GROUNDWATER QUALITY AT IDU URUAN WATER HEADWORK AND ADJOINING ENVIRONMENT IN AKWA IBOM STATE, NIGERIA

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ABSTRACT

This experiment was carried out to analyze groundwater quality at Idu Uruan water headwork. Five samples were collected at random from the study area while the Idu Uruan water headwork was the control sample. The test result showed that all samples met the Nigerian Standard for Drinking Water Quality (NSDWQ) and World Health Organization (WHO) specifications for the physico-chemical parameters. Samples A, B, D and E met the NSDWQ and WHO specifications being maximum of 5 Nephle-metric turbidity unit (NTU) and sample C with turbidity of 10.2NTU which is above specification. The PH result of the samples showed that all samples are slightly acidic. The bacteriological analysis showed that samples C and D were bacteria free, sample B had E. Coli 0 per 100ml and total coliform count of 10 per 100ml which shows that according to NSDWQ B is fit for drinking. Samples A and E showed evidence of heavy pollution and water from these sources are not fit for drinking due to fecal intrusion. It was recommended that all wells should be filled and abandoned wells should never be used for waste disposal as it was a path for contaminants to enter the aquifer and septic tanks should be pumped out every 1 to 2 years.
Keywords: *Groundwater quality, Idu Uruan, drinking water*

INTRODUCTION

Water is the most essential and necessary factor for living. Living things survive by the intake of water in diverse forms which include drinking, cooking, bathing alongside other purposes as washing and industrial use. Seeing the importance of water to man and other living things, water forms part of the human blood cells (leucocytes), following the saying that blood is life, it can be said that water is life. According to Itah, Akpan and Dr (2005), quality water must be free from high concerntations of chemicals or ions such as leads, sulphate, low pH, high turbidity etc. Water must possess the characteristics of being aesthetically wholesome, chemically tolerable and bacteriological safe before it meets up with the requirements of WHO as a portable water. Water quality is determined by the level of various factors for water quality control. Cancer, arthritis, skin irritation and eruption, heart disease, central nervous system pathology, skin rashes, kidney problems and bronchitis etc are the diseases associated with water pollution by chemicals.

The amounts of concentration that can cause sickness to its consumers depend on concentration and composition of the contaminant chemicals (Eja, 2002). In recent times, research data have shown that much water meant for drinking are contaminated

both chemically and bacteriologically. The World Health Organization has a set of standards for water quality assessment adopted by the National Agency for Food, Drug Administration and Control (NAFDAC) in Nigeria. In August 2008, the Nigerian Industrial Standard also came up with standards for drinking quality water in Nigeria adopted as the Nigerian Standard for Drinking Quality Water (NSDQW). Edema and Fapedu (2001) in their study on the microbiological and physico-chemcial properties of drinking water in Abeokuta found that some samples of water have offensive odor and taste. Also research conducted by Inyang (2004) on the quality of water in Ekpri Nsukkara and its surrounding villages in Uyo showed that all five wells when tested did not meet up the WHO standards while other parameters such as hardness, total dissolve solids, pH were within specifications of WHO. However, water quality cannot be properly assessed by measurement of few water parameters since one water sample when tested can be physio-chemically fit but not bateriologically fit. Coliform bacteria are used as indicators water pollution due to faecal intrusion from man and animals. Coliforms occur in different shapes and sizes some of which are aerobic, facultative, and anaerobic, spores, rod shape etc all of which have their different purposes. No sample of 100ml should contain more than three coliform organisms.

The World Health Organization (WHO) standard for E.Coli is 0 and total coliform is 0 (Wright, Gundry and Conny, 2004). The Nigerian standard for drinking water quality is E.Coli 0 and total coliform 10. However, underground water may employ several processes of treatment depending on the quality of water produced. The cost effectiveness depends on what types of equipment and chemicals required to carry out these processes. Filtration is employed to remove very fine particles and colloidal matters which might have escaped from the sedimentation tank. Some micro-organisms are also removed by filtration. The filter is usually constructed of porous materials such as zone graded sand gravel (Agunwamba, 2008). Lime softening is the application of lime in the hydrated form which is a dry powder. If calcium carbonate deposits only slowly on the filter sand without cementing it to lumps, this can be an acceptable method for stabilizing water and maintaining pH (disinfection) (Wright, Gundry and Conny, 2004).

Although filtration removes about 99% of the micro-organisms, there is still need for disinfection because of the large number of micro-organisms. Disinfection is aimed at the destruction of pathenogenic organisms in water. Sterilization is not synonymous with disinfection (Agunwamba, 2008). After bringing the pH of the water to neutral say 6.5 to 8.5, the water is certified safe by final quality control check. In all of these, three major things have been done to the water which are that, the water has been aesthetically wholesome, chemically tolerable and finally bacteriological safe (WHO, 1989).

Idu Uruan water headwork comes as a blessing to the people of Idu Uruan and Akwa Ibom State as a whole which is an African Development Bank (ADB) assisted project. Before the project, water supply at Idu Uruan and Akwa Ibom used to be epileptic due to power failure but now that the supply is a bit steady the major

problem has now shifted to that of quality which is important to determine whether the water is suitable for domestic, irrigation or industrial purposes and that of cost whereby the treated water supplied is very expensive and therefore some group of individuals cannot afford the quality water. The headwork supplies portable water to locations within the Le Meridien, University of Uyo permanent site and its neighbouring environs, further to locations along the Ibiaku, Idu, Eman Uruan, Edah, Ekpri Nsukkara and to neighbourhoods enroute Nwaniba and terminates supply at the Nwaniba-Edet Akpan junction linking up with the Ifa Atai headwork supply.

Contaminated groundwater has serious health and economic impacts on individuals at Idu Uruan and its environs. Drinking contaminated groundwater causes significant health problems including nervous system disorder, blue baby syndrome, kidney and liver disorders, dysentery, diarrhea, cholera, cancer etc. The cost of clearing contaminated groundwater can be staggering. In many cases the water will not be usable again for domestic supply and property values in the affected area may fall sharply. Seeking solutions to the above posted problems has drawn attention to this research work. The aim of the study is to identify the major factors that affect groundwater quality conditions and it trend at Idu Uruan. The study's major activities include compilation and analysis of available groundwater quality information; intensive sample collection and analysis for a wide array of physical and chemical characteristics; data interpretation; and the reporting of results.

The study also helps at providing a sound understanding of the natural and human factors that affect underground water at Idu Uruan and how to improve the quality of water obtained as samples to meet up with the standards set by WHO and NSDWQ Periodic water testing and bacteriological surveillance. It also helps in knowing the aquifer yield, behaviour and characteristics at Idu Uruan and offer useful recommendations for treatment in the needed area.

MATERIALS AND METHODS

The main materials used for this study were water samples collected from Idu Uruan water headwork and four other boreholes in Uruan Local Government Area, Akwa Ibom State. A total of five different water samples were collected one water sample from the water headwork and four samples from different boreholes. Plastic containers each of two liters capacity were used in the collection of samples. The contatiners were first washed with detergent, and then rinsed with distilled water. At each sampling point, the plastic containers were rinsed twice with water to be collected. The underground water was allowed to run for sometime (15 - 20 min) at each borehole. The sample containers were then filled with water and the container lid immediately replaced. The samples for bacteriological examination were collected in disinfected bottles and thereafter were stored in a refrigerator.

Laboratory analysis was done using Hach Sension 3 pH meter for pH measurement and reading was done directly from the instrument. Conductivity measurement was measured in the water sample using Hach Sension 5 conductivity

meter and readings were also taken directly from the equipment. Turbidity measurements were carried out using Hach turbidimeter and readings were read directly from the equipment after the reading has been allowed to reach a steady state. This was also conducted using Hach Sension 5 conductivity meter. The readings were taken directly from the equipment after it has reached a steady state. Temperature measurement was conducted at insitu using Mercury in-glass Thermometer.

The total dissolve solid and suspended solid were conducted using Hach Sension 5 conductivity meter. The reading was taken directly from the equipment after it has reached a steady state. The dissolved oxygen measurement was conducted using dissolve oxygen meter and readings were taken directly from the instrument. Heavy metals such as iron, Copper, Manganese, Aluminium, Selenuin, Chromium, Cadmium, Cyanide, Lead, Zinc, Barium, and Mercury were measured using a portable spectrophotometer model Hach DR 2010. The reading was taken after it has reached a steady state. The bacteriological analysis was also carried out using the standard pour plate technique as recommended by UNEP (1996b). The method employed was the Pour plate. While, the apparatus used were autoclave, incubator, conical flasks, pipette, spint lamp, test tube or stock bottles and cotton wool. Ethanol and nutrient agar or mackonkey agar were the various reagent used. This research work took into consideration the following research areas where samples were collected with different code as shown on Table 1.

Table 1: Sample areas and code

Sample Area	***Code***
Eman Uruan	A
Eman Uruan	B
Idu Uruan	C
Idu Uruan water headwork	D
Idu Uruan	E

Fig. 1: Map of Akwa Ibom State showing the different locations in Uyo and Uruan

RESULTS AND DISCUSSION

Idu Uruan water distribution headwork supplies water to different locations in Uruan and Uyo metropolis as shown in figure 1 below (the map of Akwa Ibom State showing the different locations in Uyo and Uruan). The result of analysis shows slight difference or variation in physio-chemical Characteristics. The highest pH is seen in borehole C collected from Idu Uruan. This borehole may perhaps have undergone treatment. Boreholes A, B, D and E have pH which do not conform to the specification of the WHO standard and the above samples need to be treated chemically to attain required specification of 6 - 8.5 by WHO standard. However all samples are slightly acidic as shown in the test result (table 2).

The test results show that conductivity is generally low. The highest conductivity is seen in sample C. Others are sample A, sample B, D and E. The conductivity of all samples is within the WHO specification requirement. The result of analysis showed that samples A, B, D and E have turbidity level within specification of WHO being maximum of 5NTU in a sample. Sample C with turbidity of 10.2NTU is above specification of WHO standard for drinking water quality. The test results also show that all samples were saline free having no salt. There was no significant variation in the temperature based on the results of the temperature of the water samples. On the average, all samples met the recommended standard.

All samples analysed for the Total Dissolve Solids (TDS) met the required specification of World Health Organization of 500mg/l. The result of Dissolve Oxygen (DO) was generally low for all the boreholes. The low DO however is evidence of reduced bacterial activity within the water ecosystem as seen in the result of bacteriological analysis. The result of analysis shows that all sample had reduced or low amount of suspended solid with the highest amount in borehole C. The result of analysis of Nitrate and Nitrite level was generally low in all borehole samples and falls within specification of 50mg/l and 0.2mg/l respectively. The result shows that phosphate was low as seen in Sample A, B, C and E. All samples fall within specification of WHO and NSDWQ. The samples were analysed for copper, the WHO standard for copper was met by all samples. High concentration of copper in water may cause acute gastrointestinal disturbances. The low value of copper in samples signifies the low level of absence of substances that liberate copper in water. Low levels of iron were recorded in all samples. All samples met the maximum recommended standard of 0.02-0.04 by WHO and NSDWQ.

The result of analyses showed that both samples C and D were bacteria free and fit for drinking and domestic use. Sample B had E. coli 0 per 100ml and total coliform count of 10 per 100ml. The result shows that according to the NSDWQ, sample B is fit for drinking and domestic use, sample A with E.coli of 200 per 100ml and total coliform count of 210 per 100ml and sample E with E.coli of 100 per 100ml and total coliform count of 110 per 100ml are evidence of heavy pollution. The water from these sources is not fit for drinking due to high feacal instrusion.

Table 2: Test result of chemical examination of water samples analysed

S/No	Parameters	Result					NSDWQ	WHO
		A	B	C	D	E		
1	Temperature	29.2	29.2	29.5	29.15	29.8	Ambient	Ambient
2	pH	4.58	4.09	5.18	4.15	4.12	6.5-8.5	6.5-8.5
3	Turbidity (NTU)	1.26	1.26	10.2	1.1	1.56	5	5
4	Iron (Fe3+)mg/l	0.06	0	0.08	0.05	0.01	0.3	0.3
5	Salinity	0	0	0	0	0	0.5	0.5
6	Electricity Conductivity	10.48	18.71	49.7	10.26	20.3	1000	1000
7	Total Dissolved Solid mg/l	4.5	5.3	23.1	4.4	9.2	500	500
8	Manganese	0	0.2	0.6	0.2	0.1	<0.1	<0.1
9	Nitrate (NO_3)mg/l	0.02	0.1	1.8	0.6	0.6	50	50
10	Nitrite (NO_2)	0.003	0.006	0.017	0.009	0.006	0.2	0.2
11	Phosphate (PO_4^{3-})mg/l	0.036	0.9	0.0021	0.3	0.14	3.5	3.5
12	Suspended Solid	6	3	10	5	2	<10	<10
13	Sulphate (SO_4^{2-})mg/l	3	3	6	3	2	100	100
14	Total Hardness mg/l	48	38	44	58	30	500	500
15	Calcium Hardness (Ca^{2+}) mg/l	72	38	60	52	42	75	75
16	Magnesium Hardness mg/l	24	0	BD	BD	8	0.2	0.2
17	Acidity	4.4	3.4	11.6	4.2	4.4	4.5-8.2	4.5-8.2
18	Total Alkanlinity	7.2	7.1	0.8	5.2	6.1	100-200	100-200
19	Chloride (Cl) mg/l	0.2	0.2	0.5	0.2	0	250	250
20	Aluminum (Al^{3+})mg/l	0.01	0.01	0.01	0.01	0	0.2	0.2
21	Selenium (Se) mg/l	0.01	0	0.01	0	0	0.05	0.05
22	Chromium (Cr^{6+}) mg/l	0.01	0	0.01	0	0	0.05	0.05
23	Cadmium (Cd) mg/l	1	1	2	1	1	0.03	0.03
24	Copper mg/l 0.03	0.05	0.15	0.05	0.01	1	1	
25	Cyanide (Cn^-) mg/l	0.001	0.001	0.001	0.001	0.01	0.01	0.01
26	Lead (Pb) mg/l	6	7	10	6	5	0.01	0.01
27	Zinc (Zn) mg/l	0.01	0.01	0.02	0	0	3	3
28	Barium mg/l 2	3	5	2	2	0.01	0.01	
29	Fluoride (f^-) mg/l	UR-0.02	UR-0.06	UR-0.10	UR-0.06	UR-0/05	1.5	1.5
30	Mercury (hg)mg/l	0.2	0.2	0.3	0.2	0.2	0.001	0.001
31	Dissolved Oxygen (CO_2) mg/l	0.4	0.5	0.3	0.3	0.4		

Table 3: Results of bacteriological at 48hrs using nutrient agar

Sample	Dilution Factor	E. coli per 100ml	Total coliform per 100ml
A	101	$20x10^1$=200	$21x10^1$=210
B	101	0	1x101=10
C	101	0	0
D	101	0	0
E	101	$10x10^1$=210	$11x10^1$=110

CONCLUSION AND RECOMMENDATIONS

Water samples from different boreholes in Idu Uruan were collected and analyzed. The result showed that they were no physicochemical pollution except that all samples had very low pH. Heavy bacterial pollution was seen in sample A and E. However, it was observed that all contaminants were from human activities. therefore, regular water analysis and bacteriological status surveillance at Idu Uruan water headwork should be carried out to obtain good quality drinking water. A holistic approach to water treatment before supply should also be carried out so as to eradicate natural factors that affect groundwater quality and meet up with the WHO standards for quality. Enlightenment on the need for Idu Uruan people to support groundwater protection legislation and education at local level to help curb pollutants in the area where boreholes are located.

Take good care of septic system by having them pumped every three to five years. Do not use septic tank cleaners as a substitute for a regular pumping schedule. Never use a septic system to dispose of household hazardous chemicals such as solvents, paint thinners, pesticides, gasoline, furniture polish or antifreeze. Government should enact laws to empower the water company to carryout quality control on private boreholes before use. Nonetheless, water can be made fit for drinking if it is properly analyzed and given recommendations for treatment carefully and followed duly. Knowing that water treatment chemicals are very dangerous when not properly used it is recommended that they are administered by experts and professionals in water quality control.

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