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Electrical Conductivity of Water in Some Selected Areas of Delta State, Nigeria

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Abstract: *The electrical conductivity of water estimates the total amount of solids in it. Hence determines the water quality. The water samples were collected during the raining season from four selected locations of Abraka, Oleh, Ozoro and Warri. The samples were analyzed for electrical conductivity (µs/m), pH, TDS (mg/l), TSS, Turbidity (NTU), Iron content (mg/l), salinity (Cl^-) mg/l, and Nitrate Nitrogen (NO_3N) mg/l. The concentrations of investigated parameters in the water samples were within the permissible limits of the world health organization. However, the pH values of river water samples from Oleh call for concern as all water analyzed were acidic, and indicated corresponding high values in electrical conductivity and iron content, thus there is need to periodically examined water for their pH, total iron content, electrical conductivity to avoid health hazards associated with these parameters.*

Keywords: *electrical conductivity, water quality, turbidity, salinity, water pollution*

I. Introduction

The electrical conductivity of water estimates the total amount of solids in water. Hence, could be used to determine the water quality. Assessment of water quality is very salient for knowing its suitability for different uses (Choubey *et al*., 2008). Urbanization, rapidly growing human population and industrialization results in increase of waste water discharge into fresh water ecosystems and the release of pollutants into the atmosphere, thus impairing water quality, sometimes to an unacceptable level, thereby, limiting its beneficial use (Tanimu *et al.*, 2011).

Water is one of the most important constituents for healthy living of human society. In Delta State, some people in the areas investigated depend on ground water, surface water and rain water for both drinking and domestic purposes.

Water pollution has been reported for several urban centres around the world (cross, 1980; Rivett et al., 1990; Shahin, 1988; Sharma, 1988; Gosk et al., 1990). A wide range of pollutants has been identified: heavy metals, phenols, cyanides, pesticides, chlorinated hydrocarbons. Continuous and high frequency monitoring of streams to improve the understanding of the river water quality can be expensive; there is, therefore, a need to develop an economic and effective method for continuous estimation of nutrients in streams and other sources of water (Gali et al.,2012). Electrical conductivity is a measure of a solution's ability to conduct a current and has been used widely to measure soil salinity, clay, and water content (Kachanoski et al., 1988;

Williams and Hoey, 1987), soil nutrient levels (Rhoades et al., 1989), total dissolved solids in solution (Hem, 1985), as an indicator of concentration of soluble ions in glacial melt studies (Collins, 1979) and in hydrograph separation studies (Heppell and Chapman, 2006; Pellerin et al., 2008). The use of Electrical Conductivity data as a surrogate to estimate nutrient concentrations in streams would be ideal as it is an inexpensive approach. The goal of this study is to investigate electrical conductivity as a tool for measurement of water quality.

II. Material and methods

Study area: The study area comprises of four major towns in different local government areas (Ozoro in Isoko North, Oleh in Isoko South, Abraka in Ethiope East and Warri, Warri South) of Delta State. One thing common to these towns is that directly or indirectly petroleum exploration activities take place in and around these areas which may have contributions to the quality of water samples analysed. The area experience wet and dry season which are typical seasons in Nigeria (Eteng Inya , 1997; Etu – Efeotor,1998). The geology consist of sand, sandstones, gravel and clay (Tchokossa et al.,2013).

Sample collection

A total of 4 samples were collected from each location in clean acid free plastic bottles from four different towns of Delta state, Nigeria. All the water samples were collected consecutively within two days in July, 2014. Rain water samples were collected directly (not from roofs) in plastic bottles with funnel and were placed on an object 1 metre above the ground level. This was done to ensure that the rain water is free from possible contamination from the ground. The taps were allowed to run for about 30 seconds before samples of borehole water were collected into bottles. Well water samples were collected using clean fetching bucket at different sites. Stream/ river water samples were also collected from these four locations. All samples were properly covered, carefully labeled and were taken the laboratory for analysis.

Physio-chemical Analysis

The collected samples were analyzed for major physical and chemical water quality parameters like pH**,** Electrical conductivity (EC), Total Dissolved solids (TDS), Turbidity (NTU), Fe^{2+}**,** nitrate nitrogen as per the method Assessment of Ground Water Quality described in "Standard methods for the examination of water and wastewater American Public Health Association (APHA,1995).The parameters present in the water sample can be calculated by using various methods (Manivasakam,1996) . The pH of all the water samples was determined using a pH meter. Electrical conductivity was measured using a conductivity meter.

Results

Table1 shows the result of the physiochemical analysis of various samples

Location	Sample code	pH	Electrical conductivity(µs/m)	Temp (^{0}c)	TDS (mg/l)	TSS	Turbidity	Fe^{2+} (mg/l)	Total iron content
Warri	RW1	6.8	15.0	28	792	7	1.5	0.25	0.50
	BW1	7.2	14.8	28	752	1	1.0	0.19	0.20
	WW1	8.5	14.4	28	794	4	1.5	0.31*	0.50
	RV1	8.2	31.2	28	1661*	8	2.5	0.33*	0.90
Abraka	RW2	5.4	15.5	28	780	6	1.0	0.18	0.46
	BW2	7.8	15.2	28	766	1	1.0	0.2	0.30
	WW2	6.2	15.0	28	755	6	1.5	0.22	0.30
	RV2	7.7	28.9	28	1452*	7	1.5	0.36*	1.20
Ozoro	RW3	6.1	13.1	28	656	7	1.0	0.22	0.33
	BW3	6.9	12.9	28	650	1	1.0	0.02	0.12
	WW3	7.3	11.9	28	601	4	1.3	0.26	0.35
	RV3	6.2	27.6	28	1392*	7	2.0	0.36*	1.40
Oleh	RW4	8.2	16.2	28	842	6	2.0	0.29	0.40
	BW4	7.1	14.9	28	760	2	1.0	0.25	0.28
	WW4	6.5	21.0	28	1049*	3	1.7	0.29	0.40
	RV4	8.6*	28.1	28	1411*	6	2.5	0.39*	0.80
	Mean	7.2	18.5		945	5	1.5	0.26	0.53

* above WHO limits

III. Discussion

Electrical Conductivity

From the result of analysis the mean electrical conductivity is 18.5 µS/m in the range between 11.9 to 31.2 µS/m with RV1 indicating the highest value as shown in fig.1. the least value of electrical conductivity was in WW3.

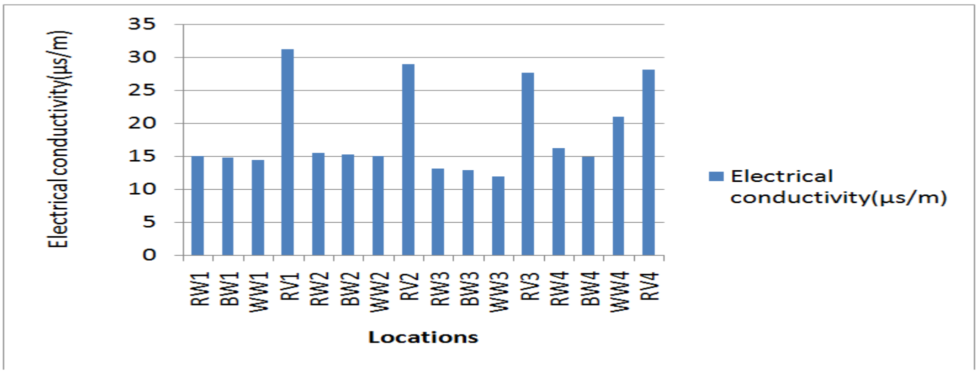

Fig. 1 Plot of Electrical conductivity of samples by Location

Total Dissolved Solids (TDS)

The TDS of samples analyzed indicated a trend in that high values of electrical conductivity showed corresponding high values in TDS of same samples. The mean value of TDS was 945μS/m with the highest value in RV1 and least in WW3 in fig.2.

Water from these rivers is of low quality since the Electrical conductivity and TDS are high. This might be as a result of indiscrimate waste disposal in these rivers. Also well water ww4 indicated high values of Electrical conductivity and TDS.

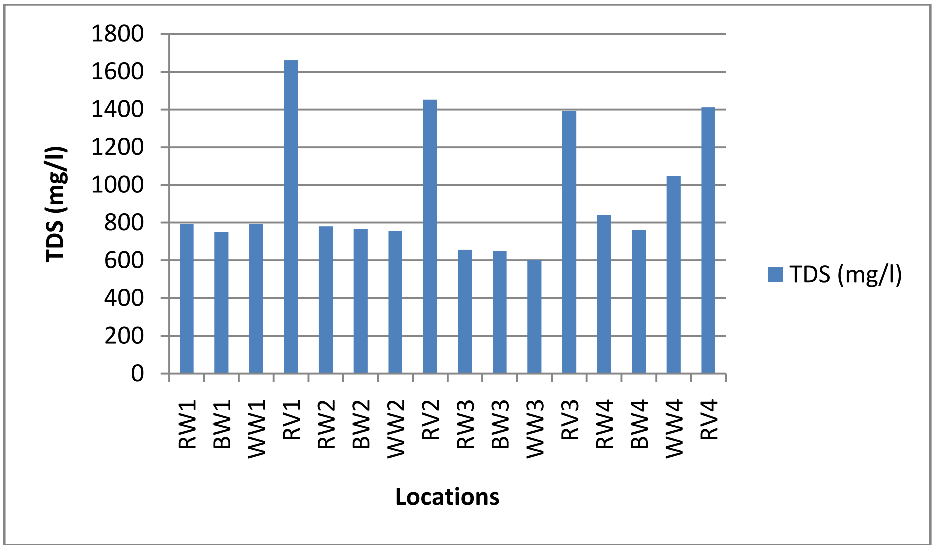

Fig. 2 A Plot of TDS of samples by Location

Iron content

WHO (1996; 2007) set the maximum permissible limits of iron (0.3mg/l) in water. All the water samples analyzed in this work were not fully within these limits; however it will pose no danger to consumers as these values are concerned.

IV. Conclusion

The TDS in mg/l of the four rivers sampled were above WHO permissible limits for water and have the high corresponding electrical conductivity values. The mean electrical conductivity is 8.5 μS/m with highest value in samples from Abraka river (RV3). This study reveals that electrical conductivity is a sufficient parameter to determine the quality of water in terms of physiochemical properties, and is cost effective and time saving. Through extensive monitoring over long period, data in this study area, better relationships can be developed resulting in a possible method for estimating more accurate determination of water quality.

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