ASSESSMENT OF DRIKING WATER QUALITY FROM NATMAUK TOWNSHIP, MAGWAY REGION

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Abstract

Unsafe drinking water is one of the main concerns in developing countries. In order to determine drinking tube-well water quality for human consumption, some physicochemical properties and bacteriological analyses were evaluated in drinking tube-well water from seven sites of Natmauk Township, Magway Region. The drinking water samples were collected from December, 2016 to November, 2017.The standard methods were used for the physicochemical analyses and compared with WHO standard values. The temperature values of drinking water samples were found to be within 28-30 ^{o}C. The electrical conductivity values of water samples were found to be (477-931) μS cm^{-1}. The total dissolved solids in drinking water were 200-400 mg L^{-1} and it do not exceed the WHO standard 1000 mg L^{-1}. The turbidity of all water samples were found to be <5 FTU. This value agrees with the standard value. The observed pH values of water samples were in the range of 7.52 to 8.23. The total hardness, total alkalinity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD) and chloride contents were determined. Some metals such as such as sodium, calcium, iron, manganese, cadmium and lead were analyzed by Atomic Absorption Spectrophotometric (AAS) method. Bacteriological analyses such as Coliform and *E-coli* were done.

Keywords: tube-well water quality, physicochemical properties, turbidity, hardness, chloride

Introduction

Water is a transparent and nearly colourless chemical substance that is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. It also occurs in nature as snow, glaciers, ice packs and icebergs, clouds, fog, dew, aquifers, and atmospheric humidity (Benit, 2015). Water covers 71 % of the Earth's surface. It is vital for all known forms of life. On Earth, 96.5 % of the planet's crust water is found in seas and oceans, 1.7 % in groundwater, 1.7 % in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001 % in the air

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as vapour, clouds (formed of ice and liquid water suspended in air), and precipitation (Elangovan, 2010). Only 2.5 % of this water is fresh water and 98.8 % of that water is in ice (excepting ice in clouds) and groundwater. Less than 0.3 % of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003 %) is contained within biological bodies and manufactured products (Devendra, 2014).

Water is a good solvent for a wide variety of chemical substances; as such it is widely used in industrial processes, and in cooking and washing (Grode, *et.al*., 2014). Tube-Well water is a type of ground water. Water well along 100-200 mm (3.9-7.9) inches wide stainless steel tube or pipe bored in underground aquifer (Gupta, et.al, 2010). The natural water analysis for physical, chemical properties including trace element contents are very important for public health studies especially for children (Aminur, 2015).

Natmauk is a town in Magway region. It is constituted by seven quarters. The local people in Natmauk rely on tube-well water for drinking, domestic uses and agricultural purposes. Therefore, the drinking water quality from tube-well water in Natmauk township had been carried out.

Materials and Methods

Collection of Samples

Tube-well water samples were collected from seven sites of Natmauk Township, Magway Region. Water samples were collected from the tube-wells at the depth of 2591 cm, 2743 cm, 2896 cm, 3109 cm, 3200 cm, 3658 cm and 3962 cm. Three liters of each water samples were taken by means of polyethylene bottles for physicochemical determination. The samples were stored in laboratory and temperature was maintained at 25 ^{o}C (Sulieman, 2010).

Physicochemical Examination of Water Samples

The physicochemical properties of water samples were determined by the following procedures (APHA, 2012).

Determination of temperature

The temperature of water samples was measured by using a thermometer.

Determination of electrical conductivity

The conductivity of water samples was measured by using a conductivity meter.

Determination of total dissolved solids

50 mL of water was transferred to a porcelain crucible and weighed and then evaporated to dryness in an oven to obtain constant weight.

Determination of turbidity

10 mL of distilled water was filled to the colorimeter tube. A filter (415 nm) was placed into slot of colorimeter. This tube was inserted into the chamber and covered. Then, 0 % T and 100 % T were adjusted with controls. This tube was used as the 100 % T blank. 10 mL of water sample was filled to another colorimeter tube and then capped. The test sample was inserted into chamber, covered and measured percent T as soon as reading stabilized.

Determination of pH

The pH of water samples was measured by using a pH meter.

Determination of hardness by EDTA titrimetry

10 mL of water sample was added to 100 mL conical flask. 1 to 2 mL of buffer solution at a pH of 10.0 was added to the sample. And then 1 to 2 drops of Erichrome Black T (EBT) indicator solution was added and titrated with ethylene diamine tetra acetic acid (EDTA) titrant to change in colour from wine red to blue.

Determination of total alkalinity (TA) of drinking water samples by titrimetry

Ten mL of water sample was pipetted into a 100 mL conical flask. Two drops of phenolphthalein indicator were added and titrated against 0.1M HCl. When the solution became colourless and phenolphthalein alkalinity (PA) was calculated as $CaCO_3$ (mg/L) using the equation. A is the volume of titrant (mL) used in the titration. Methyl orange was added to the same flask and continued titration till the colour changed from yellow to orange. The total volume of titrant corresponds to total alkalinity (TA) as $CaCO_3$ (mg/ L). B is the total volume of titrant (mL) consumed with both the indicators.

$$\text{Phenolphthalein Alkalinity (PA)} = \frac{\text{A} \times \text{Normality of acid} \times 50000}{\text{Volume of sample (mL)}}$$

$$\text{Total Alkalinity (TA)} = \frac{\text{B} \times \text{Normality of acid} \times 50000}{\text{Volume of sample (mL)}}$$

Determination of biochemical oxygen demand (BOD)

Two bottles 100 mL with lid were taken and cleaned well. 25 mL sample was put into each bottle and 75 mL of distilled water was added to each of the bottles. Then the bottles were closed well. One bottle was kept in the incubator at (20-22) ^{o}C for 5 days. Then 10 mL of manganese sulphate solution and 2 mL of alkali-iodide solution were added to the other bottle well below the surface of the liquid by using a syringe. Then the bottle was closed and mixed by inverting the bottle several times. When the precipitate settled leaving a clear supernatant above the precipitate it was shaken again slowly by inverting the bottle, and when setting had produced at least 50 mL supernatant, 8mL of concentrated H_2SO_4 were added. Then the bottle was closed and mixed by gentle inversion until dissolution was completed. Then 100 mL of the sample was titrated with 0.05 M $Na_2S_2O_3$ solution until a pale yellow solution was obtained. Then 2 mL of freshly prepared starch solution was added and titration was continued until a blue colour appeared. The procedure was then repeated using 100 mL distilled water (blank). Then the procedure was repeated for incubated sample.

Determination of chemical oxygen demand by permanganate method

Water sample (10 mL) was taken in a 100 mL conical flask. Then 5 mL of concentrated H_2SO_4 was added and 1 g of copper sulphate was also added. Then 3 mL of prepared 1 M $KMnO_4$ solution was added to the mixture and the bottle was immersed in boiling water for 30 min while keeping the surface of the boiling water at the higher level than the surface of the sample. Then 3 mL of prepared 1 M sodium oxalate solution was added and immediately titrated with 1 M potassium permanganate until violet colour appeared. Then the procedure was repeated for the blank separately under same condition using 10 mL of distilled water instead of 10 mL of sample.

Determination of Chloride

Water sample (5 mL) was filled to the Chloride Titration tube. Then 3 drops of potassium dichromate were added to the sample in the Titration tube. This tube was shaken to mix until the yellow colour appeared. The sample solution was titrated with 1 M silver nitrate solution by using micro burette until the yellow colour changes to pink colour.

Determination of some metals by AAS and bacteriological examination of tube-well water

Some elements such as sodium, calcium, iron, manganese, lead and cadmium were analyzed by AAS (Atomic Absorption Spectroscopy). Bacteriological examination was done at the Public Health Laboratory, Ministry of Health and Sports, Mandalay.

Results and Discussion

Nature of the Sampling Sites

Tube-Well drinking water samples were collected from seven sampling sites of Natmauk Township, Magway Region. Their locations and depth of tube-well are shown in Table 1 and Figure 1.

Table 1: Location of the Sampling Sites

Sampling Site	Location	Depth of Tube-Well (cm)
I	Aung San Quarter	2591
II	Tamar Pin Quarter	2743
III	Yan Aung Myin Quarter	2896
IV	Zay Quarter	3109
V	Myoma Quarter	3200
VI	Myoma Kwatthit Quarter	3658
VII	Kangyi Quarter	3962

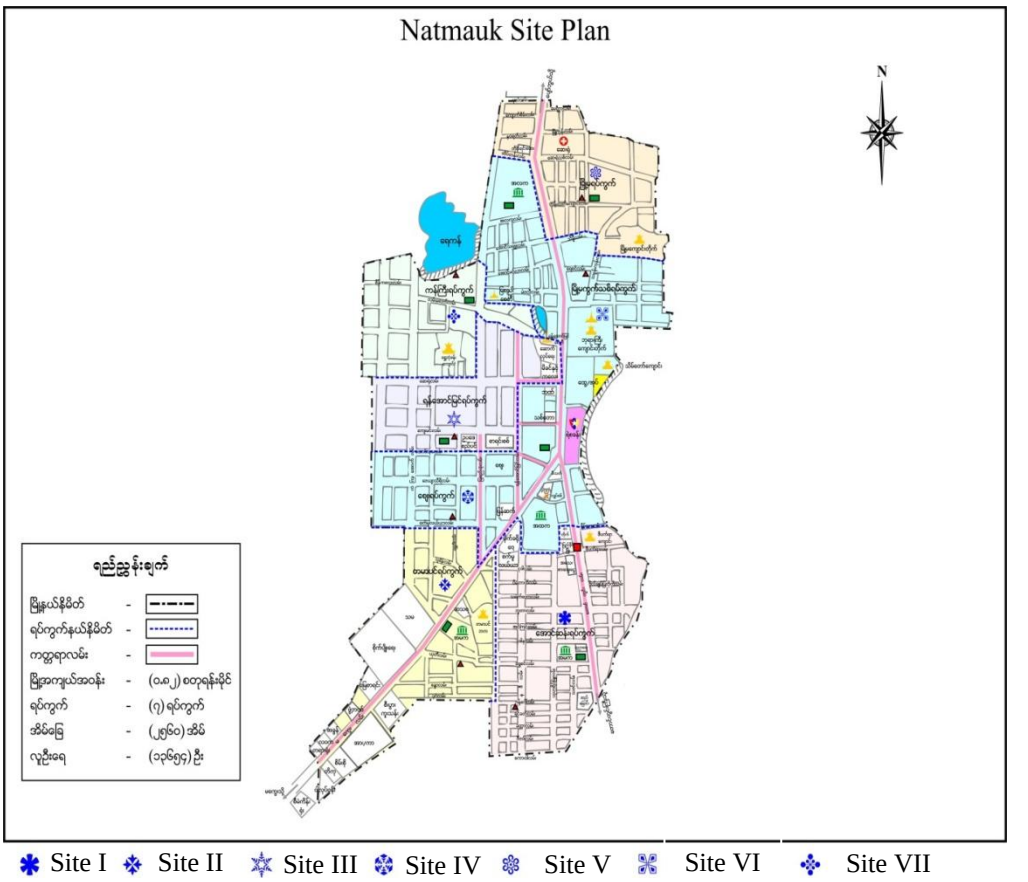

Figure 1: Map of sample collecting sites

Physical Parameters of Drinking Tube-Well Water from Seven Sites of Natmauk Township

The physical parameters such as temperature, electrical conductivity, total dissolved solids, and turbidity were determined. The results are described in Table 2, figure 2, 3 and 4. The temperature values of drinking tube-well water samples were found to be within (28-30) ^{o}C. The electrical conductivity values of water samples were found to be (477-931) μS cm^{-1}. Therefore, the water has been good for drinking purpose (EC < 800 μS cm^{-1}). It means that the presence of low amount of dissolved inorganic substances were present in ionized form. The total dissolved solids in drinking water were (200-400) mg $L^{-1}$and it was lower than the WHO standard (2008) 1000 mg L^{-1}. The turbidity of all water samples was found to be < 5 FTU. This value agrees with the standard value of drinking water 5 FTU or less. Thus the drinking water samples are clear. The analyzed water samples may not have colour and odour. The water samples may contain fair amount of suspended particles.

Table 2: Determination of Some Physical Parameters of Drinking Tube-Well Water from Different Sites

No	Parameters	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	WHO standard 2008
1	Temperature (^{o}C)	28	28	29	30	29	28	29	-
2	Electrical Conductivity (μS cm^{-1})	650	759	745	931	764	477	698	< 1500
3	Total Dissolved Solid (mg L^{-1})	400	400	200	200	400	200	320	1000
4	Turbidity (FTU)	<5	<5	<5	<5	<5	<5	<5	5

From figure 2, the electrical conductivity value of site IV was found to be the highest value. According to figure 3, the total dissolved solids values of site II, IV, V and VII were found to be higher than the other sites.

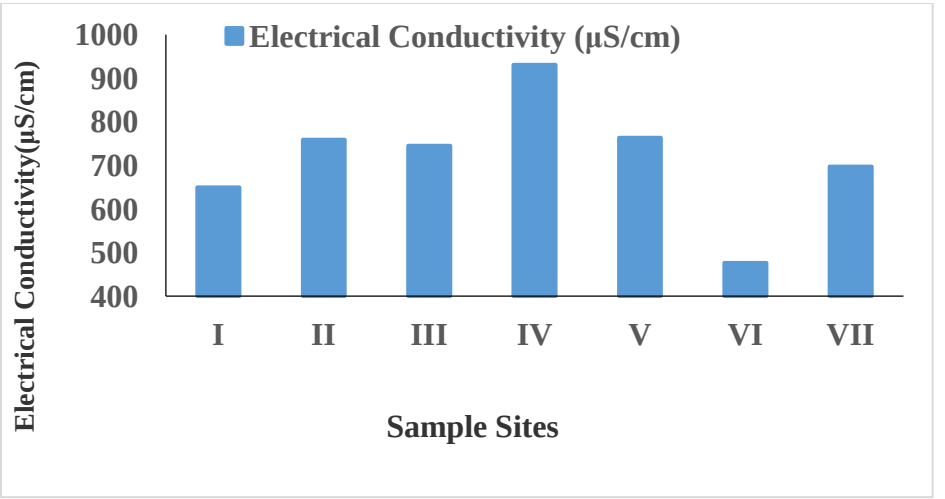

Figure 2: Electrical conductivity values of tube-well water samples from different sites

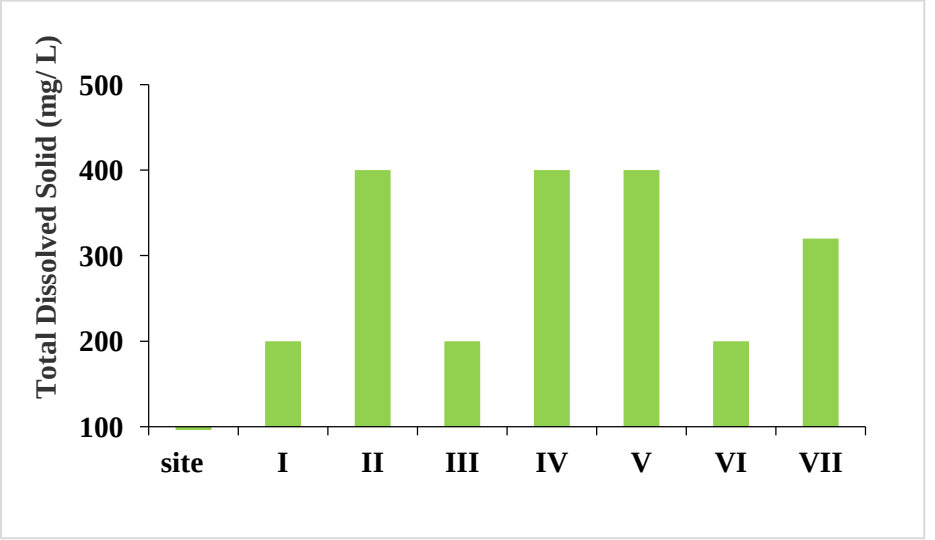

Figure 3: Total dissolved solids values of tube-well water samples from different sites

The relationship between electrical conductivity and total dissolved solids of tube-well water samples was shown in figure 4. From this figure, if electrical conductivity values increased, the total dissolved solids also increased.

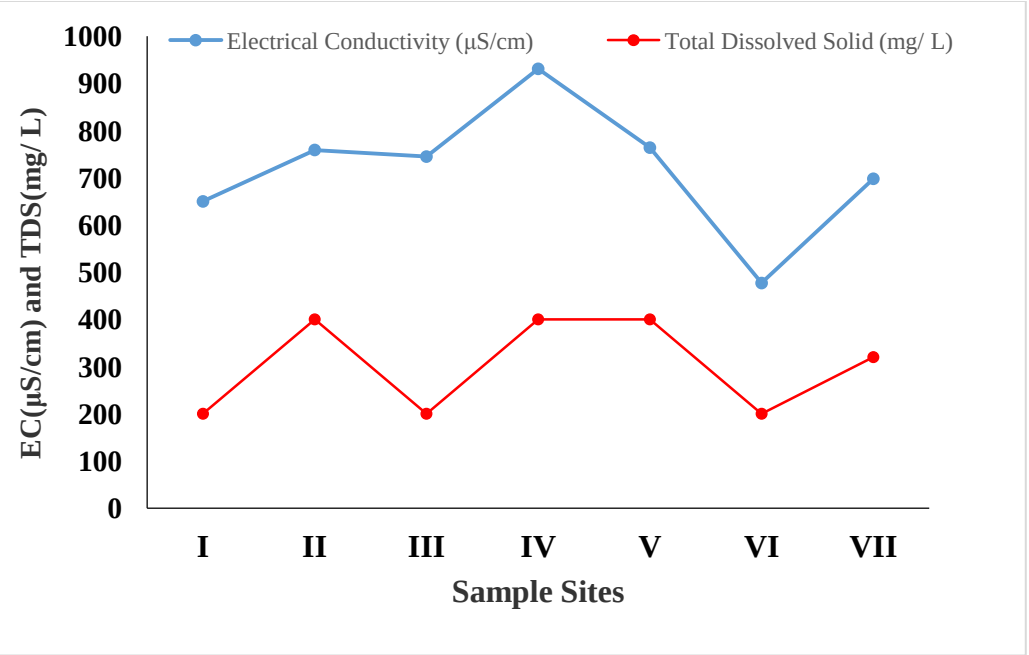

Figure 4: Relationship between electrical conductivity and total dissolved solids values of tube-well water samples from different sites

Determination of Some Chemical Parameters of Drinking Tube-Well Water

The chemical parameters such as pH, hardness, alkalinity, biochemical oxygen demand, chemical oxygen demand, and chloride ion content of the water samples were investigated and the results are described in Table 3.

Table 3: Determination of Some Chemical Parameters of Drinking Tube-Well Water from Different Sites

No	Parameters	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	WHO standard
1	pH	8.23	8.08	7.98	7.87	7.90	8.06	7.52	6.5-8.5
2	Hardness (mg L^{-1})	417	416	494	538	472	450	479	300
3	Alkalinity (mg L^{-1})	100	150	150	100	150	100	120	200
4	BOD (mg L^{-1})	1.35	0.92	0.85	0.98	1.34	1.22	1.24	0.16
5	COD (mg L^{-1})	0.24	0.34	0.21	0.72	0.33	0.25	0.23	4.50
6	Chloride (mg L^{-1})	70	80	65	70	50	90	65	250

The observed pH values of water samples were in the range of 7.52 to 8.23. Thus all of the water samples may be slightly alkaline. But these values did not exceed the WHO standard (2008) limit of 6.5-8.5. The hardness values of water samples were found to be 416-538 mg L^{-1}. From this determination, all of the water samples may be hard water. Alkalinity of water samples was found to be 100-150 mg L^{-1} and these values were lower than WHO standard value. In the BOD determination of tube-well water samples, the BOD values were 0.85-1.35 mg L^{-1}. The observed COD values of water samples were in the range of 0.21-0.72 mg L^{-1}. The experimental values are lower than the standard value. So tube-well water samples were found to be not polluted. Chloride concentration of water samples was found to be 50-90 mg L^{-1}. These values are lower than the standard value.

Elemental Analysis of Drinking Tube-Well Water by AAS

Some elements such as sodium, calcium, iron, manganese, lead and cadmium in water samples were analyzed by Atomic Absorption Spectrophotometric (AAS) method. The results are shown in Table 4.

Table 4: Some Elements in Drinking Tube-Well Water from Different Sites by AAS

No.	Element	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	WHO standard (2008)
1	Na (mg L^{-1})	3	2	4	3	2.5	3	4	200
2	Ca (mg L^{-1})	85	70	90	150	110	115	75	250
3	Fe (mg L^{-1})	0.05	0.31	0.22	0.05	0.03	0.04	0.71	0.3
4	Mn (mg L^{-1})	0.2	0.3	0.1	0.1	0.3	0.2	0.1	0.3
5	Pb (mg L^{-1})	ND	ND	ND	ND	ND	ND	ND	0.01
6	Cd (mg L^{-1})	ND	ND	ND	ND	ND	ND	ND	0.01

ND = not detected

From elemental analysis, the concentration of sodium and calcium were found to be lower than the standard values. The iron content of site VII exceed the WHO standard of 0.3 mg L^{-1}. The manganese values were found to be agree with the standard value. Heavy metals such as lead and cadmium were not detected.

Bacteriological Observation of the Tube-Well Water Samples

Bacteriological examination of Coliform count and *E.coli* were done at the Public Health Laboratory, Ministry of Health and Sports, Mandalay. The results are shown in Table 5.

From bacteriological examination, the coliform count of site I, II, V, VI and VII were found to be 0 MPN. The *E.coli* was not isolated in the water samples from these sites. Therefore, the tube-well water from these sites were used satisfactory for drinking purpose. In the water samples of site III and IV, the coliform count was found to be 2/5 and 3/5 MPN. The *E.coli* was isolated in site III and IV. Thus the tube-well water from site III and IV were used un-satisfactory for drinking purpose.

Table 5: Bacteriological Examination of Drinking Tube-Well Water Samples from Different Sites

Site	Coliform Count (MPN)	*E.coli*	Remarks
I	0	Not Isolated	Satisfactory
II	0	Not Isolated	Satisfactory
III	2/5	Isolated	Un-Satisfactory
IV	3/5	Isolated	Un-Satisfactory
V	0	Not Isolated	Satisfactory
VI	0	Not Isolated	Satisfactory
VII	0	Not Isolated	Satisfactory

MPN= most probable number

Conclusion

The present study deals with the study of physicochemical properties of dinking tube-well water from seven sites of Natmauk Township, Magway Region. The physicochemical parameters such as temperature, electrical conductivity, total dissolved solids, turbidity, pH, hardness, alkalinity, biological oxygen demand, chemical oxygen demand and chloride ion content were determined. In addition, some elements such as sodium, calcium, iron, manganese, cadmium and lead were analyzed. These data were compared with WHO standards. The electrical conductivity values of tube-well water samples show that this water has been good drinking for humans. The pH values of water samples were found to be slightly alkaline. The hardness values of water samples are higher than desirable values of WHO standard. Thus the water samples may be hard water. The values of BOD and COD for water samples are lower than the standard values. The elements such as sodium, calcium and manganese did not exceed the standard values. The iron concentration of site VII exceed the standard limit. The toxic heavy metals such as lead and cadmium contents in the water samples were not detected. So all of the water samples from seven sites of Natmauk Township were not contaminated with heavy metals. From the examination of bacteria, the samples from Yan Aung Myin and Zay Quarters show the presence of *E.coli* (2/5) and (3/5) MPN. This fact indicates that tube-well water samples from these two sites were still

polluted. The suggestion of this research is that these tube-well drinking water should be used for drinking after the water had been boiled and any appropriate treatment.

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References

Aminur, R. (2015). "Physicochemical and Bacteriological Analysis of Drinking Tube-Well Water from Some Primary School, Magura, Bangladesh to Evaluate Suitability for Students.'' *Int. Journal of Applied Science and Engineering Research*, vol.4, (5), pp 735-748

APHA, R. (2012). "Standard Methods for the Examination of Water.'' 22nd Edition, Washington, D.C., USA, American Public Health Association, pp 38-50

Benit, N. (2015). "Physicochemical Properties of Wastewater Collected from Some Different Sewage Sources.'' *International Journal of Innovative Science, Engineering and Technology*, vol.2, (11), pp 691-696

Devendra, D. (2014). "Analysis of Ground Water Quality Parameter: A Review.'' *Research Journal of Engineering Science*, vol.3, (5), pp 26-31

Elangovan, K. (2010). "Carried out Characteristics of Tube Well Water for District Erode.'' *Int.Journal of Environmental Science*, vol.1 (2), pp 735-748

Gorde, S.P. and M.V. Jadhav (2013). "Assessment of Water Quality Parameters: A Review.'' *Journal of Engineering Research and Applications*, vol.3 (6), pp 2029-2035

Gupta, N.B. Shikha and B.A. Patra (2010). "Physicochemical Analysis of Drinking Water Quality from 32 Locations in Delhi,'' *Journal of Indian Water Works Association*, **3** (6), pp 124-235

Sulieman, E.I. (2010). "Chemical, Physicochemical and Physical Properties of Wastewater from the Sudanese Fermentation Industry.'' *Int. Journal of Applied Science and Engineering Research*, vol.4, (5), pp 735-748

WHO,(2008). ''Guidelines for Drinking-Water Quality, Volume **1**, Recommendations.'' Geneva: Third Edition, World Health Organization, PP 53