Int.J.Curr.Microbiol.App.Sci (2017) *6*(12): 1252-1258

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 6 Number 12 (2017) pp. 1252-1258**
Journal homepage: http://www.ijcmas.com

IJCMAS INTERNATIONAL JOURNAL OF CURRENT MICROBIOLOGY AND APPLIED SCIENCES 2017 DECEMBER VOL NO.: 6, ISSUE-12 www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.612.141

Physico-Chemical Analysis of Ground Water in the Selected Area of Visakhapatnam, AP, India

E. Madhusudan Yaduvams[1], S.V. Ranga Rao[2], CH. Venkata Ramana[1*] and T. Byragi Reddy[1]

[1]SMBTAV & SN Degree College, Veeravasaram, AP, India
[2]Department of Environmental Sciences, Andhra University, Visakhapatnam, AP, India
**Corresponding author*

A B S T R A C T

Keywords

Ground water, Physico-chemical analysis and over exploration.

Article Info

Accepted:
10 October 2017
Available Online:
10 December 2017

Ground water is important source for industrial, agricultural and domestic purpose. Recent decades, due to over exploration of ground water is drastically decreased. Our present study, carried out of physico-chemical analysis of ground water, Visakhapatnam, AP, India. Major parameters like pH, Electrical Conductivity, Total Dissolved Solids (TDS), Chlorides, Sulphate, Total Hardness, Total Alkalinity, Nitrates and Dissolved Oxygen (DO) were analyzed. Results showed that the most of the parameters were exceeded the recommended ground water quality levels of Bureau of Indian Standards (BIS). Results indicated ground water is slightly polluted and recommended to treatment of ground water it's before use.

Introduction

Ground Water quality plays an important role in groundwater protection and quality conservation. Hence, it is very important to assess the groundwater quality not only for its present use but also from the viewpoint of a potential source of water for future consumption (Kori *et al.*, 2006). It is well known that occurrence of ground water and its availability for various uses is controlled by the nature of rock formation in which it occurs as well as geological structures, geomorphologic and hydrological setting and hydrometreological conditions. This resource is generally developed through ponds, lakes, wells and tube wells depending up on the need for which it is being used and its availability in the area (Raju, 1983).

An uncontrolled use of bore-well technology has lead to the extraction of ground water at such a high rate that often recharge is not sufficient. Water intended for human consumption should be "safe and wholesome" *i.e.* free from pathogenic agent and harmful chemicals, pleasant to taste and useable for domestic purpose (Parashar *et al.,* 2006). The study area selected was all over urban area of Visakhapatnam for ground water quality testing. The city is dividing into five different zones, and six samples are collected from each zone. The physico-chemical parameters like pH, EC, Total hardness, Total alkalinity, Chloride, Sulphate, Sodium, Potassium, Mg and Nitrate were studied to analyze the potable ground water quality of the city of lakes. Water is the principal need of life on earth, the requirement of water in all lives, from microorganism to man is a serious problem today because all water resource have been reached to a point of crises due to unplanned urbanization and industrialization (Singh *et al.*, 2002). Water pollution is the state of deviation from pure condition, whereby its normal functioning and properties are affected. Aggravated environment problems often reflect the misuse or misunderstanding of technology (Petak, 1980).

Materials and Methods

The study area selected was total urban area of the city of Destiny, Visakhapatnam, Andhra Pradesh, India. The study area is located between latitude- 17° 30′ 15″ to 18° 11′ 15″ North and longitude- 82° 57′ 37″ to 83° 28′ 12″ East. Visakhapatnam has been notified as one of the most polluted industrial cluster by central pollution control board of India. The study area experiences a semi-arid climate, with temperature in the range of 14–38°C. The annual average rainfall is 1080 mm. The sub-surface geology indicates that the average weathered rock portion extends up to 16m and the fractured rock zone up to 30m depth from the ground surface. The red sediments vary in depth from 1 to 3m, with an average of about 2m, from surface level, depending upon the topography. Water samples were drawn from bore-wells and hand pumps during Post-monsoon period of the year 2013. The water samples were collected in plastic container as possible to avoid unpredictable changes in physico-chemical characteristics. The testing of samples was done according to the procedure prescribed by APHA (2005). Present study comprises of interpretation and analysis of water samples collected from thirty different stations at all over city. In our study, first we mark the sampling stations in five different zones of the city, then stations were established and water samples were collected. The samples were analyzed for different chemical, physical parameters and the results were carefully studied and analyzed.

Results and Discussion

Ground-water has been considered a safe source of potable water since the ages and till date a lot of people depend on it for drinking. But the quality of ground water is deteriorating and it is of paramount importance to assess the quality regarding various parameters. The physico-chemical, heavy metal and biological parameters of ground-water need to be studied to determine its quality. The present study mainly focuses on the physico-chemical characteristics in the ground water from the study area and the results (Table 1) were compared with BIS standards.

In the groundwater regime, all chemical and biological reactions directly depend on the pH of the system. The chemical state of groundwater is usually defined in terms of pH, temperature and oxidation-reduction potential (Nelson, 2002). In the present study the pH of the ground water ranges from 7.12 to 8.20 with mean of 7.47. None of the samples found to have exceeded the BIS limit (6.5-8.5) of pH for drinking water.

The conductivity of the ground water indicates its ionic strength and its degree of ionic mineralization, e.g. elevated concentrations of heavy metals (Naudet *et al.*, 2004). The electrical conductivity (EC) of the ground water samples of the study area were ranges from 490 to 3711 µS/cm, with mean of

1372 µS/cm (Table 1). Maximum value was recorded at Dabagardens (3711 µS/cm) while lowest value recorded at Tatichetlapalem (490 µS/cm). It is significant to mention that electrical conductivity of water at all the study sites was found to exceed the maximum permissible limits of 750 µS/cm for drinking water (BIS, 1991). High values of conductivity indicate high concentration of soluble salts present in ground water sources and reflect the contribution from seepage of domestic, industrial and municipal sewage (Hussain *et al.*, 2002).

The concentration of total dissolved solids in water can be approximated in the field by measuring the specific conductance of a sample (Hem, 1985). Fresh water is usually considered to be water containing less than 1,000 mg/L total dissolved solids (Drever, 1988).The of total dissolved solids (TDS) of the ground water samples of the study area ranges from 330 to 2487 mg/L, with mean of 920mg/L (Table 1). Maximum value recorded at Dabagardens (3711 µS/cm) while lowest value recorded at Tatichetlapalem (330 µS/cm). The reason of these changes could be the dissolution of salts and minerals, which are present in soil due to rise in water table. Kripanidhi (1984) reported similar trend in ground water of a typical hard rock terrain and pollution in village wells in Karnataka state.

Chlorides are leached from various rocks into soil and water by weathering (WHO, 1996). Chloride is the most abundant ion in seawater, with a concentration greater than 19,000 mg/L (Stumm and Morgan, 1996). The concentration of chloride in the ground water samples of the study area were ranges from 100 to 565 mg/L, with a mean of 275mg/L. The concentration of chloride Maximum value was recorded at Dabagarden (565 mg/L) while lowest value recorded at Tadichetlapalem (100 mg/L) may be due to low water level and minimum in the rainy season due to dilution factor.

Fig.1 Showing sampling locations

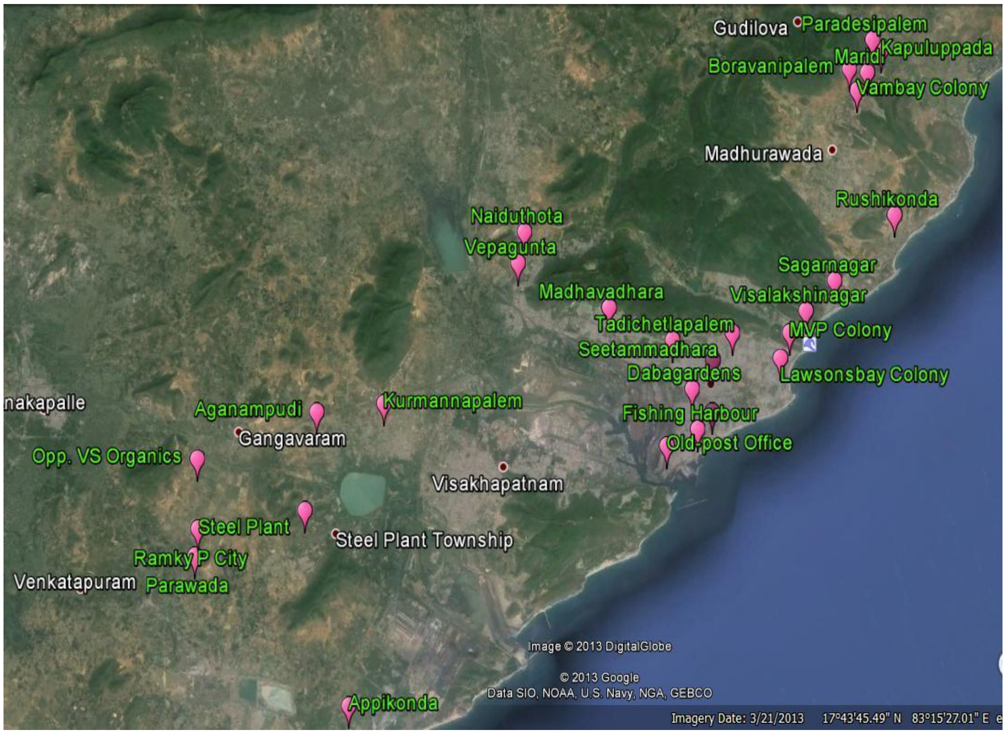

Table.1 Physico-chemical parameters of Visakhapatnam

Location	pH	EC	TDS	Chlo	Sulp	TH	TA	Nitr	DO
Paravada	7.28	842	563	260	40	245	74	10	3.7
Opp V.S organics	7.28	663	445	335	41	243	74	9	3.5
Appikonda	7.56	1851	1240	365	140	461	73	5	2.5
Steel Plant	7.42	1249	837	210	64	260	82	6	3.7
Aganampudi	7.38	826	555	300	48	323	76	11	4.5
Kurmanapalem	8.2	587	394	190	48	322	66	7	4.5
Tadichatlapalem	7.12	490	330	100	26	158	105	12	5.3
Madavadhara	7.36	1405	942	198	81	375	148	11	4.8
Gnanapuram	7.34	1693	1135	243	50	477	110	9	5.5
Allipuram	7.36	858	576	229	41	262	134	10	5.4
Dwarakanagar	7.69	2375	1591	420	125	248	148	6	5.9
Dabagardens	7.76	3711	2487	565	229	1045	156	14	5.8
Seethammadhara	7.39	1365	915	372	68	465	122	10	5.2
Fishing harbor	7.3	856	573	264	54	268	136	14	5.2
Old-post Office	7.52	1635	1095	315	52	390	128	10	5.3
Maharanipeta	7.42	1203	805	255	78	285	128	14	5.5
Lawsons Bay	7.46	917	614	206	42	300	130	16	4
MVP Colony	7.62	1503	1006	204	98	440	104	14	4.8
Visalakshinagar	7.32	755	507	212	42	256	116	13	4.1
Sagarnagar	7.37	1151	771	280	70	348	122	14	4.8
Rushikonda	7.56	1703	1142	344	118	400	122	12	3.9
BoravaniPalem	7.77	2009	1347	250	120	510	18	1.5	2.3
Kapuluppada	7.6	1708	1146	340	126	510	16	1.4	4.6
Maridi	7.34	1371	918	199	104	404	28	1.2	1.2
Vambay colony	7.44	1582	1061	220	110	540	27	1.4	1.8
Min	**7.12**	**490**	**330**	**100**	**26**	**158**	**16**	**1.2**	**1.2**
Max	**8.20**	**3711**	**2487**	**565**	**229**	**1045**	**156**	**16**	**5.9**
Mean	**7.47**	**1372**	**920**	**275**	**81**	**381**	**98**	**9.3**	**4.3**
IS Standards 15000	**6.5- 8.5**	**750**	**500**	**250**	**200**	**300**	**200**	**45**	**> 5**

(Note: All the parameters are expressed in mg/L except pH & EC)

(EC: Electrical Conductivity; TDS: Total Dissolved Oxygen; Chlo: Chloride; Sulp: Sulphate; TH: Total Hardness; TA: Total Alkalinity; Nit: Nitrate; DO: Dissolved Oxygen)

As per Indian Drinking Water Standard IS 10500: 1991 the desirable limit for chloride is 250 mg/l as Cl, beyond this limit the taste become salty, corrosive and palatability is affected. Permissible limit in the absence of alternative source is 1000 mg/l (Sameer *et al.,* 2011). Higher values of chlorides indicate pollution of water and give an undesirable taste. Higher values are hazardous to human consumption and create health problems (Kataria and Iqbal, 1995). People who are not accustomed to high Chloride in water are subjected to laxative effect as suggested by Raviprakash and Krishna Rao (1989).

Ground water impacts from anthropogenic sources of sulfate, however, are typically much smaller than from natural sources.

Gypsum is an important source in many aquifers having high concentrations of sulfate (MPCA, 1999). The concentration of sulphate in the present study varies from 26 to 229 mg/L, with a mean of 81 mg/L. Except one sampling location i.e. Dabagardens (229mg/L) is exceeded and other of these samples below the BIS desirable limits (200 mg/L) and within the safe limit and ground water appears to be suitable for drinking purpose. The Minnesota Department of Health (MDH) recommends a limit of 400 mg/L for water used in infants.

Hardness of water is due to the presence of divalent metallic cations, like calcium, magnesium, iron, and manganese ions (Sharma.2004). TH is normally expressed as the total concentration of Ca^{2+} and Mg^{2+} in mg l^{-1}, equivalent $CaCO_3$ (Suman, 2006).The total hardness represented by $CaCo_3$ concentrations in water ranges from 158 to 1045 mg/L, with a mean of 381 mg/L (Table 1). Maximum concentrations were recorded at Dabagardens (1045 mg/L) while lowest concentration was recorded at Tadichetlapalem (158mg/L). According to BIS, desirable limit of Total hardness and maximum permissible limits are 300mg/L and 600mg/L in ground water. The total hardness is relatively high in all samples due to the presence of calcium, magnesium, and chloride and sulphate ions to be found in areas with mainly igneous rock formations, while areas with mainly sedimentary rock tended to have greater water hardness (Rafi *et al.,* 2011).

The constituents of Alkalinity in natural system mainly include Carbonate, Bicarbonate and Hydroxide. These constituents result from dissolution of mineral substances in the soil and atmosphere (Mittal and Verma, 1997). The alkalinity of ground water ranges from 16 to 156 mg/L, with a mean of 99mg/L (Table 1). Maximum concentrations were recorded at Sriharipuram (156mg/L) while lowest value at Kapuluppada Village (16mg/L). The samples were detected to have alkalinity lower than the desirable limits of 200 mg/L. A decrease in alkalinity value in the study area is ascribed to dilution due to rainfall (Khabede *et al.*, 2003. Alkalinity itself is not harmful to human health: still water supplies with less than 100 mg/L are desirable for domestic use (Trivedi and Goel, 1984). Ramaswamy and Rangaraju (1991) reported higher alkalinity values in the ground water of Tirrupur, Tamilnadu that may be due to the contamination of these resources with domestic and industrial wastes. High values of alkalinity in the water samples indicate pollution of organic nature and give an unpleasant taste. In the absence of alternate source of water, alkalinity up to 600 mg/L is permissible (BIS, 1991).

Nitrate in aquatic system usually originates from nitrogenous fertilizers, domestic waste discharge and animal wastes (Peavy *et al.*, 1986). The nitrogenous fertilizer used in intensive agriculture percolates down to ground water and it is probably one of the reasons for high concentration of nitrate.

The Nitrate concentration varies from 1.2 to 16mg/L, with a mean of 9.3mg/L. Maximum value was recorded at Lawsons Bay Colony (16mg/L) and lowest value recorded at Maridi (1.2mg/L). The desirable limit of nitrate in drinking water is 45mg/L (BIS, 1991) / 50 ppm (WHO, 1984). The nitrate contents of ground water samples are well within the desirable limit in the present study.

Oxygen is the regulator of metabolic process of plant and animal communities and indicator of water condition (Gautham and Sharma, 2011). Dissolved oxygen is a highly fluctuating factor and this value varies depending upon water temperature and the partial pressure of oxygen in its gas phase

(Renn, 1970). In the present study the value of DO ranges from 1.2 to 5.9 mg/L with mean of 4.3 mg/L. Maximum value recorded at Dwarkanagar (5.9mg/L) while minimum values were recorded at Maridi (1.2mg/L). About most of the sampling locations not up to permissible according to drinking water quality standards (BIS, 2006) is >5 mg/L (tolerance level). Due to physical chemical and biological activities in water, the dissolved oxygen was low in all the ground water. The DO values may also vary with the temperature and altitudinal change. Low DO in certain sites may be due to sewage, industrial and domestic solid waste seepage (Raja *et al.*, 2002).

References

APHA (American Public Health Association). 2005. Standard method for examination of water and wastewater, NW, DC 20036.

BIS (Bureau of Indian Standards) 10500.1991. Indian standard drinking water- specification, First revision, pp 1-8.

BIS Tolerance limits for Inland surface water IS: 2296-1982 and BIS standard 2006.

Bureau of Indian Standards (BIS), 1991. Indian standard specification for drinking water, IS 10500, pp. 2-4.

Dennis Nelson., 2002. Natural Variations in the Composition of Groundwater; Presented at Groundwater Foundation Annual Meeting November.

Drever, J.I., 1988. The Geochemistry of Natural Waters, 2nd Edition: Prentice Hall, Inc., Englewood Cliffs, New Jersey, 402 p.

Gautham DK., M R Sharma. 2011. India Journal of Env. Protection 31(6) 464-466.

Hem, J.D., 1985. Study and interpretation of the chemical characteristics of natural water: U.S. Geological Survey Water-Supply Paper 2254, 263 p.

Hussain I.; L. Raschid; M. A. Hanjra; F. Marikar; W. van der Hoek. 2002. Wastewater use in agriculture: Review of impacts and methodological issues in valuing impacts. (With an extended list of bibliographical references).Working Paper 37. Colombo, Sri Lanka: International Water Management Institute.

Kataria, H.C. and Iqbal, S.A. 1995.Chloride Content in Borewells (Ground Water) of Bhopal City. Asian J. Chem Rev. 6: 35-38.

Khabade, S. K., Mule, M. B. and Sathe, S. S. 2002. Studies on physicochemical parameters of Iodhe water reservoir from Tasgaon Teshil (Maharastra): Indian. J. Environ and Ecoplan. 6(2): 301-304.

Krupanidhi, K. V. J. R. 1984. Mechanism of groundwater pollution in village wells. Journal of the Geological Society of India, 25(5), 301–302.

Minnesota Pollution Control Agency. 1999. Minnesota Water Quality – Water Years 1998-1999. The 2000 Report to the Congress of the United States. St. Paul, MN.

Mittal, S.K. and Verma, N. 1997.Critical Analysis of Ground Water Quality Parameters. Indian J. Env. Prot. 17(6):426-429.

Mohemmad Rafi K., N. Md. Akram, M. Umamahesh and T. Ramachar. 2011. A Chemical Analysis of Groundwater and Study on its Pollution Impact in and Around Jammalamadugu Area of YSR District, Andhra Pradesh, India. International Journal of African Studies ISSN 1451-213X Issue 4, pp.41-49.

Naudet V., A. Revil, E. Rizzo, J.Y. Bottero and P. Begassat., 2004. Ground water redox conditions and conductivity in a contaminant plume from geoelectrical investigations; Hydrology and earth

Systems Sciences, 8(1), 8-22.

Peavy, H.S., Rowl, D.R. and Techobunglons, G. 1986. Environmental Engineering. M.C. Graw Hall Book Company. New Delhi.

Ramaswami, V. and Rajaguru, P., 1991. Studies on ground water quality of Madras, Indian J. Environ. Hlth., 3 J. Environ. Hlth., 33, pp. 481-4867.

Raviprakash and Krishna, Rao, G. 1989. The Chemistry of Ground Water in Pravada area With Regard to their Suitability for Domestic and Irrigation Purpose. Indian J. Geochem. 4(1): 39 – 54.

Renn, C.E.1970. Investigating water problems. Educational products division, La Moltechemical products company, Maryland.

Sameer. V. Yamakanamardi, Hampannavar. U.S, Purandara. B. K., 2011. Assessment of Chloride Concentration in Groundwater: A Case Study for Belgaum City; International Journal of Environmental Sciences Volume 2 No.1.

Sarma, V. V. J. and Swamy, A. N. 1981. Ground water quality in Visakhapatnam basin, India. Jour. Water, air and Soil Pollution. 16, pp 317 329.

Stumm, W., Morgan, J., 1996. Aquatic Chemistry. Chemical Equilibria and Rates in Natural Waters. Third Edition.

SumanMor, KhaiwalRavindra, R. P. Dahiya and A. Chandra., 2006. Leachate characterization and assessment of groundwater pollution near municipal solid waste landfill site; Environmental Monitoring and Assessment, 118: 435–456.

Trivedi, R. K. and Goel, P. K. 1984. Chemical and biological methods for water pollution studies Karad Environmental Publication, pp. 1-251.

Trivedi. P, and P.K. Goel. 1986. Chemical and Biologiccal methods for water pollution studies. Environment Publications. pp.215.

WHO (World Health Organization). 1984. Guidelines for drinking water quality. vol. 2 Pp 80-95.

WHO. 1996. Health criteria and other supporting information; second ed. Guidelines for drinking water quality, Vol. 2. World Health Organization. Geneva. Switzerland.

How to cite this article:

Madhusudan Yaduvams, E., S.V. Ranga Rao, CH. Venkata Ramana and Byragi Reddy, T. 2017. Physico-Chemical Analysis of Ground Water in the Selected Area of Visakhapatnam, AP, India. *Int.J.Curr.Microbiol.App.Sci*. 6(12): 1252-1258.
doi: https://doi.org/10.20546/ijcmas.2017.612.141