IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 11, Issue 9 Ver. I (September. 2017), PP 33-37
www.iosrjournals.org

A Study to assess the water quality of Drinking water by using the physico-chemical and Biological parameters in the areas of Chennai City

Veena Gayathri Krishnaswamy and Rita Jayaraj
Department of Biotechnology Stella Maris College, Chennai
Corresponding author: veenagayathri@yahoo.com

Date of Submission: 28-08-2017 Date of acceptance: 13-09-2017

I. Introduction

Water plays a vital role in human life. The importance of groundwater for existence of human society cannot be overemphasized. There are several states in India where more than 90% populations are dependent on groundwater for drinking and other purpose [1,2]. Most of the industries discharge their effluent without proper treatment into nearby open pits or pass them through unlined channels, resulting in the contamination of groundwater [3]. The incidence of groundwater pollution is highest in urban areas where large volumes of waste are concentrated and discharged into relatively small areas [4]. The hydrogeochemical conditions are also responsible for causing significant variations in groundwater quality[5].

Groundwater pollution (also called groundwater contamination) occurs when pollutants are released to the ground and make their way down into groundwater. It can also occur naturally due to the presence of a minor and unwanted constituent, contaminant or impurity in the groundwater, in which case it is more likely referred to as contamination rather than pollution. Leachate from sanitary landfills can lead to groundwater pollution. It is most commonly used in the context of land-filling of putrescible or industrial waste. Leachate from a landfill varies widely in composition depending on the age of the landfill and the type of waste that it contains.[6] It usually contains both dissolved and suspended material. The generation of leachate is caused principally by precipitation percolating through waste deposited in a landfill. Once in contact with decomposing solid waste, the percolating water becomes contaminated, and if it then flows out of the waste material it is termed leachate. Additional leachate volume is produced during this decomposition of carbonaceous material producing a wide range of other materials including methane, carbon dioxide and a complex mixture of organic acids, aldehydes, alcohols and simple sugars.

Groundwater pollution with pathogens and nitrate can also occur from the liquids infiltrating into the ground from on-site sanitation systems such as pit latrines and septic tanks, depending on the population density and the hydrogeological conditions[7].

The treated effluent from sewage treatment plants may also reach the aquifer if the effluent is in filtrated or discharged to local surface water bodies. Therefore, those substances that are not removed in conventional sewage treatment plants may reach the groundwater as well. This is because in conventional sewage treatment plants, micro-pollutants such as hormones, pharmaceutical residues and other micro-pollutants contained in urine and feces are only partially removed and the remainder is discharged into surface water, from where it may also reach the groundwater [8]

Further causes of groundwater pollution are excessive application of fertilizer or pesticides, chemical spills from commercial or industrial operations, chemical spills occurring during transport (e.g. spillage of diesel fuels), illegal waste dumping, infiltration from urban runoff or mining operations, road salts, de-icing chemicals from airports and even atmospheric contaminants since groundwater is part of the hydrologic cycle. Over application of animal manure may also result in groundwater pollution with pharmaceutical residues. Groundwater is also an alternative source for agricultural and industrial sector. During last decade, it is observed that the groundwater pollution has drastically increased due to human activities. Consequently, number of water borne diseases has also increased among public. Contaminated drinking water is believed to be the cause of various diseases which is on the rise during summer. Water-borne diseases may be of microbial origin such as diarrhoea, dysentery, cholera, and typhoid and chemical origin such as fluorosis and methemoglobinemia.

So, basic monitoring of groundwater has necessitated observing the demand and status of groundwater quality. This present study was attempted to carry out qualitative analysis of some physico-chemical and biological parameters of groundwater in the study area of Chennai.

II. Materials and methods

This study was aimed to assess the quality of groundwater in and around Chennai city. For the purpose of this study, Chennai city was divided into three zones based on the Legislative constituency into North, Central, and South Chennai. From these three zones, three locations were randomly selected (Zone 1, North Chennai included Perambur,Villivakkam, and Purasawalkam; Zone 2, Central Chennai included Triplicane, Mylapore, Royapettah , Teynampet; and Zone 3, South Chennai included Alandur, Velachery, and St.Thomas Mount) for assessment of water quality. One water sample for each location was assessed in this study. Hence, total of nine groundwater samples were collected from nine different study locations.

Sample collection and Analysis

Groundwater samples were collected in pre-cleaned 1L polypropylene containers and kept in an ice box and transported to the laboratory within 2-3 hours for further analysis from the specified locations. 100 ml of samples were collected separately in a clean sterile glass container for microbiological study [9]. Samples were collected in triplicates for the study and mean averages were taken. The samples were then analyzed for nine parameters such as pH, total dissolved solids (TDS), turbidity, total hardness, sulphates, chlorides, and nitrates, using the following procedures: pH was assessed by electrometric method using pH meter; TDS, turbidity, hardness assessed using multipurpose meter; Determination of chlorides was done by argentometric titration and nitrate was assessed using colorimetry. The bacteriological analysis (CFU/100ml) were carried out immediately without storing the samples.

III. Results and discussion

The water quality analysis of two zones of water samples have been carried out for pH, Electrical conductivity, TDS, Total hardness, Chlorides and sulphates, Total phosphorous, nitrate, nitrite, ammonia. The status of water quality of these ground water sources are presented in Table 1.

pH and Hardness

pH is a term used universally to express the intensity of the acid or alkaline condition ofa solution. pH is considered as an important ecological factor and provides an important piece factor and piece of information on many types of geochemical equilibrium or solubility calculation [10]. On assessment of pH of drinking water, in all the zones pH ranged from 7.2 to 8.2, which were above the permissible limit for drinking water according to the BIS. However, the pH ranged in other location 7.3 to 8.3 in other locations. The pH of the study area belongs to moderately alkaline in origin. Similarly, Hardness of drinking water in zone 3 showed the higher value compared with the rest. Hardness was highest in the area of Villivakkam, Triplicane and Saidapet (Sump water) when compared with all the other locations.

Electrical conductivity (EC)

Electrical conductivity (EC) is a measure of water capacity to convey electric current. Navneet Kumar and Sinha (2010) suggested that the underground drinking water quality of the study area can be checked effectively by controlling conductivity of water and this may also be applied to water quality management of other study areas. EC signifies the amount of total dissolved salts [12] and is a useful tool to evaluate the purity of water. Conductivity shows significant correlation with ten parameters such as temperature, pH value, alkalinity, total hardness, calcium, total solids, total dissolved solids, chemical oxygen demand and chloride and iron concentration of water. EC values of the drinking water samples collected in this study were in the range of 114- 2068µs. Most of the water samples were colourless and had chlorine smell. High EC values were observed at 29% of the sampling points with reference to WHO standards, indicating the presence of high amount of dissolved inorganic substances in ionized form.

Total Dissolved Solids (TDS)

A total dissolved solid always indicates the salinity content of the groundwater. Water which Contains more than 500 mg/L of TDS is not considered desirable for drinking purposes, but in unavoidable cases 1500 mg/L is also allowed [13], highly mineralized water may be used where better quality water is not available [14]. TDS values of the study area varied from 135 – 986 mg/L which were found within the permissible limits of WHO 1000 mg/L

Total Hardness

Hardness is the property of water, which prevents the lather formation with soap and increases the boiling points of water [15]. The hardness values of the present drinking water ranges from 212 mg/ to 980 mg/L. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. According to some classifications, water with hardness up to 75 mg/l is classified as soft, 76 150 mg/l is moderately soft, 151 300 mg/l as hard and more than 300 mg/l as very hard [16]. The Saidapet area in Chennai had the highest hardness of 980 mg/L which exceeds the WHO limit of 100-500 mg/L.

Chloride (Cl-)

The chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects [17]. In the present water analysis, chloride concentration was found in the range of 125 to 1760 mg/L. 50% of the water samples collected from different zones was above the prescribed limits - 200 mg/L of WHO. About 1760 mg/L was recorded at St.Thomas Mount and Villivakkam location. The chloride present in the soil may be supplied by the local leaching of sedimentary rocks. The average chloride content of sedimentary rocks is about the same as the evaporate rocks 150 ppm [18] and indicating sedimentary deposited in the environment i\n water samples collected.

Other parameters

This study demonstrated a higher value for sulphates and Carbonates in zone 1. Ingestion of sulphates in large quantities has demonstrated to cause catharsis and gastrointestinal Irritation (Park 2009). Figure 1 and 2 shows the other parameters like sulphates, carbonates, nitrate and nitrite assessed in the drinking water samples of the study area. In this study Nitrate and Nitrite concentrations varied from 0.032- 0.533 mg/L.

Loganathan et al (2011) reported that the groundwater in Chennai city is suitable for drinking and groundwater is fast deteriorating with the water table falling to below sea level in some areas. Investigations made on groundwater of North and South Chennai by Loganathan et al (2011) revealed that the groundwater quality was within the ISI standards. Domestic uses in respect of all the constituents expect total hardness and Nitrate. In 2005, a study by Public Works Department revealed that Chennai has no good quality groundwater anymore and the quality of the available. Balan et al (2012) reported except the pH of their study location all the other parameters are well within the permissible limits which also correlated with our present study. The Most probable number method analysis was performed to assess the biological contamination of the drinking water samples, results of the analysis is presented in the Table 2. Biological analysis by performing the Most Probable number method showed that Zone 3 showed higher MPN index > 14 [19].

IV. Conclusion

Soil pollution is becoming a greater threat to the environment, especially as populations and industrial economies expand. Groundwater quality is being increasing threatened by agricultural, urban and industrial wastes, which leach or are injected into under lying aquifers. In many cases, the abstraction of excessive quantities of groundwater has resulted in the drying up of wells, salt-water intrusion & drying up of rivers that receives their flows in dry seasons from groundwater. The present investigations made on the groundwater of different areas of Chennai revealed that the water quality was within the ISI standard [20] except the few parameters this may due to the intrusion of sea water, industrial effluents intrusion into the groundwater and also improper maintenance of the sewage system. Hence, there is a need for groundwater treatment before it is used for consumption.

Table.1 Results of chemical analysis of physicochemical parameters of the Study area

S.No Water sample details	Colour	EC	Odour, Taste	pH	DO (mg/L)	Salinity	TDS (mg/L)	Chloride (mg/L)	Total Hardness (mg/L)
WHO 2005 [19]	-	**500**	-	**6.5 - 8.5**	-		**1000**	**0-200**	**100-500**
Zone - 1 Perambur Bore water	Colourless	1868	Odourless tasteless	8. 32	1. 2	101	154	258	212
Villivakkam	Colourless	1856	Odourless	7. 08	1. 8	988	135	1760	524
Purasaivakkam	Colourless	1831	Odourless	7.82	1. 4	800	152	1340	324
Zone -2 Royapettah	Pale yellow	386	Chlorine smell	7. 44	1. 4	189	282	16	360
Triplicane	Clear	1287	Little salty	7. 52	3. 6	641	910	228	568
Mylapore	Clear	387	Chlorinated smell	7. 13	3. 6	192	285	90	440
Teynampet	Colourless	2067	Odourless tasteless	8. 16	1. 2	663	946	334	424
Zone-3 Saidapet Sump water	Transparent	347	Odourless tasteless	7. 88	5. 2	175	362	270	980
Alandur	Dirty White	215	No odour No taste	8. 10	2. 4	116	162	432	103
Velachery	Pale yellow	117	No odour Salty	7. 74	1. 2	850	840	32	360
St.Thomas Mount	Colourless	1856	Odourless	7. 08	1. 8	988	1 35	1760	524

Table. 2 Results of Most Probable Number (MPN) analysis of the Collected Water Samples

S.No Water sample details	**No. of tubes Giving Positive reaction Out of**			**MPN Index [23] Per 100 ml**
Places Of samples Analysed	3 of 10 mL each	3 of 1 mL each	3 of 0.1 mL each	
Zone – 1 Perambur Bore water	2 Colour changed gas positive	0 Colour changed gas positive	0 No colour change gas negative	**9**
Villivakkam	2 Colour changed gas positive	0 Colour changed gas positive	0 Colour changed gas positive	**9**
Purasaivakkam	0 Colour change	0 No colour change gas negative	0 No colour change gas negative	< 3
Sowcarpet	3 Colour changed gas positive	2 Colour changed gas positive	2 Colour changed gas positive	>14
Zone -2 Royapettah	1 Colour changed gas positive	2 Colour changed gas positive	0 Colour changed gas negative	11
Triplicane	1 Colour changed gas positive	2 Colour changed gas positive	0 Colour changed gas positive	11
Mylapore	1 Colour changed gas negative	2 Colour changed gas positive	0 No colour change gas positive	11
Teynampet	2 Colour changed gas negative	0 Colour changed gas negative	0 No colour change gas negative	>14
Zone-3 Saidapet Sump water	2 Colour changed gas positive	0 Colour changed gas positive	0 Colour changed gas positive	>14
Alandur	2 Colour changed gas negative	1 Colour changed gas negative	1 Colour changed gas negative	>14
Velachery	2 Colour changed gas negative	0 No colour change gas negative	0 No colour change gas negative	>14
St.Thomas Mount	2 Colour changed gas negative	0 Colour changed gas negative	0 Colour changed gas negative	>14

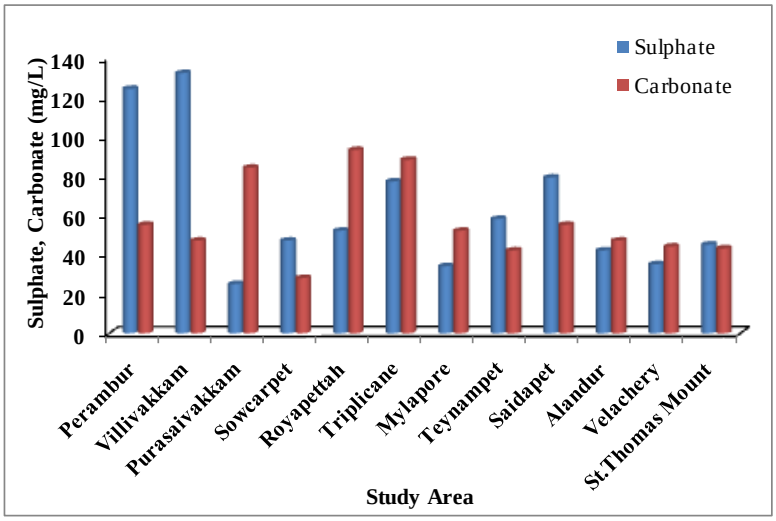

Figure 1 Concentration of Sulphate and Carbonate in the water samples

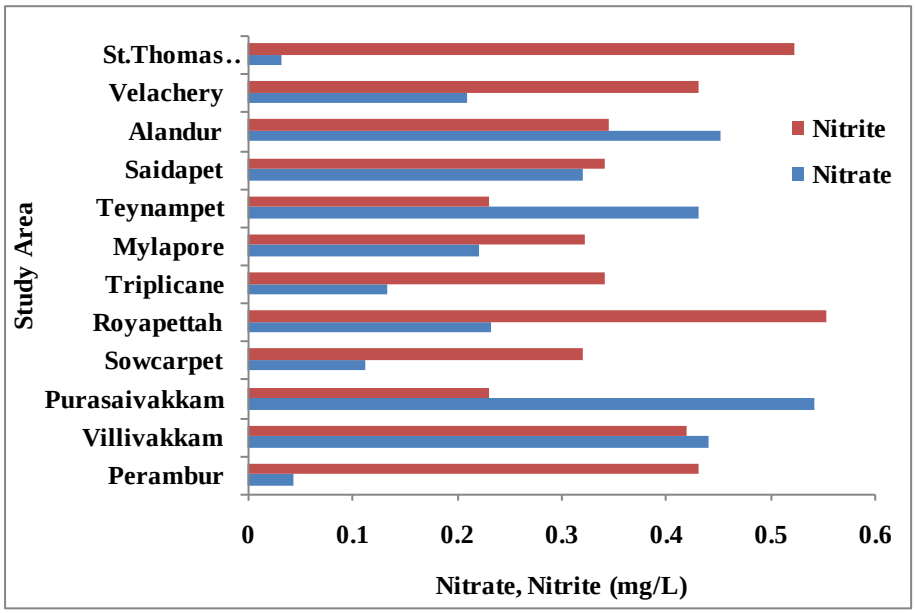

Figure 1 Concentration of Nitrate and Nitrite in the water samples

References

[1] C.Ramachandraiah Right to drinking water in India. Centre for Economic and Social Studies. 2004, 56.
[2] T. Dinesh Kumar and CP Singh Chandel Analysis of the major ion constituents in groundwater of Jaipur city. Nature & Science, 8(10), 2010, 1-7.
[3] A Jinwal and S Dixit Pre and post monsoon variation in physio-chemical characteristic in groundwater quality in Bhopal, India. Asian J. Exp. Sci. 22 (3), 2008, 311-316.
[4] M Rao Sudhkar and P Mamatha Water quality in sustainable water management. Cur. Sci. 87 (7), 2004 942-947.
[5] BN Mahanta, BC Sarkar, G Singh, K Saikia and PR Paul Multivariate statistical modeling and indexing of ground water quality in and around Jharia coalfields, Jharkhand. Proc. of the National Seminar on Environmental Engineering with special emphasis on Mining Environment, NSEEME-2004, 19-20, March. Indra N. Sinha, Mrinal K. Ghose and Gurdeep Singh (Eds). 2004 :1-14.
[6] J. Henry, and G.Heinke, Environmental Science and Engineering, Prentice Hall, ISBN 0-13-120650-8 1996.
[7] L.Wolf, , A. Nick and A.Cronin, How to keep your groundwater drinkable: Safer siting of sanitation systems – Working Group 11 Publication. Sustainable Sanitation Alliance 2015.
[8] P.J Philips ; A.T.Chalmers,; J.L.Gray,; D.W. Kolpin,; W.T. Foreman,; G.R.Wall, . Combined Sewer Overflows: An Environmental Source of Hormones and Wastewater Micropollutants . National Center for Biotechnology 2012.
[9] APHA 1992 Standard Methods for the Examination of Water and Wastewater. 18th edition, American Public Health Association (APHA), American Water Works Association (AWWA) and Water Pollution Control Federation (WPCF), Washington, D.C.
[10] R.Shyamala, , M.Shanthi, and P. Lalitha, Physicochemical analysis of borewell water samples of Telungupalayam area in Coimbatore District, Tamilnadu, India. E-J. Chem., 5(4): 2008, 924 929.
[11] Kumar, Navneet., D.K.. Sinha, Drinking water quality management through correlation studies among various physicochemical parameters: A case study. Int. J. Environ. Sci.,1(2): 2010, 253 259.
[12] B.Shrinivasa Rao, P. Venkateswaralu,. Physicochemical analysis of selected groundwater samples. Indian J. Environ. Prot., 20(3) 2000 : 161.
[13] C.K. Jain A hydro-chemical study of a mountainous watershed: the Ganga,India. Water Res., 36(5): 2002, 1262 1274.
[14] V.T . Patil,., R.R.Patil, Physicochemical analysis of selected groundwater samples of AmalnerTown in Jalgaon District, Maharashtra, India. E J. Chem., 7(1), 2010: 111- 116.
[15] Saravanakumar, K., Ranjith Kumar, R.2011. Analysis of water quality parameters of groundwater near Ambattur Industrial Area, TamilNadu, India. Indian J. Sci. Technol., 4(5): 560 562.
[16] Behne, W.: Untersuchungen zur Geochemie des Chlor und Brom. Geochim. et Cosmochim. ACla, 3: 1953 186- 215.
[17] Dahiya, S., Kaur, A. 1999. Physico chemical characteristics of underground water in rural areas of Tosham subdivisions
[18] K.Park Textbook of Preventive and Social medicine. 20th ed 2009. Banarsidas Bhanot publishers, Jabalpur, India.
[19] D. Loganathan, S . Kamatchiammal and R. Ramanibai Status of groundwater at Chennai city, India. Indian J Sci Technol 2011;4:566-72.
[20] Balan IN, Shivakumar M, Kumar PDM. An assessment of groundwater quality using water quality index in Chennai, Tamil Nadu, India. Chron Young Sci 3, 2012;:146-50.
[21] WHO, 2005. World Health Organisation Guidelines for drinking water quality WHO press
[22] ISO 1988 Water Quality C Enumeration of Viable Microorganisms. Colony Count by Inoculation in or on a Solid Medium. International Standard ISO 6222, International Organization for Standardization, Geneva.
[23] WHO, 2011. Guidelines for drinking water quality, 4th edn. WHO press. 564 .

Veena Gayathri Krishnaswamy . " A Study to assess the water quality of Drinking water by using the physico-Chemical and Biological parameters in the areas of Chennai City." IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT), vol. 11, no. 9, 2017, pp. 33–37.