	Parameters	IS: 10 500	WHO	ICMR
1.	Odour	Unobjectionable	Unobjectionable	Unobjectionable
2.	Turbidity/Colour, NTU	5	5	-
3.	Total Dissolved Solids, mg/L	500	1000	1500
4.	Electrical Conductivity, μS/cm	750	1000	1000
5.	pH	6.5-8.5	7.0-8.5	6.5-9.2
6.	Alkalinity as $CaCO_3$, mg/L	200	-	-
7.	Total Hardness as $CaCO_3$, mg/L	300	500	600
8.	Calcium Hardness as $CaCO_3$, mg/L	75	200	200
9.	Magnesium Hardness as $CaCO_3$, mg/L	30	50	50
10.	Sodium, mg/L	20	200	-
11.	Potassium, mg/L	-	55	-
12.	Chloride, mg/L	250	250	1000
13.	Fluoride, mg/L	1.0	1.5	1.5
14.	Sulphate as SO_4^{2-}, mg/L	200	400	400
15.	Nitrate as NO_3^-, mg/L	45	45	100

Total dissolved solids (TDS): Total dissolved solids is important parameter for drinking water and water to be used for other purposes. Water containing more than 500mg/L of TDS is not considered desirable for drinking water supplies. However, in unavoidable cases 1500 mg/L is also used. In the present investigation, TDS varied from 670 to 1910 mg/L. All the water samples are above the permissible limit and are unfit for human consumption. TDS concentration above the permissible limit causes gastrointestinal irritation. Hence, water with high TDS values should not be used for drinking purposes. If it has to be used due to scarcity, it can be used after reverse osmosis.

Biochemical oxygen demand (BOD): The maximum desirable limit of BOD for drinking water is 3.0 mg/L. In the present investigation BOD values of water samples vary from 3.2-6.1 mg/L. The water samples S2, S5, S6, S14 and S15 have high BOD values higher than the maximum desirable limit of 5mg/L. The high BOD values clearly indicate organic pollution, which may be attributed to the percolation of wastewater loaded with biodegradable compounds. It is important to note that the Corporation water supply has higher BOD.

Dissolved oxygen (DO): Dissolved oxygen is an important parameter for water quality assessment. Low dissolved oxygen gives bad odour to water due to anaerobic decomposition of organic wastes. In the present study, dissolved oxygen values of water samples varied from 6.6 to 7.5mg/L. The DO level in natural waters depends upon physical, chemical and biological activities prevailing in the water bodies. The amount of DO also varies with water temperature and altitude.

Total alkalinity: In the present study total alkalinity values ranged from 84 to 212mg/L.

Total hardness: Total hardness levels varied from 92 to 304 mg/L. All the water samples were within the permissible limits for drinking water. Calcium hardness of the water samples was in the range of 72 to 168 mg/L and that of magnesium hardness was 20 to 136mg/L. The permissible limit of total hardness for drinking water is 600mg/L.

Chlorides: The chlorides in the water samples ranged from 56 to176mg/L. The permissible limit for chloride content is 250mg/L. All the water samples were within the permissible limit for chloride content.

Table 3: Results of physico-chemicals analysis of water samples. All the values are in mg/L except pH and electrical conductivity (μmho/com).

Parameters	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S10	S11	S12	S13	S14	S15
pH	7.9	7.7	7.8	7.6	7.7	7.9	8.2	7.9	7.6	7.3	7.4	7.2	7.6	7.8	7.9
Electrical Conductivity	1064	2850	1486	1358	1348	1426	1416	1476	1484	1386	1412	1396	1496	1426	1384
Total Dissolved Solids	670	1910	864	816	824	898	906	934	926	864	868	884	976	888	856
Dissolved Oxygen	6.7	6.7	7.4	6.8	6.6	7.2	7	7.1	7.1	7	6.7	6.9	7.3	7.5	7.1
Biochemical Oxygen Demand	3.3	5.1	4.6	4.8	5.2	6.1	4.9	3.3	3.5	3.2	4.9	4	5	5.7	5.4
Chemical Oxygen Demand	67	74	96	76	124	120	132	134	136	130	142	138	126	140	134
Total Alkalinity as CaCO$_3$	156	212	156	192	84	188	184	192	196	180	192	196	208	196	192
Total Hardness as CaCO$_3$	196	304	180	200	92	184	192	168	180	184	188	192	196	200	192
Calcium Hardness as Ca	124	168	112	128	72	100	124	92	104	96	88	100	112	124	96
Magnesium Hardness as Mg	72	136	68	72	20	84	68	76	76	88	100	92	84	76	96
Sodium	24	505	30	29	42	28	26	29	29	28	25	24	25	24	24
Potassium	2	24	2	1	1	1	1	1	1	1	1	1	1	1	1
Chloride	56	176	56	52	80	68	64	60	64	56	56	60	64	56	60

Sodium and potassium: The sodium content in the water samples varied from 24 to 505mg/L. Sample S2 has the highest sodium content and all other samples were within the permissible limit. Potassium content in the water samples ranged from 0 to 2 mg/L and all the water samples were within the permissible limit.

CONCLUSION

Potable water is defined as water that is free from disease producing microorganisms and chemical substances deleterious to health. Unfortunately, clean, pure and safe water exists only briefly in nature and is immediately polluted by prevailing environmental factors and human activities. Water from most sources is, therefore, unfit for immediate consumption without some sort of treatment.

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