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Investigation of Pollution State of Aba River along Its Course Using Pollution Index.

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Abstract: *An investigation on the pollution state of ABA RIVER along its course at designated stations Up Stream ABA River (USAR), Paterson Zochonis(PZ),Nigerian Breweries Limited (NBL),Abattoir (ABT) and Down Stream ABA River,(DSAR) stations were studied. Results obtained of some physico- chemical parameters revealed a mean pollution index of 2.3595 at the USAR,2.5065 at PZ,2.7518 at NBL,2.6212 at ABT and 2.6294 at DSAR respectively .For the stations studied it was found that the pollution indices exceeded the WHO set critical value of 1.0 for surface waters. Analysis was also conducted for some heavy metals on the ABA River for the period of June2014 through to March 2015 and the results revealed that the presence of Cu was greatly significant at the Abattoir station in the month of August/September of the year 2014 with a mean value of 4.482mg/l; WHO value for Cu being1.0mg/l. Cr at NBL in the same period had mean concentration value of 1.084mg/l for Cr WHO set limit is 0.05mg/l ;Fe for entire period under investigation at all the stations along the river had mean concentration values exceeding the WHO set value of 0.3mg/l by several thousand times, with a range of 20.7mg/l minimum to 77.287mg/l maximum. Cd min 0.015mg/l to max 0.098mg/l ,WHO set limit for Cd is 0.003mg/l ;Zn at ABT and DSAR had respective maximum values of 7.6244mg/l and 7.4082mg/l ,WHO set limit being 5.0mg/l; Ni ranged 0.05mg/l min to 0.304mg/l max, WHO set limit being 0.02mg/l ; Pb ranged min 0.04mg/l max 5.73mg/l ,WHO set limit is 0.05mg/l ; Mn ranged min 0.688mg/l max 13.274mg/l at ABT station, WHO set limit is 0.5mg/l. These values confirm that ABA river was highly polluted due to industrial discharges and other human activities along its course.*

Keywords: *Aba River,Physico-chemical Parameters,Pollution.*

I. Introduction

Water is the sustainer of life on planet Earth atmosphere .Life cannot be sustained without water. There are many sources of water to humans which include lakes, streams, rivers, spring and pond waters. Over a period of time man has learnt to help himself out with bore holes where the availability of water is not near to the surface.(Adebusi,1981).

The presence of some materials in water that disturb the normal use of water is termed pollution/pollutants. A number of factors contribute to this and include human, animal, and agricultural activities. Nature do play some significant roles in the provision of pollutants in water bodies in different forms. When water gets contaminated it becomes less useful to man, animal and agriculture. In some situations the water might not be used by the construction industries(Martin et al,1998). This contamination in most cases changes the physical, chemical and biological properties of water .There are many sources of pollutants in the aquatic ecosystem. These include substances that add disagreeable taste and odor to the water. Some do upset the ecosystem but may not affect man directly while some others may indirectly be harmful to humans and cause damage. Among the substances that cause damage to water include Oxygen demanding wastes, disease causing agents, plant nutrients, synthetic organic compounds, oil , radioactive materials, heat, inorganic chemicals, and mineral substances. Heavy metals and toxic materials which include Mercury, Arsenic ,Lead, Cadmium, and Copper. These substances do bio accumulate at the lower beds of rivers in water sediments. These metals may be taken from one site to another by aquatic organisms (Aremu,2002).

1.1 Pollution Index:

Pollution Index is calculated from the equation: $Pij = \sqrt{\{[(Max\ C\ i / lij)^2 + (Mean\ Ci / lij)^2]/2\}}$. The relative values of Ci / lij is the expression of pollution index by Horton(1965). I is the number of ith item of the water quality and j is the number of jth water used. Each value of (Ci/lij) shows the relative pollution contributed by the single item. A value of 1.0 is the critical value for each (Ci/lij). Values greater than 1.0 indicates that the water requires some special treatment before use for specific purpose.

The pollution Index of ABA River was determined based on the water quality index by Horton along the course of the river at designated stations over the period June 2014 through to March 2015. Egereonu et al .2010 had done similar work on Ndibe river and ground waters in Afikpo area of Nigeria.

II. Materials And Methods

2.1 The Study Area.

The ABA River is located on Longitude 7^0 19^E to 23 ^{1} and Latitude 5^0 05^l to $5^0 10^l$N in ABA ,ABIA , State ,Nigeria. The river runs through the industrial layout of the commercial city of ABA. Industrial effluents flow into the river from the numerous industries dotted along the river sides . Agro-based industries , abattoirs , vegetable farms, dying centers, poultry and piggery farms. The river flows into Azumini River through to the Cross River in Cross River State to the Atlantic Ocean. The river joined the Imo river in its North –South direction flow and it is re charged by precipitation and ground water. This river is used for many human activities including car washing, domestic rearing of farm animals and fishing. Among the industries that do discharge their effluents directly into the ABA river include Nigerian Breweries limite, (NBL) ,Paterson Zochonis (PZ),Abattoires, Hotel and eating homes.

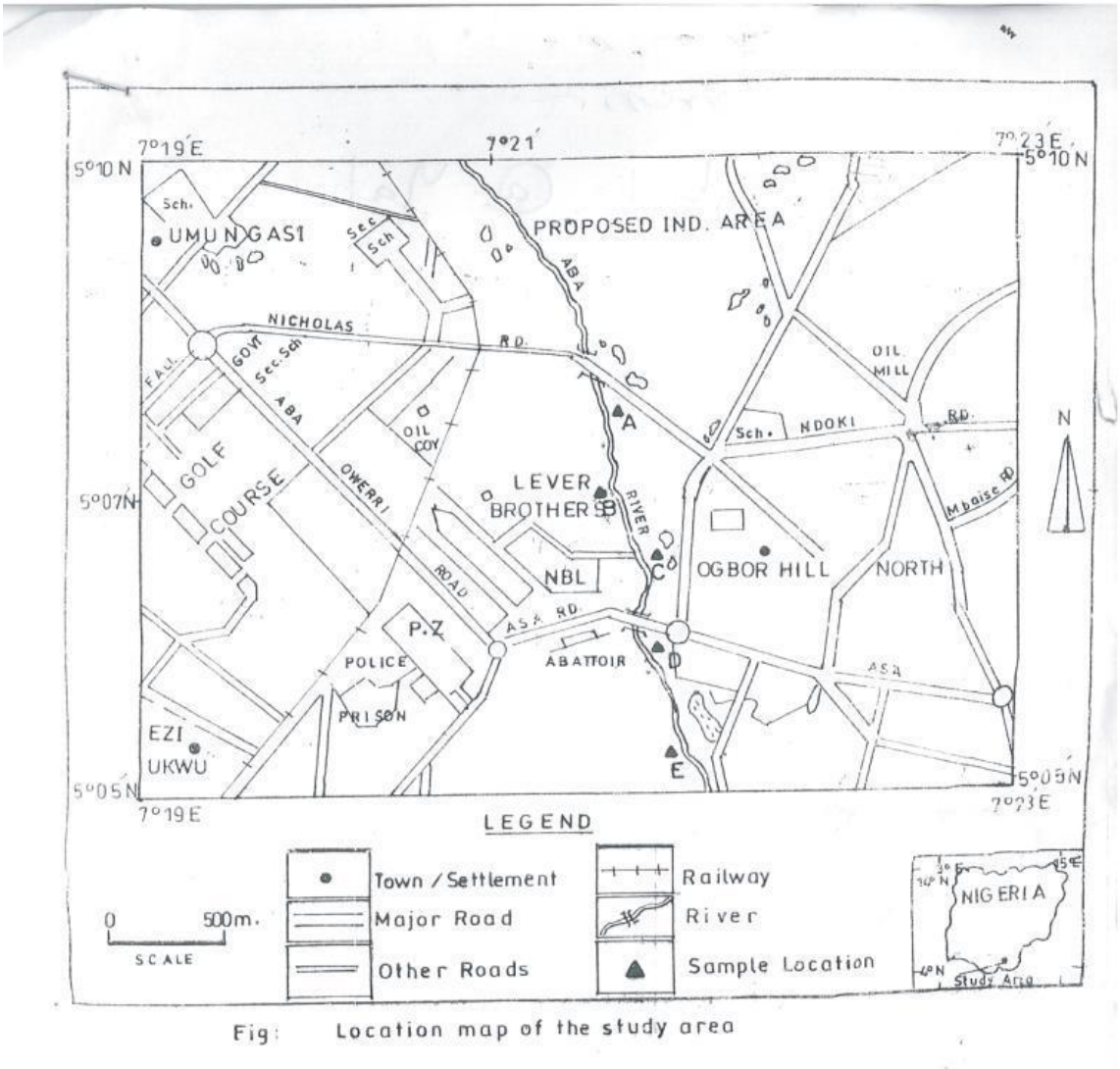

Fig: Location map of the study area

2.2 Sampling

The sampling sites were established along the river banks and mid stream in areas filled with human activities within the ABA metro polis . The sites were also selected based on accessibility of the sites and ease of collection of samples. Samples were collected in labeled ,dated plastic bottles. These containers were initially washed thoroughly with concentrated Nitric Acid and rinsed severally with distilled water, finally with de-ionized water. At the site the containers were washed severally

with the water sample before collection .The mouth of the bottle was kept some few centimeters below the water surface and against the water flow allowing no air bubbles at a mid stream position from a fishing boat at a stand still position on the river. Amber glass bottles were used for the collection of $BOD_{5,}$ DO and COD samples.

2.3 Method of Analysis

Physico-chemical Analysis.

The analyses carried out included : Total Dissolved Solids, TDS; Electrical Conductivity, EC ;were determined using Conductivity/TDS probe meter. Nitrate ,Iron and Copper were determined using Data logging spectrophotometer at wave lengths 400nm,265nm,and 560nm respectively. Dissolved Oxygen was determined using DO meter probe. PH and Temperature were determined using SUNTEX probe meter .Phosphate was determined by photometrical methods at 690 nm while Sulphate was by gravimetric methods respectively. .Alkalinity was determined using colorimetric methods. Total Suspended Solids (TSS) and Turbidity were determined by Photometric methods at wave lengths of 810nm and 860nm respectively using the HACK DR/2010.The Biological Oxygen Demand (BOD) was determined by Winkler methods (Aremu,2010).

Table 1: Mean Physico-Chemica Parameters on ABA River June 2014 through March 2015.

Parameters/Site	USAR	PZ	NBL	ABT	DSAR	WHO
Chloride(mg/l)	85.00	80.00	182.30	140.00	122.60	250
Turbidity(NTU)	3.45	5.60	2.40	19.80	15.00	50
Alkalinity(mg/l)	17.93	15.00	13.60	22.33	17.63	-
pH	5.97	5.66	5.73	5.59	5.73	6.8-8.5
Acidity(mg/l)	178.68	134.70	116.80	178.40	120.26	-
T/Hardness(mg/l)	72.13	73.80	49.40	56.20	40.53	2.96
TDS(mg/l)	61.06	48.66	54.43	62.63	61.60	250.00
TSS(mg/l)	32.13	31.00	31.4	39.06	41.03	10.0
Conductivity	10.69	9.29	46.58	17.08	13.11	100.00 (µs/cm)
BOD(mg/l)	32.60	42.30	36.94	40.41	48.74	40.00
COD(mg/l)	204.30	182.00	252.00	195.60	157.30	120.00
TOC(mg/l)	40.40	38.90	37.87	45.40	42.80	_
DO(mg/l)	56.60	58.53	49.06	57.06	62.00	≥4.00
PO_4(mg/l)	1.996	1.519	1.301	1.501	1.727	100.00
NO_3(mg/l)	1.92	2.20	3.20	3.25	3.26	10.00
Temperature	27.60	26.86	26.81	27.21	27.31	(^{0}C)

WHO--__World Health Organisation

mg/l-- millgram per liter. NTU -- Nethelometri turbidity unit

It was observed from table 1, that DO, TOC, COD ,BOD, TSS, Total Hardness, PH and Acidity were very much above WHO set limits .These results confirms ABA River polluted.

Table2: Pollution Index of ABA River June 2014---March 2015.

Site/Time	June-July	Aug-Sept	Oct-Nov	Dec-Jan	Feb-Mar2015	Mean
USAR	1.3203	1.5528	3.9586	2.5728	2.4532	2 .3595
PZ	1.3500	2.2874	4.0626	2.3107	2.5065	2 .5065
NBL	1.9193	3.9506	2.4247	3.2111	2.7518	2. 7518
ABT	2.2681	2.8847	2.6807	2.5772	2.6212	2 .6212
DSAR	1.7407	2.6067	2.3839	2.1846	4.2313	2.6294

Table 3 gives an indication of pollution index as contributed by the respective agro based industries investigated that discharge their waste products into the ABA river as monitored from the designated points within the periods June2014 through to March 2015.

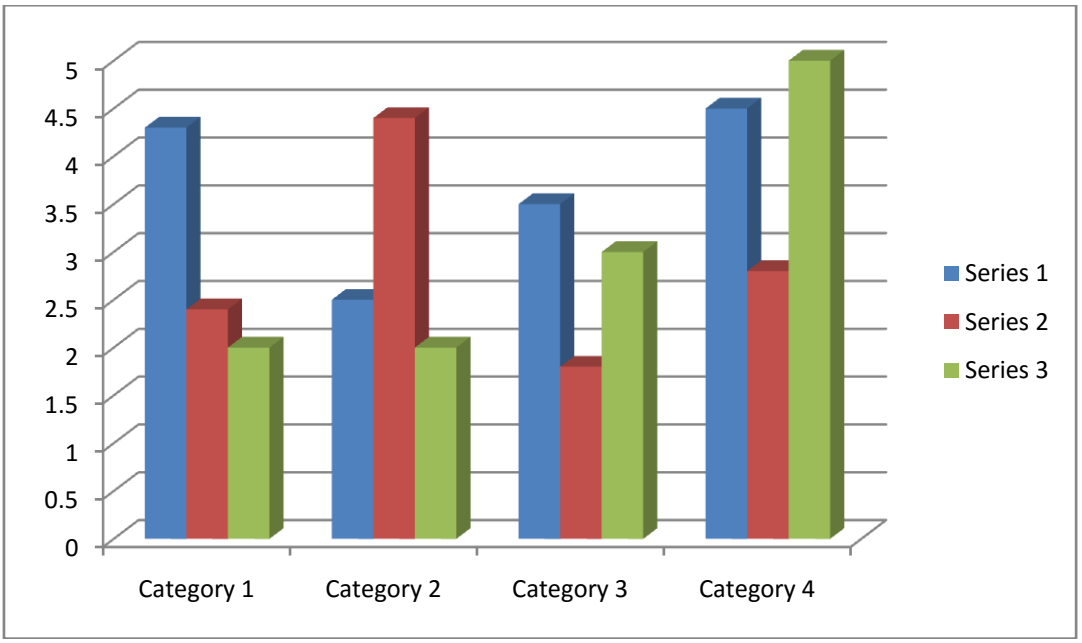

Fig 2

The pollution status of ABA River can described by the statistical histogram as being classified into three. The most significant manifestation is that all showed pollution index above 1.0 the critical World Health Organization (WHO) set value for safe drinking surface water. The first set had values a little above 1.5, the second a little above 2.5 and the last a little above 4.5 but less than 5.0.

Table 3 Mean concentration of Heavy metal on Aba River June2014 through to March 2015

Site / parameters(mg/l)	Cr	Zn	Ni	Pb	Mn	Cu	Cd	Fe
USAR	0.3018	1.1459	0 .1570	0.108	1.5588	0.1130	0.0536	50.7029
Pz	0.0738	1.7164	0.0660	0.036	0.8504	0.0944	0.0204	50.0936
NBL	0.2630	2.2146	0.0932	0.534	2.4048	0.1922	0.0376	56.8938
ABT	0.1962	3.8063	0.0450	1.3752	4.9636	1.2946	0.0316	57.7552
DSAR	0.1106	3.9903	0.1932	0.5298	2.9090	0.1710	0.0188	63.3880
WHO	0.0500	5.0000	0.0200	0.0500	0.5000	1.0000	0.0030	0.3000

At the Upstream(USAR) the mean pollution index ranged min 1.3203 to max 3.9586, the mean being 2.2772 ,this is an indication of highly polluted water body having exceeded WHO 1.0 critical value for surface water. At the Paterson Zochonis (PZ) the pollution index was found to range min1.3500 to max 4.0626, the mean being 2.5667, this result suggests that the pollution at this point was more than at the USAR. At the Nigerian Breweries Limited(NBL), the pollution index t ranged min 1.9193 to max 3.9506,the mean being 2.7649.This in turn indicates a higher pollution index than that at the PZ. At the Abattoir (ABT) the pollution index ranged min 2.2681 to max 2.8847with a mean of 2.6112.This still confirms high pollution index for the river and at the Down Stream(DSAR) the pollution index ranged min 1.7407 to max 2.6067,with a mean value of 2.2438.With these values the critical limit set by WHO was exceeded at all the designated stations tested.

III. Conclusion

From the results of the study the pollution index of the ABA River indicates that the ABA River is highly polluted and is presently to a large extent unsafe from the physic-chemical point of view for human consumption. There is therefore a dire need to properly manage wastes in the metropolis and control as well as monitor other human activities in general in other to ensure that the runoff water will have minimal effect on the ABA river.

Recommendation

It is recommended that direct discharge of these industries that are emptied into the ABA River be monitored on regular close intervals.

Making these information available to the relevant offices/government agencies that will utilize them in improving the Health status of the citizenry in ABA metropolis.

The Hazards the pollution status of the river might bring over a period of time needs be brought to the knowledge o f all that are within the course of the River.

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