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PHYSIOCHEMICAL AND MICROBIAL INVESTIGATION TO EVALUATE PROBLEMS ASSOCIATED WITH A TYPICAL ARTESIAN BOREHOLE LOCATED IN IGBOGOR EDO STATE, SOUTH-SOUTH NIGERIA

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ABSTRACT

Chemical and biological Laboratory tests were carried out on samples of water collected from the artesian borehole located at Igbogor Community, Ovia South-West Local Government Area of Edo State to determine the contamination level chemically and biologically respectively. It was observed that this water forms scum and has relatively high contents of HCO_3 (168mg/l); Ca (79.3mg/l) mg (76mg/l); SO_4. (4.8mg/l); Fe (2.20mg/1) and Ni (0.12mg/1). Biological analysis reveals contamination with E.Coli Count (1): Conliform Count (2) and Salmonella Count (3). Igbogor artesian borehole is located in Palaeocene - bentonitic clay along Iguobazuwa - Okada road. Other researches reveals that it discharges about 54.2903 m^3/ day of hard water. This volume of water discharge per day can be purified of hardness and other contaminants and it will supply potable water to Igbogor and her neighbouring communities of Okoro, Okha, Adeyan-Oba and Ofunmwegbe (New Road) who are suffering from drinkable water scarcity. The water may also be channeled to farms for irrigation purpose.

1.0 Introduction

An artesian borehole is one in which a piezometric pressure supports its water to overflow to the surface. It derives its name after the French province of Artois where the phenomenon was first recorded [1]. But [2] defined artesian well to include any well in which its water level rises above the top of the aquifer whether or not the water flows at the land surface.

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Conditions of strata that favor artesian wells formation include (a) an inclined or broadly synclinal confined aquifer; (b) exposure of the rim of the aquifer over a catchment at a sufficient height to cause a hydraulic head for overflow in such wells. The largest known artesian basin in the world is that of Queensland, Australia [3].

Groundwater quality is largely influenced by the components of the rocks underground where they flow through or are stored. Where limestone or gypsum exists in the form of $CaCO_3$, $MgSO_4$, or $CaSO_3$, temporary or permanent hardness may result.

Igbogor artesian borehole was drilled early 2006 as a community project by the Federal Government. No trace could be made of records of its actual depth drilled and the lithology penetrated. However, the depth is put to be about 450ft (137m) by the community leaders.

The main purpose of this study is to determine the quality of the artesian water and establish its suitability for use as well as proffer remedies for its present environmental effects on Igbogor community.

In-spite of the much emphasis on groundwater resource development and management nothing has been done to utilize the Igbogor Artesian water. There is no availability and functioning water supply scheme in Okada and environ. A lot of people depend on a few domestic boreholes owned by individuals which are commercialized [4]. Unfortunately, Ovia South-West Local Government Area Council invested fund in another aborted borehole project about 300 metres from the artesian borehole in 2010.

Few artesian boreholes have been drilled in the same Imo Shale belt in Okada and Ugbogui about 5km and 12km respectively from Igbogor.

2.0 THE STUDY AREA AND ITS GEOLOGY:

Igbogor is located between longitudes 005^0 20'E -005^0 23'E of the Greenwich meridian and Latitudes 6°40'N -6°43'N on the Equator average of about 250ft (76m) above sea level. Strata exposed on road cuts and river beds dip 5 to 10 degree South with East-West strike [5]. The study area is part of the Palaeocene shallow marine bentonitic clay deposit of Imo Shale [6]. They also reported the presence of gypsum mineral in the area.

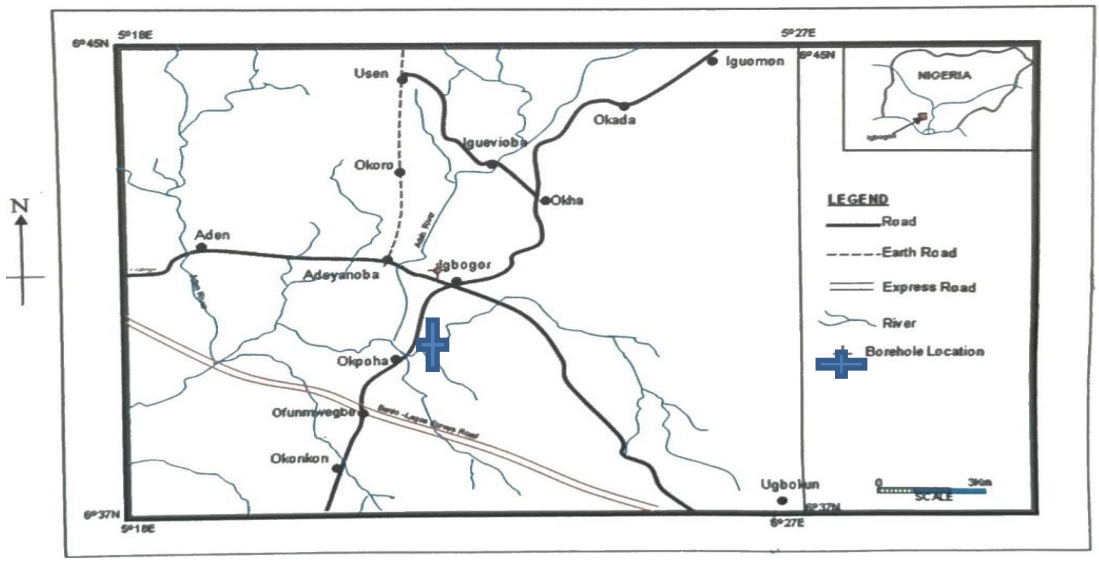

Figure 1: Map Showing Borehole Location

3.0 METHODOLOGY

The water sample was collected using a new plastic container. The container was first rinsed with the borehole water several times before filling it. The container was tightly closed, labelled and put in a black polythene bag to prevent any interaction with sunlight.

Laboratory analysis for chemical and heavy metals contaminants were carried out at Marlet Environmental Research Laboratory Limited, Benin City while the microbiological analysis was carried out at Microbiology (MCB) Department University of Benin. The results were compared with reports of the Nigeria Standard of Drinking Water Quality (NSDWQ) 2007 threshold standards for drinking water.

Turbidity and colour were determined using Handheld DR 900 calorimeter and Hach DR/2000 spectropholimeter respectively. The cations analyses were carried out using the Atomic Absorption Spectrophotometer (AAS) Model - SOLAR 969 UNICAM series with air acetylene flame.

Multiple Test Technique (MTT) was implored for determination of Escherichia coli, Coliform count, salmonella and fungi presence. Multiple fermentation tubes containing Maconkey broth were inoculated with 10ml (for double strength tubes) and 1ml or 0.1ml (for simple strength broth and incubated at 44 ^{0} C for 48 hours (E.Coli) and at 37^0 C for 24 hours (Coliform Count).

4.0 DISCUSSION OF RESULTS

The results of analysis of the water are shown in Tables 1 and 2. The in-situ temperature of 38°C is warm compared to average room temperature of 30°C. This warm nature suggests either water is in contact with folded rock at great depth or it is a hot trapped water from underlying zones of metamorphism and granitization [3]. pH of 5.6 and threshold of NSDWQ is 6.5-8.5 showing acidity. The values of the water colour (1.0pt Co); salinity (0.037 mg/1); turbidity (1.0NTU); TDS (376mg/1); TSS (20mg/1); Na (24.4 mg/l); K (8.2 mg/l); Ca (79.3mg/l) and SO_4 (4.8 mg/l) are fluctuating between high and low concentration limits of NSDWQ (2007).

Table 1: Results of the laboratory water quality test of physiochemical (38^{0}C) and heavy metal concentration (mg/l) of Igbogor artesian wells in comparison with NSDWQ (2007) recommended values.

WATER QUALITY PARAMETERS	Unit	SAMPLE RESULT	NSDWQ	REMARK
pH	mg/l	5.6	6.5 – 8.5	Acidic
EC	US/cm	82.5	1000	Ok
Salinity	g/L	0.037	-	-
Colour	Pt.co	1.0	15	ok
Turbidity	NTU	0.1	5	ok
TSS	mg/l	20	-	ok
TDS	mg/l	376	500	ok
DO	mg/l	7.1	-	ok
BOD	mg/l	9.2	-	ok
COD	mg/l	9.2	-	ok

HCO_3	mg/l	168	-	ok
Na	mg/l	24.4	200	ok
K	mg/l	8.2	-	ok
Ca	mg/l	79.3	7,5	Not ok
Mg	mg/l	7.6	0.2	Not ok
Cl	mg/l	35.5	250	ok
P	mg/l	0.18	-	ok
NH_4N	mg/l	0.006	-	ok
NO_2	mg/l	0.32	0.2	ok
NO_3	mg/l	0.7	50	ok
SO_4	mg/l	4.8	100	ok
Fe	mg/l	2.20	0.3	Not ok
Mn	mg/l	0.017	0.2	ok
Zn	mg/l	0.10	3	ok
Cu	mg/l	0.004	1	ok
Cr	mg/l	ND	0.05	ok
Cd	mg/l	ND	0.003	ok
Ni	mg/l	0.12	0.02	Not ok
Pb	mg/l	ND	0.01	ok

ND – Not detected, NSDWQ – Nigeria Standard of Drinking Water QualitY

Table 2: Results of Biological Analysis

CONTENT	NO (CONUT)	SON 2007 LIMIT
Salmonella Count	3	NIL
E Coli Count	1	NIL
Coliform Count	2	NIL
Staphylococcus	0	NIL
Total Viable Fungi Count (TVFC)	0	NIL

However, HCO_3, (168 mg/l) is relative high while Ca (79.3 mg/l) and Mg (7.6 mg/l) are above 7.5 mg/1 and 0.2 mg/1 NSDWQ (2007) standard limits respectively. These account for the hardness of the borehole water. NO_2 (0.32 mg/l) is above NSDWQ (2007) of 0.2 mg/1 threshold limit. Two heavy metals Fe (2.20 mg/l) and Ni (0.12 mg/l) were above NSDWQ (2007) permissible limits of 0.3mg/l and 0.02 mg/1 respectively as shown on Table 1. High Fe content is traceable to the ferroginized sandstone pans prevalent in Igbogor-Okada area. The rusty casing iron pipe is not also left out of Fe high content. The injection of water flowing on the surface which infiltrates into the subsurface injects surface impurities into depth [7].

4.1 MICROBIAL CONTAMINANTS

Presently the projecting casing pipe above the ground grows algae within and around it. The microbial contaminants identified in the artesian boreholes water are shown on Table 2. The presence of salmonella (3), E.Coli (1) and Coli form count (2) make the water unfit for drinking. The presence of pathogenic micro-

organism is caused by the presence of shallow latrines close to the borehole area [8]. The microbial contaminants may also be attributed to the abandoned state of the wellhead.

4.2 POSSIBLE TREATMENT

The artesian water can be purified by passing it through a simple aeration process. The metallic precipitates (Fe $[OH]_3$) formed are removed either by use of coagulants or passing the water through a sand and activated carbon beds [9].

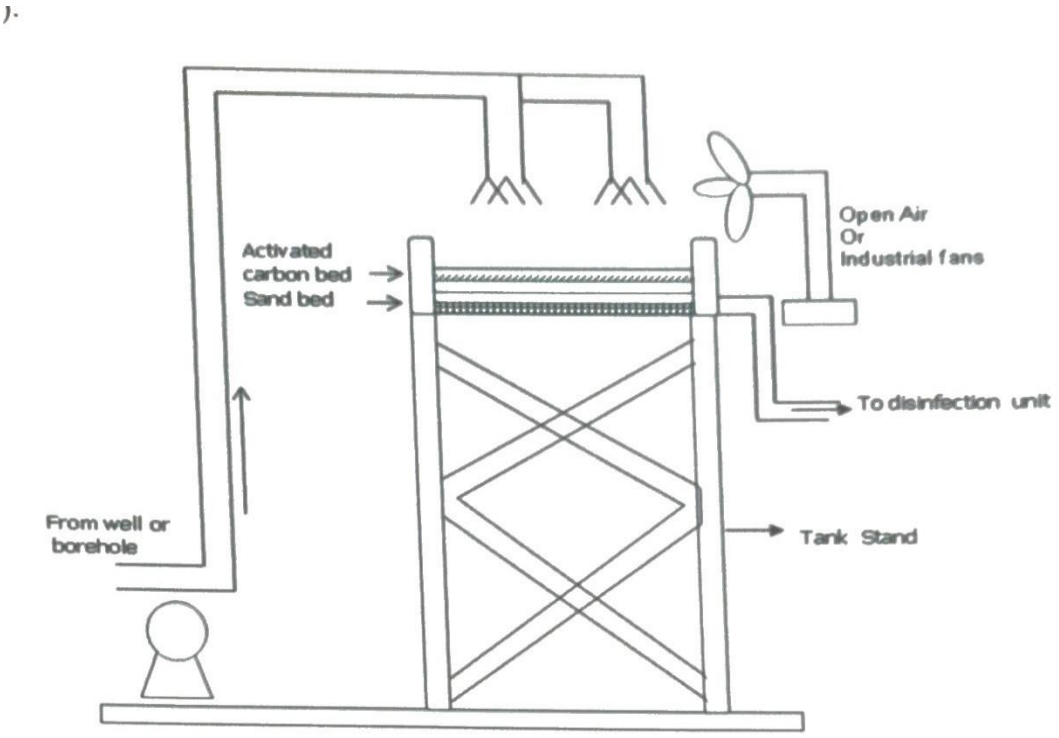

Figure 2: A Simple Aeration Process

CONCLUSION AND RECOMMENDATION

Good water is life giver to the community where it exists but Igbogor artesian borehole poses a health hazard to its neighborhood. The water is rendered unfit by high content of HCO_3 (168 mg/l); Ca (79.3 mg/l) and Mg (7.6 mg/l), added to these are the presence of Fe (2.2 mg/l) and Ni (0.12 mg/l) values above NSDWQ (2007) threshold for potable water. Microbial presence of salmonella (3) E.coli (1) and Coliform Count (2) in the borehole water is a major concern for consumers because of their health implications. The artesian water can be made potable by simple treatment of hardness, sterilizing with chlorine or passing it through simple Filtration system.

The scarcity of potable water in Igbogor and its neighboring communities of Okoro, Aideyanoba, Okha and Ofumwegbe (New Road) calls for urgent harnessing of the artesian water for its much-needed use. The water can also be piped to farm lands for all year round crop production by the community.

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