# QUALITY ASSESSMENT OF BOREHOLES WATER IN UMARU ALI SHINKAFI POLYTECHNIC SOKOTO - MAIN CAMPUS

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***ABSTRACT***

*This research presents a quality assessment of boreholes water in Umaru Ali Shinkafi Polytechnic Sokoto main campus to evaluate their constituents and contaminants that are known to be hazardous to health and give rise to complaints from consumers. Water quality assessment was carried out for seven boreholes in the study area using standard methods and procedures approved by SON and evaluated with the WHO guideline for drinking water quality. The results showed that the physicochemical parameters for PH, temperature, conductivity, TDS, odor, and, color were found within the WHO standard of Drinking water Quality. The turbidity for BHCES, BHADMS, BHMHCRM, BHADME fall above WHO standard of 5NTU. The Nitrate, calcium, Iron, sulfate, and chlorine had values within recommended standard. The microbiological parameter tested for total coliform showed that BHCES has 4MPN/100ml; and BHBGH: 8MPN/100ml while the rest of boreholes were safe from microbial pollutants. Some boreholes water was having few of their parameters above the WHO permissible limits. It was recommended that the turbidity of BHCES, BHADME, BHADMS, BHAHCRM need to be checked for appropriate purification also the public should be enlightened on the need to allow debris and other particles to settle down to the bottom of the water container before use. BHCES and BHBGH should only be used for domestic use like washing, bathing, flushing toilets, laundry etc. due to the presence of microbial pollutants.*

**Keywords:** Quality Assessment, Borehole, Physico-chemical, Microbiological

## INTRODUCTION

Groundwater is easily the most important component of the hydrological cycle, an important source of potable water in Africa and constitutes about two-thirds of the freshwater resources of the world (Diane, 2004). Surface water is not evenly distributed or accessible to large sections of the global population (Diane, 2004). In many arid and semi-arid areas of Africa, borehole water is a means of coping with water deficiencies in areas where rainfall is scarce or highly seasonal, and surface water is extremely limited (David, 2011).

There is practically no geological environment at or near the earth's surface where pH will not support some form of organic life (Chapman, 1996). Boreholes and wells locally distort the natural flow field and create a path that opens up an additional possibility of heat and mass transfer between rock formations / aquifers, surrounding and atmosphere (Berthold 2010; Akpoveta, 2011). Indiscriminate waste disposal, poor agricultural practices, septic tanks, pit latrines and graves near

boreholes, poor good construction, contribute to borehole water contamination (Egwari and Aboaba, 2002). These account for the presence of coliform bacteria in borehole water. World population cannot be sustained without access to safe water. It is therefore important to conjunctly consider both water quality and quantity in water resources management (Braunstein, 2007). Contamination of water has increasingly become an issue of serious environmental concern after years of pollution (Akpoveta *et al*., 2011).

This research shall be of value and significance to scholars in the field of engineering, medicine, agriculture and industries as it will assist them in carrying more deep research. Furthermore, the research will also help students that like to carry out a project on the quality assessment of borehole water meanwhile, adding to the existing stock of knowledge, therefore, significant to future studies in the field. The acute water shortage forced many people to drink untreated water obtained from surface and underground sources thereby exposing them to hazardous chemicals and infectious agents. Therefore the use of boreholes in the study area is of the great concerned issue to eliminate this menace. This assessment will be of significant use to consumers of these borehole waters in Umaru Ali Shinkafi Polytechnic Sokoto main campus and neighboring communities. The concentration and limitations of this research work are clearly on to the analysis of boreholes water in the Umaru Ali Shinkafi Polytechnic Sokoto main campus. This study was aimed at assessing borehole water quality in Umaru Ali Shinkafi Polytechnic Sokoto main-campus.

The objectives of this research work are:

i. To carry out analysis of the physical parameters of the boreholes water
ii. To perform the chemical analysis of the boreholes water.
iii. To determine the bacteriological tests for T-coil form on the boreholes water.

## MATERIALS AND METHODS

### Study Area

Umaru Ali Shinkafi Polytechnic main campus is located at Farfaru area by SCAS Road and is surrounded by four neighboring villages namely: Rugar Wauru, Gidan Salanke, SARDA quarters and Arikilla. The area of the study is in Wamakko Local Government of Sokoto State. The Adjoining areas extended with groundwater supply from boreholes are part of the neighboring villages namely above. It is an arid region that gradually merges into the desert across the border in the Niger Republic. It has limited rainfall from mid-May to mid-September and is subjected to the Sahara's Harmattan (dry, dust-laden wind) from November to March (Raji and Ibrahim, 2011). Sokoto state is located at Latitude $13^{O}$ 04” North and Longitude $5^{O}$ 15” east. Water samples are obtained from seven sampling points namely:

| | | |
|---|---|---|
| BHCES | - | Borehole College of Environmental Studies |
| BHAUD | - | Borehole Auditorium |
| BHADMET | - | Borehole Admin Electricity Type |
| BHADMS | - | Borehole Admin Solar Type |

| | | |
|---|---|---|
| BHPOUL | - | Borehole Poultry |
| BHMHCRM | - | Borehole Male Hostel Common Room |
| BHBGH | - | Borehole behind Girls Hostel |

**Collection and Preparation of Samples**

Each sample of borehole water was flushed for 3 minutes to remove any externally induced contamination. The water sample was collected from 7 boreholes located on the main campus at weekly intervals for three weeks between the seven boreholes. Analyses were carried out on two boreholes within a week and three boreholes in the last trips. The containers were marked and labeled for easy identification of each borehole. Samples were collected in plastic container bottles of 50ml, washed and sterilized thoroughly to avoid contamination and then immediately taken to the laboratory for analysis.

***Physico-chemical Analyses***

The Physico-chemical analysis was carried out to find the level pH, temperature, conductivity, turbidity, color, odor and total dissolved solid. The universal multipurpose pH meter model 'Sension' was used to determine the pH. Turbidity meter 2001p type by AACH limited India was used to ascertain the turbidity of the boreholes water. The total dissolved solid was determined using TDS electrode meter manufactured by Eutech instrument limited Singapore. The task was also taken to determine if there is the presence of sweet, sour, bitter, salty or any tastes. Other physical parameters like temperature, conductibility, color, and odor were also measured and analyzed by the standard methods and procedures set by the ISO guidelines (SON, 2007`). The chemical parameters were obtained using reagents or indicators of parameters like nitrate, iron calcium, chorine, and sulphate. Nitrate was measured using nitrate low range tablets after grinding and poured into 10ml water sample in a test tube.

Sulphate was obtained using one sulphate II tablet after grinding and poured into an l0ml water sample in the test tube. Chlorine was obtained using DPD indicator. All the sampling method and analysis for Physico-chemical and bacteriological parameters was carried out in accordance with Nigerian Standard for Drinking Water Quality, i.e., based on ISO guidelines (SON, 2007). All tests were conducted in the dry season periods, and optimum cares were observed to avoid error in the cause of carrying out analyses in the laboratory. Safety and complementary instructions were obtained from Sokoto state water board quality control central laboratory.

**Microbiological Analyses**

Indicator organism Total coliforms units.100ml (MPN 100ml) was analyzed from the water bottles after washing the apparatus with distilled water, wearing hand gloves, and all devices were inserted into the autoclave for fifteen minutes for sterilization. Reagents, test-tubes, and other accessories were prepared, and analysis was carried out using the same standard sampling method and laboratory analysis that comply with ISO guideline.

## 3.0 RESULTS AND ANALYSIS

The Results of Physico-Chemical and Microbiological analysis are presented in the table 3.1-3.2 below:

Table 3.1: Results of Physico-chemical analysis

| Parameter | BHCES | BHAUD | BHADME | BHADMS | BHPOUL | BHAHCRM | BHBGH | WHO standard mpl (mdl) |
|---|---|---|---|---|---|---|---|---|
| PH | 6.9 | 7,1 | 7.1 | 6.8 | 6.9 | 7.3 | 7.2 | 6.5-85 |
| Temperature (c) | 31 | 39 | 3.2 | 30.1 | 29.9 | 30 | 30.2 | $30^0$c |
| Conductivity (ms/cm) | 28 | 25 | 12.2 | 20.3 | 52 | 25 | 15 | 100ms/cm |
| Odour | Inoffensive | Absent | Absent | Inoffensive | Inoffensive | Inoffensive | Inoffensive | Inoffensive |
| TDS (mg/l) | 0.2 | 0.4 | 0.4 | 0.05 | 0.1 | 0.1 | 0.4 | 500mg/l |
| Colour ($H_3$) | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.2 | 0.1 | 4H3 calcium |
| Taste | Little Potash | Unobjectionable | Unobjectionable | Unobjectionable | Tasteless | Little bit potash | Unobjectionable | Unobjectionable |
| Turbidity (NTU) | 6.2 | 5 | 13 | 10 | 2 | 12 | 2 | 5NTU |
| 1ron (mg/l) | 0.1 | 0.2 | 0.2 | 0.1 | 0.05 | 0.2 | 0.3 | 0.3mg/l |
| Nitrate (mg/l) | 12 | 8 | 1.5 | 2 | 1.4 | 1.1 | 1.8 | 45mg/l |
| Sulphate (mg/l) | 5 | 380 | 190 | 180 | 220 | 190 | 215 | 450mg/l |
| Calcium (mg/l) | 62 | 60 | 4.55 | 6.1 | 13.5 | 10.35 | 9.2 | 75mg/l |
| Chlorine | 0.0 | 0 | 0.002 | 0.01 | 0 | 0.003 | 0.002 | 10.5mg/l |

Table 3.2: Results of Microbiological analysis

| Parameter | BHCES | BHAUD | BHADME | BHADMS | BHPOUL | BHAHCRM | BHBGH | WHO standard (mpl) |
|---|---|---|---|---|---|---|---|---|
| Total coliform (mpal/100ml) | 10.0 | 0 | 4 | 0 | 0 | 0 | 8 | OMPN (100ml) |

The pH for BHPOUL, BHCES and BHADMS waters are almost the same in value whereas water from BHADMET, BHAUD have the same pH all fall within the WHO maximum permissible limits of drinking water which lies between 6.5-8.5. A study of borehole water in Nigeria by Eniola *et al.* (2007), showed that pH of borehole water fell within the range of 6.5-7.8. The temperature for BHAUD, BHPOUL, and BHMHCRM waters was found to be within the WHO standard while BHBGH, BHADMS, BHADME, and BHCES are a little bit above the WHO standard. All samples have their conductivity within WHO standard limit for drinking water ranged between 12.2 to 52msandcm not above 100ms/cm as specified by World Health Organization.

The WHO limit for odor is inoffensive. BHAUD and BHADME are found absent of odor while rest of samples are found having an odour but harmless and within recommended limit for drinking water. The Total dissolved solids are a measure of total inorganic substances dissolved in water. TDS indicates the general nature of water quality, during this research Borehole water samples were found to have TDS ranging from 0.1mg/l to 0.5mg/l while the WHO limits is 500mg/l. Therefore, it does not outreach the standard. The colors of the sample are ranged between 0.1 to $0.2H_z$ and are all within the limit of $4H_z$ (WHO permissible limit). The tastes of most boreholes water are a unobjectionable limit and approved for drinking. Therefore the measured parameters mentioned above were indicated that the water is portable.

Turbidity is the lack of water's clarity detected from some of the boreholes as a result of pumping with silts. BHCES, BHADMS, BHMHCRM, BHAME are having values 6.2, 10.12, 13NTU respectively above WHO standard. Turbidity has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated illnesses (Regina, 2009). The iron content ranges between 0.05mg/L to 0.3mg/L all lies within the specified limit sets by World Health Organization of Drinking water quality, and the levels of nitrate detected in all the water samples were also within the WHO standard of drinking water quality therefore safe for drinking.

Sulphate content determined ranged from 5mg/L to 380mg/L and Calcium from 4.55mg/L to 62mg/L; all fall within the WHO recommended a standard of 450mg/L and 75mg/L respectively. In table 3.2 it was shown that little or no amount of whole coli form organisms were seen in BHBGH, BHADME and the remaining boreholes respectively. This might be as a result of indiscriminate waste disposal, septic tanks, poor well construction, which contributes to borehole water contamination.

## CONCLUSION AND RECOMMENDATION

### Conclusion

The Quality assessment of boreholes water within Umaru Ali Shinkafi Polytechnic Sokoto main campus was carried out to evaluate the level and degree of purity of the water for the user. In all the parameters determined, the waters were found to be safe for drinking except for turbidity and total coliforms were little numbers of coli form bacteria were observed in BHCES and BHBGH. Parameters such as temperature, conductivity, odor, color, iron, chlorine, Nitrate,

Sulphate, Total dissolved solid, calcium, and taste, are within the acceptable level based on WHO maximum allowable levels for drinking water. This study concluded that borehole water at the college of environmental studies; admin electricity type, admin solar type, behind girls' hostel and male hostel common room are moderately safe with few parameters above WHO standard. Boreholes at the auditorium, and poultry are safe for drinking and other domestic uses.

**Recommendations**

The following recommendations are drawn from this research work:

- Seasonal variation of borehole water may affect the physicochemical parameters when tested; it hinders the bacterial process and much more. Therefore further research for quality assessment of borehole water should be carried out in rainy season period of borehole water in the Umaru Ali Shinkafi Polytechnic Sokoto main campus
- The school management should instruct borehole management committee together with the school health authorities to monitor anthropogenic activities near the boreholes and carry out a weekly sanitary inspection to maintain the hygiene.
- The turbidity of BHCES, BHADME, BHADMS, BHAHCRM need to be checked monthly for appropriate purification.
- The public should be enlightened on the need to allow debris and other particles to settle down at the bottom of the water container before use.
- BHCES and BHBGH should be given priority for domestic use like washing, bathing, flushing toilets, laundry, etc.

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