Jr. of Industrial Pollution Control 29(1)(2013) pp 97-102

www.envirobiotechjournals.com

TO STUDY WATER QUALITY OF SHEGAON TOWN OF BULDANA DISTRICT IN MAHARASHTRA

R.B. BARABDE *AND Y.S. PATIL **

* Department of Environmental Science, ** Department of Microbiology,
Shri D. M. Burungale College of Science and Arts, Shegaon, Dist. Buldana(M.S.), India

Key words : Water quality, Ground water, Surface water, Drinking water standards.

(Received 29 September, 2012; accepted 22 November, 2012)

ABSTRACT

In the present study, physico-chemical and microbiological characteristics of different sources of surface and groundwaters in Shegaon town were determined during February 2012. The objective of the study was to assess the suitability of water for human consumption and other domestic purposes. Water samples from three different densely populated localities were collected and analysed for various parameters using standard methods. The physico-chemical parameters of home well water were satisfactory whereas bore well water exhibited all the values as exceeding maximum permissible limit with a few exceptions of sulphate and dissolved oxygen in bore well water . The microbiological analysis revealed that with the exception of bore well water, all other waters fail to satisfy the prescribed standards set for drinking water. Therefore, the study revealed that the entire water samples investigated in the present study failed to qualify the prescribed standards for drinking water either in the physico-chemical aspects or in the microbiological aspects or both.

INTRODUCTION

Water is one of the essential natural resources for existence and development of life on the earth. Surface and ground waters are the major sources to meet out the entire requirement. However, several factors like industrial and domestic wastes, discharge from agricultural practices, land use practices, rainfall pattern and infiltration rate, geological formation, etc. can affect water quality in a region (APHA 1975). The quality of water is getting vastly deteriorated mainly due to unscientific waste disposal, improper water management and carelessness towards the environment. This has led to the scarcity of potable water affecting human health (Agarkar and Thombre, 2005). Increased anthropogenic activities in and around the water bodies can damage aquatic systems and ultimately microbiology and the physico-chemical properties of water. According to WHO (1984) 30 to 80% human diseases occurred due to impurities in water. Traditionally, the microbiological quality of drinking water is assessed by monitoring non-pathogenic bacteria of faecal origin (Rompre *et al.* 2002). Before water can be described as potable, it has to comply with certain physical, chemical and microbiological standards to ensure that it is palatable and

*** Corresponding Authors email :** rahulbarabde@rediffmail.com

safe for drinking and other domestic purposes (Tebutt 1983).

Shegaon is a densely populated city in Buldana district in Maharashtra, which is reeling under acute shortage of potable water, especially during summer season, despite having a number of surface and groundwater re¬sources. The present situation in Shegaon attracts the attention to the urgency for investigating the causes and sug¬gestion remedies. In the present study, an attempt has been made to analyse the physico-chemical as well as the microbiological parameters of different water resources available in Shegaon, to see whether these water bodies are suitable for drinking and for other beneficial purposes.

MATERIALS AND METHODS

Sampling : The water samples were collected from three different selected regions of Shegaon during the month of February 2012. The location and source of water samples are given in Table 1.

Table 1. The Location, Source code of water collected from Shegaon.

Sl. No.	Location	Sample code & Sources	
		WI	W2
1.	GM Temple area	Home well	Bore Well
2.	Bus stand area	Home well	Bore Well
3.	Old city area	Home well	Bore Well

The water samples were collected in high grade plastic bottles of one litre capacity. Before collection, the plastic bottles were rinsed with distilled water and then thrice with respective water sample. During collection, care was taken to avoid trapping of air within the bottle by completely im¬mersing the bottle within the respective water sample until the bottle is completely filled in with the water sample.

Parameters analysed: The samples collected were brought to the laboratory and analysed for pH, electrical conductivity (EC), dissolved oxygen (DO) and total dissolved solids (TDS) immediately. Other physico-chemical parameters like colour, odour, taste, turbidity, total hardness (TH), total alkalinity, biochemical oxygen demand (BOD), calcium, chloride, fluoride, magnesium, sulphates, iron and nitrates were analysed within 36 hrs of collection. Standard methods were adopted for the analysis of water samples (APHA-AWWA-WPCF 1989).

For microbiological examination, samples were collected in 250 mL sterile bottles, and analysis was carried out within 6 hours of sample collection using standard methods outlined in BIS (1981). The parameters studied include total plate count (TPC), total coliform bacteria and faecal coliforms (*E. coli*).

Comparison with BIS and WHO standards

The physico-chemical parameters analysed for water samples were compared with BIS (1992) for drinking water and microbiological parameters with WHO standards (1996) for drinking and bathing water. The data provided in Tables 2 and 3 is an average of three samples collected from three different areas under study.

RESULT AND DISCUSSIONS

Colour, taste and odour

All the water samples were found to be colourless. Regarding taste, water sample W2 tasted salty. The odour of all the samples was not objectionable.

pH

As the pH is related to a variety of different parameters, it is not possible to determine whether pH has a direct relationship with human health, but it is argued that pH has an indirect effect as it can affect water treatment processes (Aramini *et al*. 2009). In the present study the range of pH of different water samples was from 6.8 to 7.5 and all were (Table2).

Total hardness

Total hardness of different water samples in the present study varied from 71.67 mg/L to 8600 mg/L. Generally, the hardness of water bodies increases as the concentration of calcium and magnesium salt in water increases, especially during summer season due to excessive evaporation. The maximum hardness was observed in water sample collected from bore well (W2) which was 8600 mg/L. This value is much higher than the maximum permissible limit prescribed by BIS (1992). The remaining water sample Wl showed hardness level well within the desirable limit.

Turbidity

According to BIS (1992), the desirable limit of turbidity in drinking water is 5 NTU and a maximum permissible limit is extended up to 10 NTU. The study showed that turbidity value range from 1 NTU to 4.67 NTU. Therefore, all the water samples were well within the desirable limit. The minimum value of tur-

bidity was recorded in water samples collected from home well, whereas the maximum in bore well water.

Iron

The concentration of iron (as Fe) in different water samples varied from 0.41 mg/L to 28.44 mg/L (Table 2). With the exception of sample Wl, all the water samples have iron concentration much above the maximum permissible limit for consumable water, whereas Wl has a value within the maximum permissible limit but above the desirable limit (0.41 mg/L). The intake of large amount of iron through drinking water can cause haemochromatosis, a condition in which normal regulatory mechanisms do not operate effectively, leading to tissue damage as a result of the accumulation of iron (Dillman et al. 1987). Besides this, when iron concentration in the domestic water supply exceeds permissible limit, it becomes objectionable for a number of reasons that are indirectly related to health (Cohen *et al.* 1960).

Chloride

Chloride is one of the important indicators of water pollution. The value of chloride concentration in water samples W2 under study was too much higher than the maximum permissible limit. It was 10800.50 mg/L in W2. With respect to water samples Wl the chloride concentration was satisfactory as it lies within the desirable limit of BIS drinking water specification, and were 80.22 mg/L. Sources of chloride pollution in water include fertilizers, sewage, effluents, farm drainage, salt and human and animal wastes. High chloride content can cause high blood pressure in people.

Nitrates

The high concentration of nitrates in drinking water is toxic (Gilli *et al*. 1984). It is regulated in drinking water primarily because high levels can cause methaemoglobinaemia or "blue baby" disease (Mccasland *et al.* 1985).

Sulphate

Sulphate content of water samples varied from 4.98 to 12.01 mg/L. all the samples were within the desirable limit. Sulphate above the permissible limit may cause gastrointestinal disorders and diarrhoea in human beings (Prasad *et al*. 2008).

Fluoride

The desirable limit for fluoride in drinking water is 1mg/L and the maximum permissible limit is 1.5 mg/L (BIS 1992). The excessive amount of fluoride in drinking water can cause fluorosis having disfigurement of teeth and deformities of bones (Kulshreshtha *et al.* 2004). The concentration of fluoride in the water samples varied from 0.02 mg/L to 0.12 mg/L. Therefore, all the water samples have fluoride well within the desirable limit.

Calcium and magnesium

The values of calcium and mag¬nesium in the water samples varied from 17.8 mg/L to 2100.33 mg/L and 1.95 mg/L to 633.09 mg/L respectively. Water samples Wl have acceptable value. Venkata *et al*. (2006) reported high positive correlation between TDS-Mg, TH-Ca and TH-Mg. The present study also supports this observation, as there is a positive correlation between the values of magnesium, calcium, TDS and total hardness in different samples.

Toial alkalinity

Alkalinity of water is related to the actual number of base components and can be thought of as the intensity of the pH. Alkalinity values were recorded in the range of 6.4 mg/L to 13.63 mg/L. Minimum was noticed in bore well water. As per the BIS standards all the values were well within the desirable limit (Table 2). If the alkalinity is low it indicates that even a small amount of acid can cause a large change in the pH.

Total dissolved solids (TDS)

Total dissolved solids of the water samples were in the range of 170 to 1070 mg/L. TDS is an important parameter for drinking water and water to be used for other purposes. According to BIS (1992), water containing TDS value up to 500 mg/L is considered desirable and a maximum permissible limit of 2000 mg/L under unavoidable situations. In the present investigation the water sample Wl showed a range satisfactory and within the desirable limit. The water sample W2 recorded maximum TDS value which is too higher than the maximum permissible limit and are not at all suitable for human consumption.

Biochemical oxygen demand (BOD)

BOD is the amount of oxygen required by the living organisms engaged in utilization and ultimate destruction or stabilization of organic matter in water (Hawkes, 1963). It is an important indicator of water pollution. BOD value of water samples in the present

study varied from 2.57 to 17.96 mg/L. As per BIS the maximum desirable limit of BOD for drinking water is 5 mg/L. Here, it is observed that the BOD value of water sample W2 is above the maximum desirable limit, and are 17.96 mg/L. The higher BOD values of this samples clearly indicate pollution and imply high demand for oxygen to support life processes which may be attributed to the percolation of wastewater loaded with biodegradable material.

Dissolved oxygen (DO)

Generally, an increased values of BOD and COD indirectly indicate decrease in DO values. Deficiency of DO gives bad odour to water due to anaerobic respiration of organic matter (Sallae 1974). In the present investigation, with the exception of bore well water (W2), DO values of W1 water sample were comparatively lower and the higher value of DO in water sample W2 may be because of comparatively low organic matter content.

Electrical conductivity (EC)

EC measures the ability of water to conduct an electrical current, and it is directly re¬lated to TDS (Aydin 2007). The present study showed that EC values of various samples range from 154.66 to 3376 µmhos/cm. Water samples Wl and W2 exhibited a reasonable values. The higher values of these samples may be due to high TDS value and the higher concentration of ionised substances present in the samples due to pollution by industrial effluents, domestic wastes, agricultural water, etc. (Aramini *et al.* 2009). It clearly indicates that samples W2 is unfit for human consumption.

Microbial status

An estimation of bacterial production is a crucial step in understanding quantitatively the function and contribution of bacteria in material cycling within the given aquatic habitats (Azam et al. 1990). Assessment of indicator bacteria namely coliform bacteria is a convenient way to evaluate potability and sanitary condition of water bodies. *E. coli* and Enterococcus species are traditionally used as hygiene indicator bacteria, and methods for their detection are essential for drinking water regulations all over the world.

As per the results of the present study shown in Table 3, the total bacterial load as evident from total plate count (TPC), bore well water (27×10^2/mL) and home well water (10 x 102/mL). The total coliform count per 100 mL of different water samples ranged from 0 to 113 MPN/l00mL. Coliform bacteria will not likely cause illness. However, their presence in drinking water indicates that disease-causing organisms could be in the water system. The water samples collected from bore well showed no coliform count of other water samples, home well were found to fall in higher range than the standard limit for drinking water. Water sample Wl were identified as having the presence of faecal coliform bacteria *E. coli*. There was no count for Escherichia coli in water sample W2. Confirmation of faecal coliform bacteria or *E. coli* in a water sample indicates recent faecal contamination of either human or animal origin, which may pose an immediate health risk to anyone consuming the water (Okonko *et al.* 2008). Therefore, water sample Wl give clear indication of poor water quality as they are exceeding the drinking water permissible microbiological counts suggested as per BIS (1992) and WHO (1996) standards.

As per the suggested WHO (1996,1998) values of total coliform bacteria and *E. coli* per 100 mL water for the purpose of bathing and swimming (Table 4), the water samples Wl and W2 are safe for bathing purposes as their microbial values are lying within the guide value. Both total coliform and *E. coli* count exceeded guide value but lying within the mandatory value.

CONCLUSION

The high level of many physico-chemical characteristics of water sample (W2) or microbiological parameters (Wl) or both together render all the water samples unfit for human consumption though they can be used for other purposes. The water should meet the different quality speci-fications depending on the particular use. The microbiological and physico-chemical quality adversely affected the quality of various water sources of Shegaon. The sources of pollution include agricultural practices, infiltration of irri¬gation water, infiltration of sewage effluents, construction activities, farm animals, septic tank, etc. Therefore, people in these areas have high potential risk of getting waterborne or sanitization related diseases under situations when they are forced to use these resources. Therefore, it is recom¬mended that water from these sources is to be used for drinking only after pretreatment like boiling, chlorine disinfection, filtration, reverse osmosis, electrodialysis, etc. based on the situation demand. In conclusion, effective preventive

Table 2: Physico - chemical characteristics of water samples collected from various sources in Shegaon of Buldana district for comparison with drinking water specifications of IS: 10500, BIS (1992).

Sr.No.	Parameters	BIS 1992		Water samples	
		DL	ML	W1-Home well	W2-Bore well
1.	Colour	5	25	2	3.67
2.	Odour	unobjectionable	-	unobjectionable	unobjectionable
3.	Taste	Agreeable	-	agreeable	salty
4.	Turbidity	5	10	1	4.67
5.	pH	6.5-8.5	MR	7.2	6.8
6.	TotalHardness	300	600	71.67	8600
7.	Iron	0.3	1.0	0.41	28.44
8.	Chlorides	250	1000	80.22	10800.50
9.	Fluoride	1	1.5	0.02	0.12
10.	Calcium	75	200	17.8	2100.33
11.	Magnesium	30	100	1.95	633.09
12.	Sulphates	200	400	12.01	4.98
13.	Nitrates	45	100	1.86	1087
14.	EC	-	-	154.66	3376
15.	Total Alkalinity	200	600	13.63	6.4
16.	BOD	-	- -	2.57	17.96
17.	DO	-	-	7.5	16.4
18.	TDS	500	2000	170	1070

Desirable limit (DL); maximum limit (ML). All parameters are expressed in mg/L with the exception where colour in hazen units, turbidity in NTU and electrical conductivity in ^mhos/cm.

It is reported that groundwater is often contaminated due to ni¬trogenous fertilizers and manures, and also often accompa¬nied by pesticides used in agriculture (Munsuz & Unver 1995). It is also reported that nitrate concentration depends on the activity of nitrifying bacteria which in turn get influ¬enced by presence of dissolved oxygen. In the present study values of nitrates indicate that with the exception of water sample W2, all other water samples have nitrate content well within the desirable limit. W2 sample exhibited a value of 1087 mg/L which is many times higher than the maximum permissible BIS guideline value of 100 mg/L.

Table 3. Microbiological data variation in the total plate count (TPC/mL), total coliform (MPN/100 mL) and faecal coliform (MPN/100 mL) of different water samples.

Sr. No.	Sample	Total plate count (CFU/mL)	Total coliforms (MPN/100mL)	Faecal coliform (*E.coli*) (MPN/100mL)
1	W1	10x102	113	2.00
2	W2	27x102	0.00	0.00
3	Limit as per BIS(1992)/WHO(1996)	100/mL	0/100mL	0/100mL

Table 4. Water quality requirements for bathing waters of the European Economic Community suggested by WHO (1996 & 1998).

Sr.No.	Microbiological parameters	Guide value	Mandatory value
1.	Total coliform/100mL	500	10,000
2.	*E.coli*/100mL	100	2,000

measures are to be taken immediately to save these water resources of Shegaon as it is an area of faster development and dense population.

REFERENCES

Agarkar, V.S. and Thombre, B.S. 2005. Status of drinking water quality in schools in Buldhana district of Maharashtra. *Nature Environment and Pollution Technology*. 4 (1) : 495-499.

APHA 1975. *Standard Methods for the Examination of Water and Wastewater.* 14th Edition, American Public Health Association, Washington DC.

APHA-AWWA-WPCF 1989. *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association, Washington DC.

Azam, R, Cho, B.C., Smith, D.C. and Simon, M. 1990. Bacterial cycling of matter in the pelagic zone of aquatic ecosystems in large lakes. In: M.M. Tylzer and Surruya (eds.) *Ecological Structure and Function* . Springer-Verlag, Berlin, pp. 477-88

Aydin, A. 2007. The microbiological and physico-chemical quality of groundwater in West Threce, Turkey. *Polish J. Environ. Stud.* 16 (3) : 377-383.

Aramini, J.M., McLean, M., Wilson, J., Holt, J., Copes, R., Alien, B. and Sears, W. 2009. Drinking Water Quality and Health Care Utilization for Gastrointestinal Illness in Greater Vancouver. Environmental and Workplace Health Reports and Publications.

BIS 1981, R 2003. *Methods of Sampling and Microbiological Examination of Water.* IS: 1622, Bureau of Indian Standards, New Delhi.

Cohen, J.M., Lamphake, L.J., Harris, E.K. and Woodward, R.L. 1960. Taste threshold concentrations of metals in drinking water. *J. Am. Water Works Assoc.* 52 : 660.

Dillman, E., Gale, C., Green, W.E., Johnson, D.G., Mackler, B. and Finch, C. 1987. Hypothermia in iron deficiency due to altered trycodo-thyro-nine metabolism. *Am. J. of Physiol.* 2.

Kulshreshtha, S., Sharma, S. and Singh, R.V. 2004. Impact of domestic and industrial effluent on water and soil quality of Sanganer, heritage city Jaipur. *Int. J. Chem. Sci.* 2 : 27-36.

Munsuz, N. and Unver, I. 1995. *Water Quality* (In Turkish). No. 1389. Ankara University Agriculture Faculty Publishing, Ankara, p. 168.

Gilli, G., Corrao, G. and Favilli, S. 1984. Concentration of nitrate in drinking water and incidence of gastric carcinomas, first descriptive study of the Piermente region, Italy. *Sci. Total Environ.* 34 : 34-57.

Mccasland, M., Trautmann, T., Porter, K.S. and Vagenet, R. J. 1985. Nitrate: Health Effects in Drinking Water. Natural resources Cornell cooperative extension.

Hawkes, H.A. 1963. *The Ecology of Wastewater Treatment*. Pergamon. Press, Oxford.

Sallae, A.J. 1974. Water-bom diseases. In: *Fundamental Principles of Bacteriology*, Seventh Edition. Tata McGraw Hill Publishing Company Ltd., New Delhi.

Okonko Iheanyi Omezuruike, Adejoye Oluseyi Damilola, Ogunnusi Tolulope Adeola, Fajobi, Enobong, A. and Shittu Olufunke, B. 2008. Microbiological and physicochemical analysis of different water samples used for domestic purposes in Abeokuta and Ojota, Lagos State, Nigeria. *African Journal of Biotechnology*. 7 (5) : 617-621.

Prasad, R.N., Ran Chandra and Tiwari, K.K. 2008. Status of groundwater quality of Lalsot urban area in Dausa district, Rajasthan. Nature Environ. *Poll. Tech.* 7 (3) : 377-384.

Rompre, A., Servais, P., Baudart, J., De Roubin, M.R. and Laurent, P. 2002. Detection and enumeration of coliform in drinking water: Current methods and emerging approaches. *J. Microbiol. Methods*. 49 : 31.

Tebutt, T.H.Y. 1983. *Priciples of Quality Control.* Pergamon, England, pp. 235.

WHO, 1984. *International Standards for Drinking Water*. 3rd Edn., World Health Organization, Geneva.

WHO 1996. *Guidelines for Drinking Water Quality.* Second Edition, Vol. 2, Health Criteria and Other Supporting Information, World Health Organization, Geneva.

WHO, 1998. *Guidelines for Safe Recreational Water Environments*. Vol. 1, Costal and Fresh waters. Draft for Consultation. World Health Organization, Geneva, WHO/EOS/98.

Venkata Subramani, R., Meenambal, T. and Livingston Peter Goldwyn. 2006. Correlation study on physico-chemical characteristics of groundwaters in Coimbatore District. *Poll. Res.* 5 (2) : 371 -374.