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*Short Communication*

# Seasonal variation of some physico-chemical properties of borehole water in Abraka, Nigeria

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**The influence of seasonal changes on the properties of the borehole water in Abraka Ethiope east LGA Delta state, Nigeria was investigated. Composites samples from 7 representative quarters in Abraka township were collected and assessed for both dry and wet seasons. The vales of the various parameters were as follows: pH 6.3 to 7.1 for dry season and 6.2 to 8.00 for wet season; conductivity 62 to 84 µs/cm for dry season and 57 - 67 µs/cm for wet season; total suspended solids (TSS) 7.21 to 12.11 mg/L for dry season and 11.33 to 14.30 mg/L for wet season; total dissolved solids (TDS) 0.0 to 2.11 mg/L for dry season and 0.39 to 7.11 mg/L for wet season; biological oxygen demand (BOD) dry season 1.44 to 2.68 mg/L for dry season and 0.26 to 1.53 mg/L for wet season. The values for the trace metals and other parameters were within the WHO permissible limit for drinking water. The water is therefore portable.**

**Key words:** Physico-chemical properties, borehole water and seasonal variation.

## INTRODUCTION

Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formation (Anonymous, 2009a). This is the water that percolated downward from the surface through the soil pore. Ground water is naturally replenished by surface water from precipitation, streams and rivers. Groundwater is not as susceptible to pollution as surface water but once polluted restoration is difficult and long term (Henry and Heinke, 2005). Groundwater contamination occurs when man made products such as gasoline, oil, road salts and chemicals get into the groundwater and cause it to become unsafe and unfit for human use (Anonymous, 2009b). Generally rural dwellers rely on groundwater as drinking water and for other domestic chores since it does not generally require treatment. The problems of water in the Niger Delta are not that of availability but of portability (Efe et al., 2005). The water quality of borehole is generally neglected based on the general belief that it is pure through the natural purification process. There is inadequate information or knowledge of the quantity, quality and pattern of distribution of Nigeria's water resources (Ayoade and Oyebande, 1983). Due to the absence of municipal water supply, many of the inhabitants of Abraka, in Delta State of Nigeria depend on boreholes for their need. This work examines the influence of seasonal variation on the physicochemical qualities of water from boreholes in this area.

## EXPERIMENTAL

Abraka lies at a height of about 45 m above sea level and between longitude 06° and 06° 15' E and latitudes 05°45' and 05°50' north (Ejemeyovwi, 2006). The rainfall varies from 1778.0 - 2,032.0 mm and spread over 11 months but it is heaviest in the May, June, July, September and October (Ejemeyovwi, 2006).

Water samples were collected from 7 area of the town representing the various quarters. The choice of location was guided by availability of borehole. Two litres of each of the water samples from the borehole from each quarter was taken to give a composite sample. Two litres of this was the sample used for analysis. Samples were taken in both the dry and wet season. The containers used for collection and storage had been previously washed and rinsed with 5% nitric acid and then thoroughly rinsed with deionised water. The samples were put in plastic bottles and were preserved in a freezer at 4℃ pending analysis. Samples for heavy metal determination were acidified *in situ* with 5 ml $HNO_3$.

Non conservable parameters such as pH, temperature and electrical conductivity were determined at the time of sampling. Water chemical analysis was done using standard analytical procedures (APHA, 1995). The pH of water sample was measured with a pH meter previously calibrated with buffer solutions. Conductivity was measured with a conductivity meter calibrated with potassium chloride solution. Temperature was measured with a thermometer. Alkalinity was determined by titrating a known volume of water sample with 0.02 M HCl. Total dissolved solid (TDS) was determined gravimetrically by evaporating a known volume of water

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**Table 1.** Physicochemical characteristics of water during the dry season. Results are given in range ± mean.

| Parameter | Dry season | | Wet season | | WHO standards |
|---|---|---|---|---|---|
| | Range | Mean | Range | Mean | |
| pH | 6.3 - 7.1 | 6.8 | 6.2 - 8.00 | 6.9 | 6.5 - 9.0 |
| Temperature (°C) | 25 - 29 | 27 | 27 - 29 | 28.5 | 30 - 32°C |
| Conductivity (µs/cm) | 62 -84 | 71.4 | 57 - 67 | 60.5 | 100 |
| TSS (mg/L) | 7.21 - 12.11 | 9.66 | 11.33 - 14.3 | 12.44 | 30 |
| TDS (mg/L) | 0.0 - 2.11 | 0.85 | 0.39 - 7.10 | 3.89 | 500 mg/L |
| DO (mg/L) | 5.9 - 9.66 | 7.68 | 7.70 - 10 - 20 | 7.09 | 7.5 |
| BOD (mg/L) | 1.44 - 2.68 | 2.16 | 0.26 - 1.53 | 1.23 | 20.40 |
| Total hardness (mg/L) | 00 - 0.8 | 0.3 | 0.00 - 6.90 | 1.30 | 200 mg/L |
| Alkalinity (mg/L) | 1.0 - 1.3 | 1.19 | 1.0 - 1.70 | 1.3 | 500 mg/L |
| Fe (ppm) | 0.01 - 0.06 | 0.03 | 0.01 - 0.04 | 0.02 | 0.03 |
| Pb (ppm) | 0.02 - 0.04 | 0.03 | <0.001 - 0.003 | 0.001 | 0.01 |

to dryness in a reweighed crucible on a stream bath. Total suspended solids (TSS) were determined by filtering a known volume of sample through a thoroughly dried filter paper and the residue weighed. Total hardness was deteremined by titration with EDTA using Eriochrome black T as indicator. Biochemical oxygen demand (BOD) determination was BOD = $DO_1$ - $DO_5$. Heavy metal was determined by digesting a known volume of water sample with analytical grade $HNO_3$. This was filtered into 20 ml standard flask, made up to mark with distilled- deionized water and stored in a nitric acid prewashed polyethylene bottle in the refrigerator prior to analysis. Metal analysis was carried out using an atomic absorption spectrophotometer. Each sample was analysed in duplicate and the average of results reported. General laboratory quality assurance measures were maintained.

## RESULTS AND DISCUSSION

The quality of water resources depends on the management of the water sources. This would include anthropogenic discharges as well as the natural physico-chemical properties of the area. This study area as described by Ejemeyovwi (2006) as an emerging urban area could be experiencing some deteriorating water quality resource associated with an unplanned urban area. The results of the seasonal variation of some physico-chemical parameters and selected heavy metals in borehole water are presented in Table 1. The pH for the dry season ranges between 6.3 - 7.2 with a mean of 6.8 while that of the rainy season ranges between 6.2 - 8.00 with a mean of 6.9. This water result would be regard as neutral in both seasons. These values are within the permissible level of WHO drinking water standards. According to Fakoyode (2005), such pH that is near to neutral is indicative of unpolluted water. The total suspended solid (TSS) relatively measures the physical or visual observable dirtiness of a water resource. The TSS of the water in the study area range from 7.21 - 12.11 mg/L with a mean of 10.2 mg/L for dry season and a range of 11.33 - 14.30 mg/L with a mean of 12 - 44 mg/L for raining season. It was observed that the raining season values are a bit higher than that of the dry season. The low levels as compared with the WHO standard are quite understandable as groundwater has passed through some natural filters and borehole water is extracted by filter aided mechanical pumps. The total dissolved solids (TDS) are an indication of the degree of dissolved substances such as metal ions in the water. Dry season range between 0.0 - 2.11 mg/L with a mean of 0.85 mg/L while the raining season has range between 0.39 - 7.10 mg/L with mean of 3.89 mg/L. The raining season values are higher which could be due to some form of leachate. The values for both seasons are far below the WHO permissible value. Dissolved oxygen (DO) is very crucial for survival of aquatic organisms and it is also used to evaluate the degree of freshness of a river. The DO mean value of dry and wet season is 7.68 and 7.09, respectively, and is quite adequate and within the WHO permissible limit. The water studied is all soft since they had value below 75 mg $CaCO_3$/L. The trace heavy metal levels are all below the WHO permissible level. In conclusion, the borehole water under study is all portable.

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