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Assessment of Electrical Conductivity and Total Hardness of Borehole Water Resources in Delta State Polytechnic, Ozoro, Delta State, Nigeria.

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Abstract— *This study was carried out with the aim of determining the organoleptic properties, the electrical conductivity and total hardness of borehole water resources in Delta State Polytechnic, Ozoro. Borehole water samples were collected at four different sites at considerable distances-(old administrative building and Engineering complex) in campus 1 and (new administrative building and Science Laboratory Technology complex) in campus 2. The analysis was done using relevant internationally acceptable standard methods. The entire water samples were observed to be colourless, odourless and tasteless. The value of electrical conductivity obtained ranged from 0.9 to 1.3µs/cm. It was highest in sample D with a value of 1.3(µs/cm), while the lowest was obtained from sample A with a value of 0.9(µs/cm. The result of total hardness obtained ranged from 0.7 to 2.6mg/l. It was lowest in sample B with a value of 0.7mg/l and highest in sample D with a value of 2.6mg/l. These values are by far below the acceptable limit of 1000(µs/cm) and 300mg/l set by WHO for electrical conductivity and* water *hardness respectively. This water is soft and free from any form of hardness and as such good for direct consumption in terms of electrical conductivity and hardness.*

Keywords: Electrical conductivity, organoleptic, physicochemical, water hardness,

1 Introduction

Water is one of the most important natural resources known on earth. Water is abundant in nature and it form an integral part of the earth surface (Chandra et al, 2012). It essentially possesses power of life and it is a constant auxiliary to our daily life, social organization, economic, ambition and function (Baroon and Beratin, (2004); Sawere and Uwague, (2016)). There is a dare need for water to fulfill basic human self-sufficiency demand. Access to safe drinking-water is key to sustainable development and essential to food production, quality health and poverty reduction. Safe drinking water is essential to life and a satisfactory safe supply must be made available to consumers (Ackah et al, 2012). Water is thus becoming a crucial factor for development and the quality of life in many countries.

Water quality concerns are often the most important component for measuring access to improved water sources (Reda, 2016). Acceptable quality shows the safety of drinking water in terms of its physical, chemical, and bacteriological parameters (WHO, 2004). The quality of groundwater resources depends on the management of human waste as well as the natural physicochemical characteristics of the catchment areas (Saha and Bara, 2004.) Moreso, based on the geology of an area, groundwater have unique characteristics which make them suitable for public water supply. They are usually free from pathogens, have acceptable colour, odour, and turbidity and can be consumed directly without any form of treatment. Clean water is a priceless and limited resources that man has began to treasure only recently after decades of pollution and waste (Silderberg, 2003). Potable water is an essential ingredient for good health and the socio-economic development of both man and a nation (Udom et al, 2002), but it is lacking in many societies. Water that is meant for human consumption should be free of disease-causing germs and toxic chemicals that poses a threat to public health (TWAS, 2005). Individual water consumption occurs both at home and elsewhere, such as at schools and workplaces. Drinking-water is consumed not only as water *per se* but also in beverages and incorporated in food-stuffs (Sengupta, 2013).

Well over 884 million people lack access to safe drinking water; approximately one in eight people (UNICEF/WHO, 2003). Among them a good percentage consumes hard water, which is considered to be a significant etiological factor around the world resulting to various types of diseases such as cardiovascular problems, diabetes, reproductive failure, neural diseases, and renal dysfunction and so on. According to Awoyemi et al (2014), water hardness is caused by natural accumulation of salts from contact with soil and geological formation or through direct pollution by human activities. Dissolved calcium and magnesium are the two most common minerals that make water to be hard. The degree of hardness becomes greater as the content of calcium and magnesium increases. Beside calcium and magnesium ions, water hardness is caused by several other dissolved metals that are divalent or multivalent cations such as aluminum, barium, strontium, iron, zinc and manganese ions. However, monovalent ions such as sodium, potassium do not cause hardness (Sengupta, 2013). There are basically two types of hardness – the carbonate or temporary hardness which can be removed by boiling the water and the non-carbonate or permanent hardness which cannot be broken down by boiling the water.

Water hardness is the traditional measure of the capacity of water to react with soap, requiring considerably more soap to produce lather. Water containing calcium carbonate at concentrations below 60mg/l is generally referred to as soft; 60-120mg/l, moderately hard; 120-180mg/l, hard; and more than 180mg/l, very hard (McGowan, 2000). Essentially, hard water

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interferes with almost every cleaning task, from laundry and dishwashing to bathing and personal grooming. Clothes laundered in hard water may look dingy and feel harsh and scratchy. Hair washed in hard water may feel sticky and look dull. Dealing with hard water problems in the home can be a nuisance. Bathing with soap in hard water leaves a film of sticky soap curd on the skin. This film may prevent the removal of soil and bacteria and continuous laundering in hard water can shortened the life of clothes. In swimming pools, hard water is manifested by a turbid or cloudy appearance to the water. There is no convincing evidence that water hardness causes adverse health effects in humans (WHO, 2003). Whereas some studies correlate domestic hard water usage with increased eczema in children (McNally et a, 1998; M), others show weak correlation between cardiovascular health and water hardness (Pocock et al, 1981; Marque et al, 2003; Rubenowitz et al 1999).

Both calcium and magnesium are essential minerals and beneficial to human health in several respects. Inadequate intakes of calcium have been associated with increased risks of osteoporosis, nephrolithiasis (kidney stones), colorectal cancer, hypertension and stroke, coronary artery disease, insulin resistance and obesity etc. Extensively, individuals are protected from excess intakes of calcium by a tightly regulated intestinal absorption and elimination mechanism through the action of 1,25-dihydroxyvitamin D, the hormonally active form of Vitamin D. Although, calcium interact, with iron, zinc, magnesium, and phosphorus within the intestine, thereby reducing the absorption of these mineral (WHO, 2011; Sengupta, 2013). On the other hand, magnesium deficiency has been implicated in the pathogenesis of hypertension, with some epidemiological and experimental studies demonstrating a negative correlation between blood pressure and serum magnesium levels (WHO, 2011). Increased intake of magnesium salts may cause a change in bowel habits (diarrhea). Drinking-water in which both magnesium and sulphate are present in high concentration (≈ 250mg/l each) can have laxative effect (Sengupta, 2013).

This study is therefore set to determine the concentration of both calcium and magnesium in terms of total hardness as well as the electrical conductivity of borehole water resources in campus 1 and 2 of this institution, where over 80% of the populace depends on this water source for their daily water needs.

2 MATERIALS AND METHODS

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2.1 Description of Study Area

Ozoro, where one of the three (3) Delta State Polytechnics is situated, is the administrative headquarters of Isoko North Local Government Area, one of the two administrative units of the Isoko region of Delta State, Southern Nigeria. The community which is on latitude $5^{0}32'18''$N and longitude $6^{0}12'58''$E is made up of five quarters- Uruto, Urude, Erovie, Etevie and Oruamudhu. There is no definite population census figure but is one of the largest communities in Isoko kingdom. The economy of the area is boosted by the presence of the tertiary institution. (www.wikipedia.org).

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2.2 Sample Collection and Analysis

Borehole water samples were collected from four different sites at considerable distances- (old administrative building and Engineering complex) in campus 1 and (New administrative building and Science Laboratory Technology complex) in campus 2, and were labeled A, B, C and D respectively. In order to have representative samples, the tap water was allowed to run off for few seconds before the samples were collected with plastic containers. The plastic containers used to collect the samples were thoroughly washed and rinsed with distilled water and then finally rinsed with the sample before the actual sample collection. The samples were thereafter refrigerated at 4 ^{0}C in the laboratory to avoid the unusual changes in water quality prior to analysis (APHA, 2005).

The appearance of water sample was by visual observation for colour and in hailed for odour. The taste was also determined physically. The electrical conductivity was determined *in situ* using K 120 digital consort electrical conductometer . The determination of total hardness was by EDTA titrimetric method as described by (Franson, 1995; Manoj and Avinash, 2012).

3. RESULTS

Table 1: Showing physical property, conductivity and total hardness of borehole water samples.

Sample	Appearance	Taste	Odour	Conductivity (µs/cm)	Total hardness (mg/l)
A	Colourless	Tasteless	Odourless	1.0	0.9
B	Colourless	Tasteless	Odourless	0.9	0.7
C	Colourless	Tasteless	Odourless	1.1	1.2
D	Colourless	Tasteless	Odourless	1.3	2.6
WHO standard	Colourless	Tasteless	Odourless	900	300

As demonstrated in this document, the numbering for sections upper case Arabic numerals, then upper case Arabic numerals, separated by periods. Initial paragraphs after the section title are not indented. Only the initial, introductory paragraph has a drop cap.

4 DISCUSSIONS

From the organoleptic analysis, all the borehole water samples were colourless, odourless and tasteless. This is an indication that the water samples are free from dissolved salts and have good aesthetic value (Sawere and Uwague, 2016). Electrical conductivity is an indication of the concentration of total dissolved solids and major ions in a given water body. The ionic content measured by electrical conductivity in this study ranged from 0.9 to 1.3µs/cm. It was highest in sample D (Science Laboratory Technology Complex) with a value of 1.3 µs/cm, while the lowest electrical conductivity was obtained from sample A (old administrative building) with a value of 0.9 µs/cm. Electrical conductivity is a useful tool to assess the purity of water (Reda, 2016). The purer the water the lower the electrical conductivity. The allowable limit of electrical conductivity is 900 µs/cm (WHO, 2011). The result obtained from this study is far below the permissible limit. This is probably because of no natural and human impacts in the environment. Thus, the water sample is safe for all forms of domestic uses as its electrical conductivity value is far below the permissible limit. Essentially, water hardness causing ions are calcium and magnesium in the form of bicarbonates, carbonates, sulphates and chlorides which are usually present in ground water. From this study, the result of total hardness obtained ranged from 0.7 to 2.6mg/l. It was lowest in sample B (Engineering Complex) with a value of 0.7mg/l and highest in sample D (Science Laboratory Technology Complex) with a value of 2.6mg/l. Following the classification of Durfor and Becker (1964) and McGowan, 2000, all the water samples can be seen to be soft and free from any form of hardness. The values of water hardness obtained in this study lies below the acceptable limit (300mg/l) by WHO (2011).

5 CONCLUSION

This study revealed that the groundwater in the Polytechnic environment is of good quality. All the parameters tested for are below and within the WHO guideline. The borehole water was tasteless, odourless and colourless. The electrical conductivity is very low, an indication that the groundwater is free from dissolved salts. Rain water and distilled water are soft because they contain few ions. The total hardness of the borehole water samples is quite insignificant compared with the permissible limit. The water indeed can be said to be soft .

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7 REFERENCES

[1] S. Chandra, A. Singh, and P.K. Tomar. (2012). ''Assessment of water quality values in Porur Lake Chennai, Hussain, Sagar Hyderalad and Vihar Lake Mumbai, India. *Chemical Science Transactions,* Vol.1, issue 3, pp508-515.J.S.

[2] L. Baroon, and L. Beratin. (2004). ''Evaluating the environmental impact of various datary patterns combined with different food pallation system''. In *European Journal of clinic Nutritio*, Vol. 12, issue 5, pp1-28.

[3] B.T. Sawere, and A. Uwague. (2016). Physicochemical analysis of the quality of sachet water marketed in Delta State Polytechnic, Ozoro. *International Research Journal of Advanced Engineering and Science,* Vol. 1, Issue 3, pp66-70.

[4] M. Ackah, A.K. Anim, E.T. Gyamfi, J. Acquah, and E.S. Nyarko, (2012). Assessment of the quality of sachet water consumed in urban townships of Ghana using physicochemical indicators: A preliminary study. *Advances in Applied Science Research.* 3:2120-2127. (2012-3-4-2120-2127. pdf).

[5] A.H. Reda. (2016). Physico-chemical Analysis of Drinking Water Quality of Arbaminch Town. *J. Environ. Anal Toxicol* 6:356. Doi:10.4172/2161-0525.1000356.

[6] WHO. (2004). Guidelines for Drinking Water Quality. Geneva:World Health Organization (http://www.who.int/water sanitation health/dwq/GDWQ2004web. pdf)

[7] A.M. Saba, and A.H. Baba. (2004). Physicochemical and Bacteriological Characterization of River Landzu, Bida, Nigeria. Proceedings of the 8th National Engineering Conference, Kaduna Polytechnic, Kaduna.

[8] M.S. Silberberg. (2003). Higher Education Chemistry. The Molecular Nature of Matter and Change, McGraw Hill.

[9] G.J. Udom, F.A. Ushie, and E.O. Esu. (2002). A geochemical Survey of groundwater in Khama and Gokana local government area of Rivers State Nigeria. *J. Applied Sci., Environ. Manage.*, 6: 53-59.

[10] TWAS. (2002). Safe Drinking Water; The need, the problems, Solutions and Action Plan. Third World Academic of Science, Italy. Pp8-12.

[11] P. Sengupta. (2013). Potential Health Impacts of Hardwater. *Int. J. Prev. Med, Vol*. 4(8): 866-875

[12] UNICEF/WHO, (2008). Guidelines for Drinking Water Quality, Vol.1, 3rd edn., WHO Press, Switzerland.

[13] K..O. Awoyemi. (2014). Quality analysis of selected boreholes in Ogun and Kwara States, Nigeria.

[14] W. McGowan. (2000). Water processing: residential, commercial, light-industrial, 3rd ed. Lisle, IL, Water Quality Association.

[15] N.J. McNally, H.C. Williams, D.R. Phillips, M. Smallman-Raynor, S. Lewis, A. Venn, and J. Britton. (1998). ''Atopic eczema and domestic water hardness''. The Lancet 352 (9127): 527-531. doi:10.10116/S0140-673(98)01402-0. PMID 9716057.

[16] S.J. Pocock, A.G. Shaper, and R.F. Packham. (1981). ''Studies of water quality and cardiovascular disease in the United Kingdom''. *Sci. Total Environ*. 18: 25-34. doi:10.1016/S0048-9697(81)80047-2. PMID 7233165

[17] S. Marque, H. Jacqmin-Gadda, J.F. Dartigues, and D. Commenges. (2003). ''Cardiovascular mortality and calcium and magnesium in drinking water: an ecological study in elderly people'' (PDF). *Eur. J. Epidemiol*. 18(4): 305-309. Doi:10.1023/A:1023618728056. PMID 12803370..

[18] E. Rubenowitz, G. Axelsson, and R. Rylander. (1999). ''Magnesium and calcium in drinking water and dealth from acute myocardial infarction in women''. *Epidemiology* 10(1): 31-36. doi:1097/00001648-199901000-00007. PMID 9888277

[19] WHO (2011). Guidelines for Drinking Water Quality. Geneva: World Health Organization. 20 Avenue Appia, 1211 Geneva 27, Switzerland.

[20] APHA (2005). Standard methods for the examination of water and waste water. Washington. DC: American Public Health Association.

[21] M.A. Franson**.** (1995). Standard Methods for the Examination of Waters and Wastewaters. 14th Edn., APHA-AWA-WPCF, New York, pp:150-162.

[22] Manoj Kumar and Avinash Puri (2012). A review of permissible limits of drinking water. *Indian J. Occup. Environ. Med.* Vol. 16(1): pp40-44. Doi:10.4103/0019-5278.99696

[23] C.N, Durfor, and E. Becker. (1964). Public water supplies of the 100 largest cities in the United States. In Geological Survey Water-Supply. US Government Printing Office, Washington. 1812, p: 364.