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Physico-Chemical Parameters and Heavy Metal Content of Akpajo River, River State

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ABSTRACT

The aim of this study was to determine the present quality of the Akpajo River using some physico-chemical parameters in waters and heavy metals concentration in water. The study was carried out from January to December, 2013. The physico-chemical parameters in water were analyzed in situ with Horiba checker model U.50. The results showed that dissolved oxygen ranged from 8.1 – 12.6mg/L, with a mean of 10.33mg/L, temperature ranged from 27.0 – 29.60C with a mean density of 28.420C, salinity range from 7.6 – 11.4ppt, with a mean density of 9.20ppt, hydrogen ion concentration (pH) ranged from 72 – 80, with a mean of 8.00, turbidity ranged from 39.1 – 60.3NTU with a mean density of 48.43NTU. The concentrations of the heavy metals in water were also analyzed using Atomic Absorption Spectrophotometer (AAS). The result of the heavy metals analysis in surface water were: Hg (0.001 – 0.003mg/L), Pb (0.04 – 0.08mg/L), Cd (0.1 – 0.15mg/L), Cr (0.1 – 0.11mg/L), Cu (4.4 – 5.9mg/L) and Zn (14.8 – 20.3mg/L). The result further showed that mercury, lead, cadmium, chromium, copper and zinc exceeded the Maximum Contaminant Limit (MCL) of the World Health Organization (WHO) and Environmental Protection Agency (EPA). The concentration levels of most of the heavy metals in water are above the international standards and are an indication that the river is polluted and needs remediation.There should be consistent monitoring of the physic-chemical parameters and heavy metals of the river by appropriate authority.

INTRODUCTION

Aquatic pollution has become one of the major challenges of man on planet earth since the advent of industrialization. In organic chemical substances from industries associated with petroleum exploration, mining, construction, fabrication, refining and agriculture find their ways into aquatic environment either through point sources or non-point sources, thereby contaminating the water to the detriment of aquatic biota, the phytoplanktons, zooplanktons, macrophytes, zoobenthos, amphibeans, birds, mammals including humans (Sikoki, 2013).

A favorable aquatic environment is enhanced by good water quality. The quality of water bodies are determined by the levels of concentration of the physico-chemical parameters. The major ones are temperature, dissolved oxygen, biochemical oxygen demand, salinity, hydrogen ion concentration (pH) and turbidity (Murhekar, 2011, APHA, 1985 and Babalola and Ageba, 2013).

Variations in these parameters influence to a great extent, the composition, distribution and existence of aquatic biota in an aquatic ecosystem (Salvam, et al., 2013).

The quality of a water body affects species composition, assemblages and distribution of planktons, benthos, fish fauna, macrophytes and other aquatic inhabitants (Onwugbuta-Enyiet al, 2008). FGN (1988) asserted that the increase in the population of man and the activities of industries around the coastal environment is greatly affecting the neutrality of water system and are capable of putting stresses on natural waters by impairing both the water quality and hydrological budget.

Water quality also involves the measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by references to a set of standards against which compliance can be assessed. The most accurate measurements of water quality are made on-site because water exists in equilibrium with it's surrounding (Lawson, 2011). This study is aim at water quality assessment of Akpajo River in Rivers State, in relation to seasonal and spatial variation of Akpajo – River.

STUDY AREA

The Akajo-ElemeRiveris located in Akpajo town in Eleme Local Government Area of Rivers State in the Niger Delta of Nigeria. The river lies between latitude 4049' – 40056'N and longitude 7004' – 7005'E. It has brackish water, and tidal mudflats, some ripper palm and other macrophytes. The Akpajoriver is of economic importance to the people in the neighbourhoodand other settlements at the riversides. The river also serves as a waterway to Okrika, Woji and other suburbs of Port Harcourt. The flourishing fishing business there has attracted other economic activities to the area. Sand excavated from the river are supplied to the entire Eleme and Port Harcourt Metropolis. A total of five different stations was used in the sampling process for wet and dry season (fig 1).

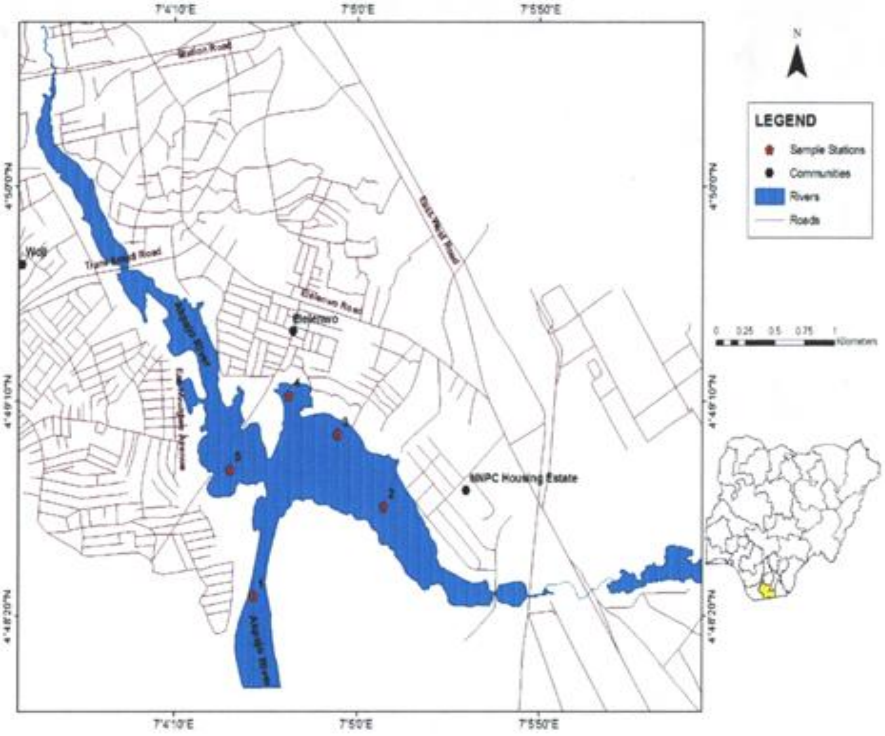

Figure1. *Map of Akpajo River Showing Sample Stations*

MATERIALS AND METHODS

Samples were collected in clean laboratory bottles and containers using appropriate measures and procedures. Water samples for temperature, dissolved oxygen (DO), salinity, pH and turbidity were analysed in situ (on site) with Horiba water checker U-50. The sample for biochemical oxygen demand (BOD) was stored in milder reagent of a dark room at 200C for five days. Water samples were put into the Horiba checker and the various parameters were determined.

The extract in the solution were analyzed for the various heavy metals namely: mercury, lead, cadmium, chromium, copper and zinc using atomic absorption Spectro-photometric methods (A.A.S), the samples were chemically digested using routine laboratory methods.

In a 150ml conical flask made up of borosilicate glass, 50ml distilled water was added to 5.0ml of conc. Hcl. The mixture was heated on a hot plate to evaporate gradually at 950C.

RESULTS

The results of the mean variation of physico-chemical parameters of the surface water and heavy metal concentration in water are presented in table 1 and 2 and Figure 2 and 3. Water samples from Akpajoriver were determined during the 12 months (January to December 2013). Sampling periods at five sampling stations (S-1 to S-5) showed that surface water temperatures ranged from 270C to 310C, fluctuations in water temperatures occurred due to seasonal changes. The pH (Table 1) of the surface water ranged from 7.2 to 8.9. Dissolved oxygen, turbidity and biochemical oxygen demand increases as follows: DO (8.1 – 12.6mg/L), Turbidity (39.1NTU – 60.3NTU) and BOD5 (1.2mg/L – 4.3mg/L) (Table 1), while salinity ranges from 7.6‰ – 11.4‰. (Table 1) (Fig 2)

Table1. *Monthly summary of mean variation in physico-chemical parameters*

Month	DO (mg/L)	Temp. (0C)	Salinity (‰)	pH	BOD	Turbidity (NTU)	Mean	S.D	S.E	Mean ± S.E
JAN	8.1	30.6	10.4	7.2	4.3	39.1	16.62	14.51	5.92	16.62±5.92
FEB	8.6	29.0	9.4	7.5	3.5	40.1	16.35	14.67	5.99	16.35±5.99
MAR	8.7	28.4	9.6	7.4	3.5	40.0	16.27	14.52	5.93	16.27±5.93
APR	8.3	29.6	8.5	8.2	3.0	49.8	17.90	18.17	7.42	17.90±7.42
MAY	9.7	28.1	10.1	8.4	3.4	54.6	19.05	19.35	7.90	19.05±7.90
JUN	12.6	27.0	7.6	8.5	2.5	60.3	19.75	21.54	8.79	19.75±8.79
JUL	12.1	27.2	9.0	8.3	3.0	52.3	18.65	18.40	7.51	18.65±7.51
AUG	9.9	28.0	9.1	7.5	2.6	44.8	16.98	16.15	6.59	16.98±6.59
SEP	12.3	27.5	7.8	8.3	2.1	55.8	18.97	19.98	8.16	18.97±8.16
OCT	9.9	27.0	9.0	8.4	1.2	50.9	18.15	18.17	7.42	18.15±7.42
NOV	12.3	27.5	8.5	8.9	1.5	52.1	18.47	16.60	7.59	18.47±7.59
DEC	8.9	31.1	11.4	7.4	3.1	41.4	17.22	15.34	6.26	17.22±7.59
Mean	10.33	28.42	9.20	8.00	2.81	48.43				

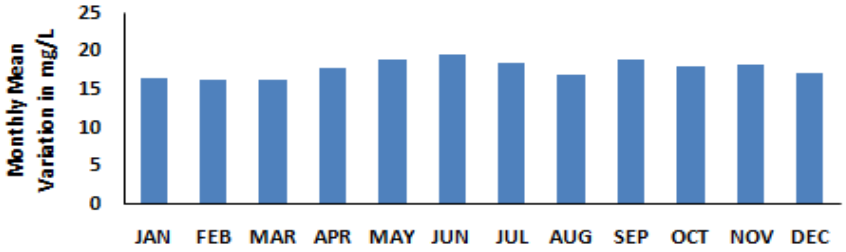

Figure2. *Monthly Summary of Mean Variation in Physico-chemical parameters*

The results of the mean value of heavy metals concentration of surface water showed that zinc (Zn) concentrations in water were higher than the values for the other metals. Dry season recorded higher concentrations for all the metals than the rainy season. Mercury concentration in the rainy months ranged from 0.002mg/L-1 to 0.001mg/L-1. The highest values of mercury were recorded in the month of July and September 2013 (0.002mg/kg). The concentration of copper was highest in the month of May (32.7mg/L-1) and lowest in January (27.3) Table 2 (Fig. 3).

Table2. *Mean variation of heavy metals concentration in water (mg/L)*

Month	Hg	Pb	Cd	Cr	Cu	Zn	Mean
JAN	0.002	0.06	0.12	0.11	4.4	15.5	3.37
MAR	0.003	0.07	0.12	0.1	5.0	14.8	3.35
MAY	0.002	0.04	0.15	0.11	5.9	18.3	4.08
JUL	0.002	0.08	0.1	0.1	5.4	18.1	3.96
SEP	0.001	0.06	0.1	0.09	5.0	17.9	3.86
NOV	0.001	0.09	0.11	0.1	4.6	20.3	4.20
Mean	0.002	0.067	0.117	0.102	5.050	17.483	

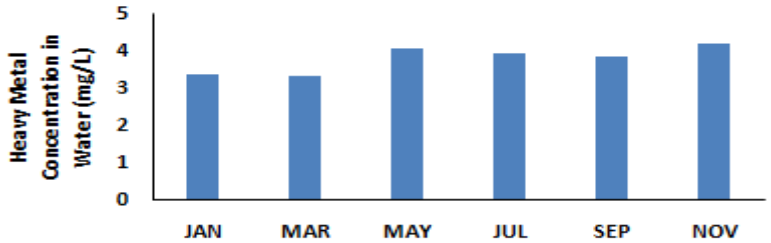

Figure3. *Mean Variation of Heavy Metal Concentration in Water mg/L*

DISCUSSION

The fall in oxygen concentration may have been caused by the use in temperature due to depressed rainfall and increase in organic load in the water body with corresponding increase in BOD and DO. The highest salinity recorded for the months of January and December which are of the dry season is attributed to lack of floods and rains within the period which are capable of diluting the salinity levels of the wet season. Turbidity had the highest value in the months of May and September which are of the wet

season, while those of the dry season months of January, February and December recorded the lowest levels of turbidity in the river. These results agree with several reports within and outside the Niger Delta (Nwibari, 2011 and Francis, 2003). The highest temperature values recorded in the dry season also synchronizes with the report of Babalola and Agbebi (2013) on Kuramo Lagoon, Lagos Nigeria. The low temperature in the wet season is attributed to the effect of runoff as mentioned by Chapman (1996).

Only six of the heavy metals were studied and responded to seasonal changes with regards to their respective concentrations in surface water. Higher concentrations were recorded during the season. Cadmium (Cd), Zinc (Zn), Iron (Fe) and Chromium were recorded in both season, while Mercury (Hg) level was below detectable limit (BDL) in all the months of the rainy season sampling. Lead (Pb) was detected in the month of May with a very negligible value.

The study also observed gradual deterioration in the water quality of AkpojiRiver, this condition was noted to be one of the consequences of gross pollution in the water body. It is evident that specific research must be carried out into the problem of how flora and fauna of marine coastal and estuarine waters can survive under environmental conditions made progressively less suitable as a result of sea water pollution caused by human activities.

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