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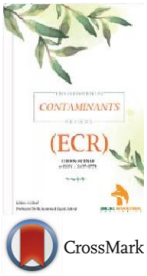

REVIEW ARTICLE

ASSESSMENT OF THE QUALITY OF WATER USED FOR DOMESTIC AND SANITARY PURPOSES IN PARTS OF PORT HARCOURT METROPOLIS, RIVERS STATE NIGERIA

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ABSTRACT

This study was carried out to assess the impact or effect of industrial activities and refuse dump site on the quality of water used for domestic and sanitary purposes in parts of Port Harcourt metropolis, Rivers State Nigeria. The quality assessment was focused on physiochemical parameters. A total of twenty water samples were collected from twenty locations (randomly selected from industrial and refuse dump site areas) within the study area. Ten major physiochemical parameters which include: potency of hydrogen (P^H), salinity, electrical conductivity, total dissolved solids (TDS), turbidity (NTU), calcium (Ca^{2+}), magnesium (Mg^{2+}), chloride (Cl), sulphate (SO_4^{2-}) and nitrate (NO_3^-) were analyzed. The results obtained were compared with the standards of World Health Organization (WHO) and show that the water samples have P^H values between 3.78 and 7.23 which is not within the permissible limit of WHO and thus, indicating that they are acidic and not fit for domestic purposes. Salinity values range between 0.018 and 0.202mg/L indicating that the water is fresh and good for sanitary purpose, electrical conductivity values range between 38.0 and 378.7μΩ/cm, total dissolved solid and turbidity values range from 32.7 to 263.0mg/L and 0.2 to 0.9NTU respectively which is within the limit prescribed by WHO. The concentration of nitrate and sulphate range between 0.47 and 3.00mg/L and <1.0 and 17.2mg/L respectively after analysis and are within the limit prescribed by WHO. The knowledge from this study can be applied in environmental and water management studies and hydrological activities.

KEYWORDS

Turbidimeter, Conductivity, Turbidity, Saltiness, Acidosis

1. INTRODUCTION

Water is indispensable to all life on earth, in nature, water occurs underground, on land, in oceans, ice and glaciers. However, fresh water is constantly recharged through a process known as the hydrological cycle. It controls the temporal and spatial distribution of water in the form of evapotranspiration, precipitation and runoff (Mishra and Pandey, 2008). Ground water is the process by which water percolates down the soil and reaches the table (aquifer). Water is a key resource for industrial and economic developments, it is used for domestic, recreation, industrial and agricultural purposes. It also plays an important role in sustaining the natural or eco systems (Mishra and Pandey, 2008). Amongst other natural resources, water is the most vital resource on planet earth. It is the only chemical compound that exists in solid, liquid and gaseous form.

Rainfall is the major source of ground water recharge, other sources are recharge from rivers, streams, irrigation water etc (Chavan and Zambare, 2014). Water is the world's most abundant natural substance and it is constant circulation, covers about 75% of the earth's surface, mostly in oceans and other large water bodies, with about 1.6% of water found below the ground as groundwater in aquifers and about 0.001% found in the air as vapour, clouds and precipitation. It is a dispersion medium for all biochemical reactions which constitutes the living process and takes part in almost all of these reactions. Without water, life cannot survive; it is very paramount to life (humans, plants and animals) (Hussein et al., 2012). The quality of water is of vital concern for mankind since it is directly linked with human welfare.

Groundwater is believed to be comparatively much clean and free from pollution than surface water. However, indiscriminate discharge of industrial effluents, domestic sewage and solid waste dump cause the pollution of groundwater and creates health problems for human beings (Patil and Patil, 2010). The problem of water quality is much more acute in the areas which are densely populated, highly industrialized and have shallow water table. The rapid growth of urban areas has further affected water quality due to over exploitation of resources and improper waste disposal practices. Hence, there is always a need for and concern over the protection and management of water quality (Patil et al., 2001).

2. STUDY AREA

The study area for this research as shown in Figure 1 is Port Harcourt metropolis and covers about 260Km². The area is located within Niger Delta Region of Nigeria and is between Latitudes $4^0$45'E - $4^0$60'E and Longitudes $6^0$50'E - $8^0$00'E (Wokocha and Omenihu, 2015).

3. MATERIALS AND METHOD

The materials used for this research include borehole water samples, distilled water, white plastic containers of three liters capacity, detergents, analytical reagents, P^H meter, conductivity meter, turbidimeter, thermometer and GPS.

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3.1 Collection of Water Samples

The white plastic containers were washed with detergent and rinsed with distilled water. The water samples were collected using the plastic containers without any air bubble as per standard procedure and were taken, kept in the laboratory at normal room temperature. Water samples from twenty water boreholes (sampling points) at different locations within Port Harcourt metropolis were used for this study. Table 1 shows the sampling locations and sources.

3.2 Physiochemical Parameter Analysis

The water samples were analyzed in the laboratory for the various physiochemical parameters, within 24 hours of sampling, using WHO standard procedure. Physiochemical parameters examined are P^H, salinity, electrical conductivity, total dissolved solids, turbidity and presence of calcium, magnesium, chloride, sulphate and nitrate.

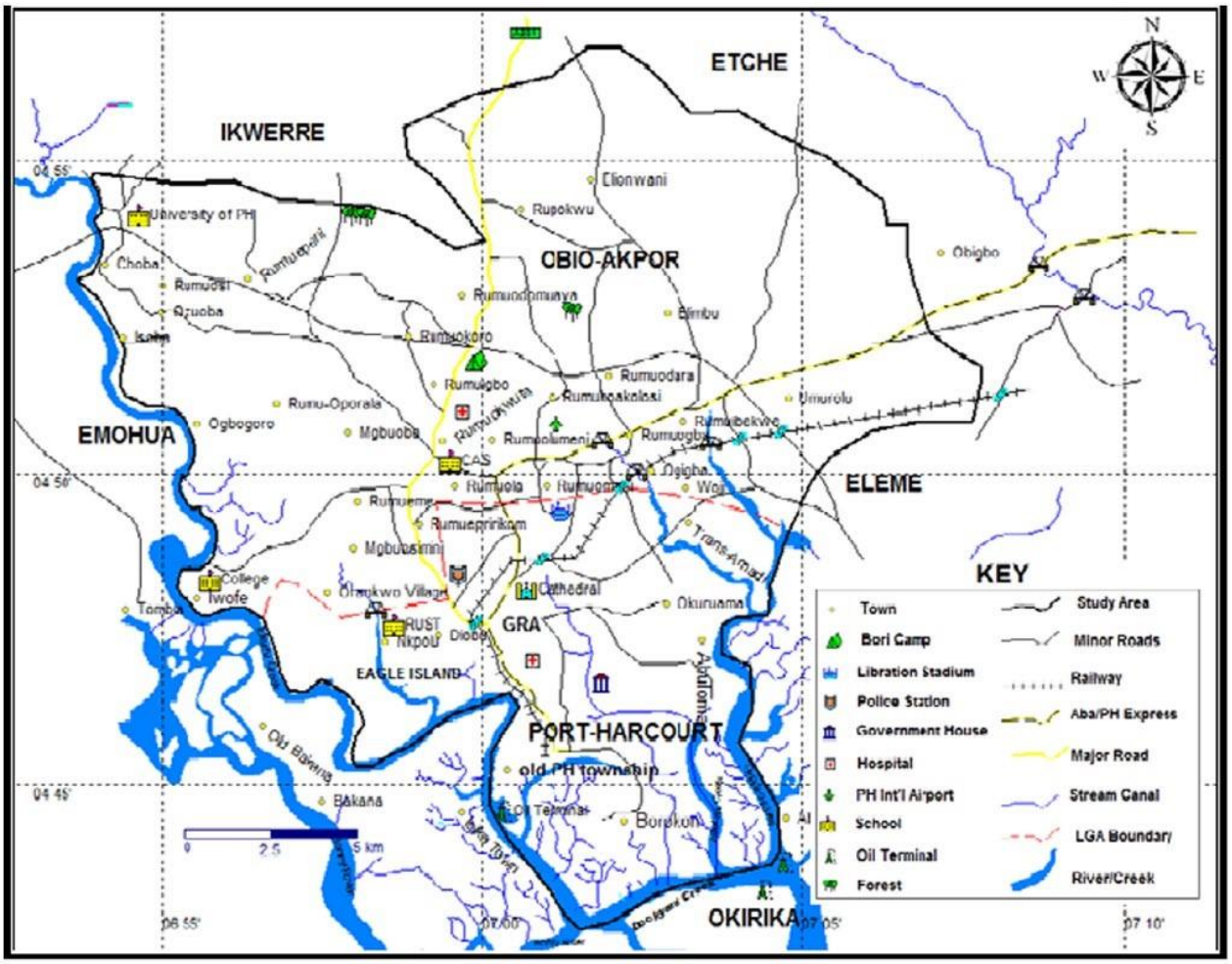

Figure 1: Map of Port Harcourt Metropolis

Table 1: Sampling Locations and Source

S/N	Sampling Location	Source	Sample Code
1	Rukpokwu	Borehole	BH 1
2	Ozuoba	Borehole	BH 2
3	Odili road	Borehole	BH 3
4	Trans Amadi	Borehole	BH 4
5	Eneka	Borehole	BH 5
6	Rumuobiakani	Borehole	BH 6
7	Aluu	Borehole	BH 7
8	Woji Town	Borehole	BH 8
9	Borokiri	Borehole	BH 9
10	Rumuolumini	Borehole	BH 10
11	Choba	Borehole	BH 11
12	Iwofe road	Borehole	BH 12
13	Rumumasi	Borehole	BH 13
14	Mgbuoshimiri	Borehole	BH 14
15	Elimgbu	Borehole	BH 15
16	Rumuokwurushi	Borehole	BH 16
17	Igwuruta	Borehole	BH 17
18	Eliozu	Borehole	BH 18
19	Rumuagholu	Borehole	BH 19
20	Abuloma	Borehole	BH 20

4. Results and Discussion

The results of the physiochemical parameters obtained from the laboratory analysis are shown in Table 2, while Table 3 shows the highest and lowest values of the parameters as well as the water borehole sample.

4.1 P^H

From the values of P^H recorded range between 3.69 and 7.70 which is not within the permissible limit of WHO and thus, indicating that the water samples are acidic and not fit for domestic purpose. Prolonged intake of acidic water may predispose an individual to the dangers of acidosis, which according to health experts, may lead to cancer or cardiovascular damage including the constriction of blood vessels and reduction in oxygen supply, even at mild levels (Ogundipe and Obinna, 2008). Intake of acidic water, over time could also cause leaching of valuable minerals from the body. Examples of such minerals include calcium, magnesium and sodium (Ubong et al., 2016).

4.2 Electrical Conductivity (EC)

Conductivity is due to ionizable salt content or ionizable dissolved substances in solution (Ubong et al., 2016). It depends on the quantity of dissolved salts present and for dilute solutions, it is approximately proportional to the TDS content in solution (Ubong and Gobo, 2001). Electrical conductivity values for the water samples range between 38.0 and 378.7μΩ/cm (micro-Ohms per centimeter) and is with the acceptable standard of 1000μΩ/cm. Highest electrical conductivity value was

recorded at BH4 indicating high amount of dissolved salt whereas lowest value was recorded at BH17 indicating low amount of dissolved salt.

4.3 Salinity

Salinity is the amount of salt present in a given volume of water. This implies that it indicates the degree of saltiness of water. Salinity values of the water samples is between 0.018 and 0.202mg/L indicating that the water is fresh and good for sanitary purposes. Highest salinity value was recorded at BH4 whereas the lowest value was recorded at BH10 and BH17.

4.4 Total Dissolved Solids (TDS)

Total dissolved solids give the overall impression of the quality (purity) of water. Total dissolved solid values range from 32.7 to 263.0mg/L, the higher the TDS, the lower the quality (purity) of water whereas, the lower the TDS, the higher the quality of water. Water sample from BH4 recorded the highest value of TDS and thus is said to be the most impure and poorest in quality while BH9 recorded the lowest value of TDS and is said to be the purest and best in quality amongst the water samples.

4.5 Turbidity

This is the measure of transparency or clarity of water, and it is reflected in all the water Ubong and Gobo, turbidity is due to the presence of colloidal solids which give liquid a cloudy appearance and is aesthetically unattractive and may be harmful (Ubong and Gobo, 2001). Turbidity values of the water samples range from 0.2 to 0.9NTU which is within the limit prescribed by WHO.

4.6 Calcium

The concentration of calcium in the water samples as analyzed range from 0.09 – 10.12mg/L. BH19 recorded the highest concentration value whereas BH18 recorded the lowest concentration of calcium in the water sample.

4.7 Magnesium

The concentration of magnesium in the water samples has range of value from 0.05mg/L – 3.38mg/L. BH19 recorded the highest magnesium concentration with a value whereas BH17 recorded the lowest value.

4.8 Chloride

The concentration of chloride in the water samples range from 0.4mg/L – 24.0mg/L. The highest concentration was recorded at BH4 whereas the lowest concentration was recorded at BH9.

4.9 Sulphate

The concentration of sulphate in the water samples range from <1.0mg/L – 17.2mg/L. BH 4 recorded the highest concentration whereas others recorded the lowest concentration of <1.0mg/L.

4.10 Nitrate

The nitrate concentration in the water samples range from 0.47mg/L – 3.00mg/L. The highest concentration was recorded from BH8 whereas the lowest value was recorded with BH9. Nitrate affects hemoglobin in blood and reduces babies' ability to transport oxygen, infants so affected are said to have 'Blue Baby Syndrome (BBS)' (Ayantobo et al., 2010).

Table 2: Physiochemical Parameters of Borehole Water Samples.

	Sample Code	P^H	EC	Salinity	Turbidity	TDS	NO_3^-	SO_4^{2-}	Mg^{2+}	Cl^-	Ca^{2+}	Tempt.
S/N			µΩ/cm	%	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C
1	BH 1	6.67	230.7	0.111	0.9	164.7	1.90	<1.0	0.19	11.4	5.07	29.4
2	BH 2	5.41	194.3	0.091	0.5	135.3	2.24	4.1	1.68	16.3	5.38	29.6
3	BH 3	4.08	266.3	0.125	0.3	185.7	2.24	4.5	0.91	12.8	3.12	29.5
4	BH 4	3.78	378.7	0.202	0.5	263.0	2.82	17.2	2.70	24.0	9.83	29.4
5	BH 5	4.66	210.3	0.100	0.3	146.7	2.69	<1.0	1.32	9.5	5.61	29.6
6	BH 6	3.87	322.7	0.152	0.3	225.0	2.86	3.5	0.96	15.2	0.81	29.7
7	BH 7	6.62	92.7	0.043	0.5	64.3	1.95	<1.0	1.14	5.3	0.13	29.7
8	BH 8	4.52	199.3	0.093	0.3	139.7	3.00	<1.0	1.41	9.3	3.79	29.8
9	BH 9	6.87	47.0	0.022	0.3	32.7	0.47	<1.0	0.13	0.4	0.43	30.4
10	BH 10	6.85	38.3	0.018	0.2	27.3	0.56	<1.0	0.13	1.0	0.27	30.3
11	BH 11	5.94	92.7	0.043	0.3	65.3	2.39	<1.0	0.33	3.3	0.26	30.4
12	BH 12	4.59	155.7	0.074	0.2	109.0	2.85	<1.0	0.97	6.8	4.32	30.4
13	BH 13	4.62	237.0	0.111	0.3	165.3	2.61	<1.0	1.38	20.7	1.09	30.4
14	BH 14	4.39	289.3	0.136	0.3	202.7	2.89	<1.0	1.01	23.5	0.42	30.4
15	BH 15	4.63	177.0	0.083	0.2	123.7	2.66	<1.0	0.65	9.6	1.25	30.6
16	BH 16	4.73	150.0	0.077	0.3	114.0	0.82	<1.0	0.54	6.5	1.46	30.5
17	BH 17	5.63	38.0	0.018	0.3	26.7	0.56	<1.0	0.05	1.4	0.22	30.4
18	BH 18	5.47	48.0	0.023	0.3	34.0	0.59	<1.0	0.17	1.1	0.09	30.4
19	BH 19	7.23	325.3	0.153	0.4	226.7	0.91	<1.0	3.38	17.9	10.12	30.4
20	BH 20	7.18	112.0	0.052	0.3	77.7	0.75	<1.0	0.46	6.6	1.47	30.5

Table 3: Highest and Lowest Values of the Parameters as Well as the Water Borehole Sample

S/N	Parameter	Highest Value	Lowest Value
1	P^H	7.23/BH9	3.78/BH4
2	Salinity	0.202/BH4	0.018/BH10,BH17
3	EC	378.7/BH4	38.0/BH17
4	Turbidity	0.9/BH1	0.2/BH12,BH15
5	TDS	263.0/BH4	32.7/BH9
6	Ca^{2+}	10.12/BH19	0.09/BH18
7	Mg^{2+}	3.38/BH19	0.05/BH17
8	Cl^-	24.0/BH4	0.4/BH9
9	SO_4^{2-}	17.2/BH4	<1.0/others
10	NO_3^-	3.00/BH8	0.47/BH9

5. Conclusion

After a careful and successful physiochemical analysis of the water samples, the following conclusions are drawn:

i. From the P^H values of between 3.78 and 7.23 for all the samples, it shows that the water is acidic and not suitable for domestic purposes especially for consumption.

ii. The range of salinity values (0.018 – 0.202mg/L) of the water samples indicate that the water is fresh and good for sanitary purposes.

iii. The electrical conductivity values of all the water samples are within the acceptable standard prescribed by World Health Organization (WHO).

iv. The lowest P^H and highest salinity values recorded from BH4 located at Trans-Amadi area of Port Harcourt metropolis could be attributed to the high industrial activities of that area.

v. The highest P^H recorded at BH9 located at Borokiri area is due to the discharge of chemical and acidic materials in a dump site located within that area.

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