The Physicochemical Evaluation of Tubewell Water Quality of Osmanabad City, Maharastra State, India

*S. N. Birajdar,[1] U. B. Chanshetti[2]

[1]Department of Chemistry, Shankarrao Jawale-Patil Mahavidyalaya, Lohara, Dist: Osmanabad (MH) India.
[2]Department of Chemistry, Arts, Science & Commerce College, Naldurg (MH) India.
Corresponding author: S. N. Birajdar

Abstract: The physicochemical properties of tubewell groundwater from various stations in Osmanabad City of Maharashtra State were analyzed. The samples taken in summer season (months of April-May) from twelve different stations and were analysed for major physico-chemical parameters such as temperature, pH, electric conductivity(EC), total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), Ca^{2+}, Mg^{2+}, Cl^- by using standard analytical methods. The analysis showed that drinking water quality in the study area is rationally good and doesn't show any alarming level of pollutants. Nevertheless it needs some extent of treatment before consumption as the concentration of the parameters such as Total alkalinity, Total solid, Total hardness, Dissolved oxygen, Magnesium hardness, Calcium hardness and Chemical oxygen demand go beyond the permissible limits for drinking water.
Keywords: Dissolved oxygen, Electrical conductivity, Groundwater, Osmanabad, Parameters.

I. Introduction

Water plays an important role to the biodiversity. It covers 71% of the Earth's surface. On Earth, 96.5% of water is found in seas and oceans whereas only 1.7% in groundwater. Clean, safe and adequate fresh water is essential to the survival of all organisms and the smooth functioning of key systems, entities and economies. Water based ecosystems provide a diversity for human well -being and poverty alleviation and the delivery of fresh water is a particularly important service both directly and indirectly. However due to the increase in world population, water pollution and contamination weakens or destroys natural ecosystem that ropes human health, food production and biodiversity, polluted water can lead to serious problems with diseases and death of humans, plants and animals.[1]

Groundwater resources become a major source of drinking water, so the quality of ground water plays an important role for particular usage (public water supply, industrial applications, irrigation, power generation etc).[2] The quality of ground water varies from place to place, with the depth of water table, and from season to season and is typically measured by the extent and composition of dissolved solids present in it[3-4]. For effective control measures and continuous monitoring of water quality, the physic-chemical and micro-biological characterization is essential.[5-6]
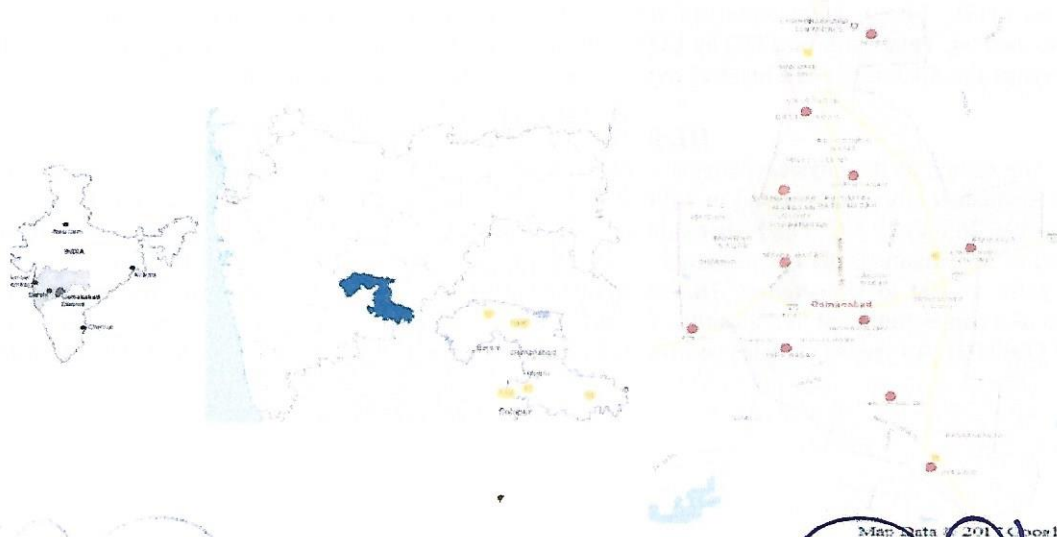

Figure 1: Map of study area (Osmanabad City)

In the present study, the physicochemical analysis of tubewell groudwater was carried in the area of Osmanabad City. The city is located, in the southern part of state surrounded by Small Mountain called Balaghat, 600 mm above sea level and is located on east side of Marathwada region within North latitude 17.35 to 18.40 degree and east latitude 75.16 to 76.40 degree. The rainy season starts from mid-June till the end of September. The climate is humid in October and November and dry and cool from mid-November to January. From February to June the climate is dry and becomes increasingly hot. During summer, the temperature of Osmanabad district is low compared to other districts of Marathwada region. The average annual rainfall in the district is 730 mm. The physicochemical data generated was compared with standard values recommended by WHO[8].

II. Experimental

2.1 Study area

The ground water collected from the tubewells located at 11 different sites of Osmanabad City, Maharashtra during March 2016 – May 2016. The depth of the tubewells ranged from 90-350 feet in all these stations. The sampling locations, source and corresponding habitats are shown in Table 1.

2.2 Preparation of water samples

All collected samples were collected in pre-cleaned 2.0 litres polypropylene bottles using standard procedure of grab or catch as per the methods of APHA.[7] Temperatures of the samples were measured in the field itself at the time of sample collection. The samples were kept in refrigerator maintained at 5°C.

Table 1. Sampling locations and corresponding habitats

Sr. No.	Sampling Site	Code	Habitat	Source
1	Shekapur road	S_1	Residential area	Tubewell
2	Ganesh nagar	S_2	Residential area	Tubewell
3	Bhim nagar	S_3	Residential area	Tubewell
4	Indira colony	S_4	Residential area	Tubewell
5	Tambri vibhag	S_5	Residential area	Tubewell
6	Manik nagar	S_6	Residential area	Tubewell
7	Usmanpura colony	S_7	Residential area	Tubewell
8	Bhanu nagar	S_8	Residential area	Tubewell
9	Shashu nagar	S_9	Residential area	Tubewell
10	Datta nagar	S_{10}	Residential area	Tubewell
11	MIDC area	S_{11}	Commercial area	Tubewell

All the chemicals and reagents used were of AR grade. The pH meter, conductivity meter, spectrophotometer, flame photometer instruments were used to analyze these parameters. It was ensured that the concentrations of various water quality parameters do not changes in time that elapses between sampling process and the analysis in the laboratory. Details of the analysis methods are summarized in Table 1.

All the samples were examined 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 for the examination of water and wastewater American Public Health Association (APHA).[7] The parameters present in the water sample can be calculated by using various methods.[8] The pH of all the water samples was determined using a pH meter (Model no LI120, Elico), Total dissolved solids (TDS) by standard methods,[8] Calcium content by EDTA titrimetric method, Total hardness (TH) by EDTA titrimetric method, chloride content by argentometric method, methyl orange for Alkalinity and Chemical oxygen demand (COD) by open reflux method.

III. Result And Discussion

The results of the physicochemical analysis of the groundwater samples S_1 to S_{11}, collected from 11 sites in Osmanabad city are presented in Table 2. The temperature of on field samples was found to be in the range between 26.0 to 27.4°C. The higher values could be attributed due to the summer season prevailed during the period of investigation. pH is considered as an important ecological factor and the pH value is based on a defined scale, similar to temperature. This means that pH of water is not a physical parameter that can be measured as a concentration or in a quantity. The pH of tubewell water samples varied between within the range 6.95-8.2 (Table 2). All eleven samples confirm pH within the limit of 6.5-8.5 prescribed by WHO for drinking water.

Table 2: Physicochemical parameters of tubewell water of Osmanabad City

Sr. No.	Sampling Site	pH	EC μs/cm	TDS mg/L	COD mg/L	TH mg/L	Alk. mg/L	Ca H mg/L	Mg H mg/L	Cl⁻ mg/L
1	S_1	8.2	450	580	9.8	710	310	260	60	90
2	S_2	7.9	410	420	10.5	630	230	210	60	70
3	S_3	7.6	380	470	11.9	560	190	170	40	80
4	S_4	7.4	320	410	11.2	520	70	170	30	50
5	S_5	7.8	400	490	10.7	610	80	80	90	40
6	S_6	8.0	440	330	10.2	590	100	80	80	30
7	S_7	7.9	370	400	10.6	420	120	40	40	40
8	S_8	6.5	260	290	12.4	270	70	20	60	40
9	S_9	6.9	230	160	12.6	160	210	50	30	20
10	S_{10}	7.6	380	410	11.1	320	350	20	50	30
11	S_{11}	8.5	590	660	8.2	1020	520	270	100	120

The TDS of all samples was observed within the limits (500 mg/L) of WHO for drinking water except sample S_{11} (660 mg/L). The disparity in TDS may be due to diverse earth beds and recharge sources. Usually the water samples have high values of TDS making them unsuitable for drinking purpose. Electrical conductivity shows significant higher value commercial sites as compared with residential sites. This shows that EC has significant correlation with TSS values. The comparative data of electrical conductivity (EC) shown in figure 2. The experimental COD values in all the stations are varying from 8.2 to 12.6 mg/L which is far lower than the permissible limit of COD for drinking water is 255 mg/L.

The average value of alkalinity in the tubewell water of study samples was 204.54 mg/L (Table 3) which exceeded the desirable limit in all stations. The standard desirable limit[9] of alkalinity in potable water is 120 mg/L. The value of alkalinity in water shows the presence of natural salts in water. The alkalinity results due to the contribution of various types of salts like bicarbonate, hydroxide, phosphate, borate and organic acids.
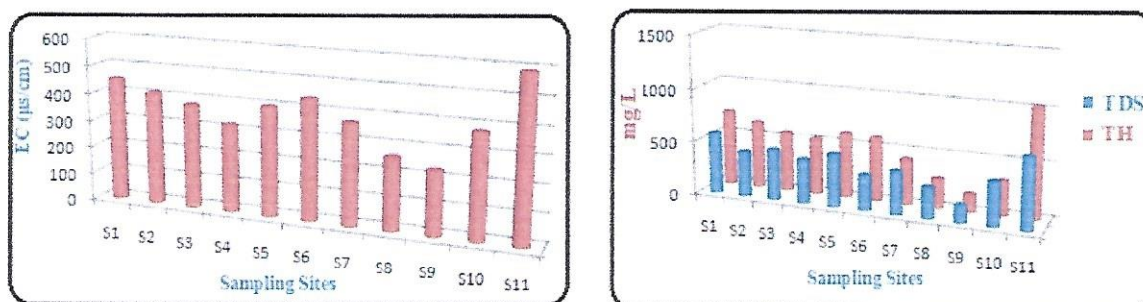

Figure 2: Variation in a) Electrical conductivity and b) Variation in TDS and Total hardness

Hardness of water is an important criterion for determining the usability of water for domestic, drinking and many industrial supplies.[10] Hardness of water prevents lather formation with soap and increases the boiling point and is mainly depends upon the amount of calcium or magnesium salt or both.[11] The present study shows that the value of hardness fluctuates from 160 mg/L to 1020 mg/L, which are far away from the tolerable limit as prescribed by ICMR, BIS and WHO. The minimum value was found in S_9 and maximum value was found in samples S_{11} (fig. 2). Calcium Hardness ranges from 20 mg/L to 270 mg/L. This possibly due to the presence of high amounts of calcium salts in tubewell water. The magnesium content of tubewell water varies from 30 mg/L to 100 mg/L which are far away from the permissible limit as prescribed by WHO for drinking water. Chloride contents in fresh water are largely attributed due to evaporation and precipitation. In our study, chloride content value ranges between 20 mg/L to 120 mg/L.

IV. Conclusion

The water quality parameters of tubewell water from eleven different stations Osmanabad city reveals that the pH, Total hardness, COD, calcium and chloride ion values are well within the permissible limits. The TDS of S_{11} was well above the desirable limit and the average of alkalinity has also within the desirable limits. In conclusion, the groundwater of Osmanabad city is robust for domestic and drinking purpose need treatments to reduce the contamination especially the alkalinity.

Principal
Jawahar Arts, Science & Commerce College,
Andur Tal. Tuljapur Dist, Osmanabad

References

[1]   D.A. Wright and P. Welbourn, Environmental Toxicology. Cambridge University Press, Cambridge, U.K. 2002.
[2]   A.E. Hassan, H.M. Bekhit and J.B. Chapman, J. Hydrol., 362, 2008, 89.
[3]   B.K. Borah, H.P. Sarmah and R. Roy, Nat. Envi. Poll. Tech., 10, 2011, 73.
[4]   D.K. Sinha, S. Saxena and R. Saxena, Poll. Res., 23, 2004, 527.
[5]   WHO, International Standards for Drinking Water, 3rd Ed. Geneva 1971.
[6]   K. Karunakaran, P. Thamilarasu and R. Sharmila, Eur. J. Chem., 6, 2009, 909.
[7]   APHA, Standard methods for analysis of water and wastewater.18th Ed. American Public Health Association, Inc., Washington D C. 1992.
[8]   a) M. Meybeck, Rev. Geol. Dyn. Geogr. Phys., 21, 1997, 215 b) N. Manivasakam, Physical Chemical examination of water, sewage and industrial effluents 3rd Ed, Pragati Prakashan, Meeret, India, 1996.
[9]   W.H.O, Guidelines for drinking water quality, Vol.1, Recommendations WHO, Geneva, 1984.
[10]   S. Mitharwal, R.D. Yadav and R.C. Angasaria, Rasayan Journal of Chemistry, 2, 2009, 920.
[11]   M.K. Singh and D. Jha, Jadoun, J. International Journal of Chemistry, 4, 2012, 96.

Principal
Jawahar Arts, Science & Commerce College,
Andur Tal. Tuljapur Dist, Osmanabad