



Effect of Brewery Effluent on Surface Water Quality of Ikpoba River, Benin City, Edo State

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Abstract-This study assessed the effect of effluent discharge from Bendel brewery on Ikpoba River in Benin City, Edo state. Water samples were collected from five sampling points located 200m apart downstream of the river from the point of discharge and monitored for two weeks in the month of September, 2013. The brewery effluent was collected at the final discharge point of Bendel Brewery limited located along Benin-Onitsha expressway and was preserved in a refrigerator to prevent microbial reaction. The following parameters were measured; sulphate, chromium, calcium, magnesium, Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), alkalinity, Total Solids (TS), Total Suspended Solids (TSS), Total Hardness, Total Dissolved Solids (TDS), Biological Oxygen Demand (BOD), conductivity, colour, turbidity, pH, iron, copper, zinc, chloride, and certain selected heavy metals. The one – way Analysis of variance (ANOVA) was used to determine homogeneity in mean variation of the physicochemical parameters across the sampling points at $P < 0.05$. Spatial variation plot were used to represent the levels of the physicochemical parameters across the sampling points.

Keywords- Effluent Discharge, Physicochemical Parameters, Contaminants, Surface Water Quality

I. INTRODUCTION

A. Background to the Study

Water resources are basic necessities in the existence of life on earth. In 1978, the UN reported consumable water levels at 2.7% of earth's water, with ground water being a major contributor. Present estimates quantify consumable water levels at 1%, ground water levels also being threatened by pollution either directly or indirectly (Davis and Cornwell, 1991). However, sustainable utilization of the earth's water is therefore being defined as the use of water resources which imposes no cost whatsoever on future generations, which might arise through depletion of the resource or through a reduction in its quality (Kehinde, 1996). Ikpoba River, a fourth order

stream, is located in Benin City, Edo State in South Western Nigeria (Lat 6.50N, Long 5-80E). Its headwater originates from North West of Benin City and flows north to south through the city (Benka-Coker and Ojior, 1995). The river flows through a dense rain forest where the allochthonous input of organic matter from the surrounding vegetation is derived through run-off from the surface of the soil. Ikpoba River empties into the Benin River system, the third largest in Nigeria. The river serves as a source of water for domestic purposes including drinking and cooking. Fishing activities also take place in the river. The water body receives a variety of wastes ranging from industrial, agricultural, domestic and natural sources. These wastes introduce foreign microorganisms, organic and inorganic matter, in addition to indigenous micro flora. The Oregbeni community flanks the river on one side behind Guinness Nigeria Plc and Bendel Breweries. The products of the brewery operations include large volumes of wastewater, conveyed over a distance of 2.5 km by an underground tunnel and discharged into the receiving river.

Increased industrial activities have led to pollution stress on surface water both from industrial, agricultural and domestic sources (Ajayi and Osibanji, 1981). Major streams in industrial areas of some Nigerian cities are already seriously polluted by waste from industries such as streams flowing through densely polluted areas of Ibadan. It has severally been noted that water is one of the most important substances on earth. People can only survive seven or less days without water.

Principally water for municipal supply is found from two sources; Surface water and underground water and the water found from rivers, lakes or other surface impoundments known as surface water. The water resources of our planet are the most threatened aspect in life existence. The drinking water sources are limited on earth. It has been stated that of 326 million miles of water on earth, fresh water, lakes and underground aquifers hold only 2.5 percent of the world water. (Soler-López, 1997, 2000) The remaining 97.75percent of the world water supply is salt water, ocean and seas.

II. RESEARCH METHODOLOGY

A. Research Design

This research will be both experimental and empirical in analyzing the methods used in both the effluent sample collections and its characterization of the physiochemical parameters present in the laboratory.

B. Presentation of Study Area

1) Location and Site

Ikpoba River is a fourth order stream situated within the rainforest belt of Edo State, southern Nigeria. The River rises from the Ishan Plateau in the northern part and flowing in south westerly direction in a steeply incised valley and through sandy areas before passing through Benin City and joining the Ossiomo River.

Edo State lies roughly between longitude 06° 04' and 06° 43'E and latitude 05°44' and 07°34' N.

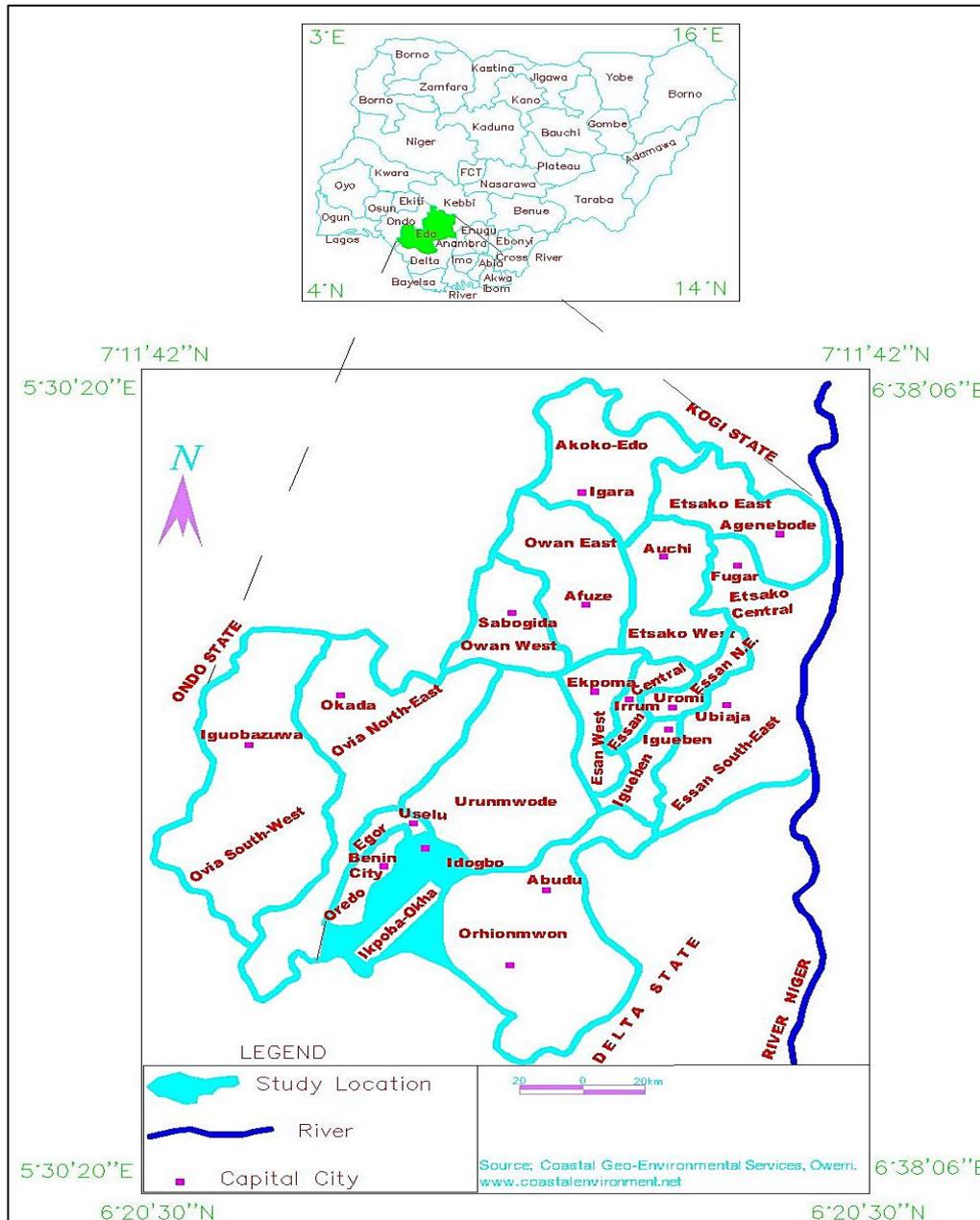


Figure 1. Map of Nigeria Showing Edo State and the Study Area

C. Sample Collection and Preparation

The Brewery effluent was collected at the final discharge point of Bendell brewery Ltd located along Benin – Onitsha express way and was preserved in the refrigerator to prevent/inhibit further microbial reactions.

D. Procedures for Determining the Physicochemical Parameters in Wastewater Experiment

1) Sulphate Determination

0ml of water sample was measured into a conical flask, 2ml of 2molar hydrochloric Acid (HCl) was added and 2ml of 0.5% Barium chloride was also added.

The mixture is allowed to boil for 5minutes then 10ml of ethylene diamine tetra acetic acid (EDTA) was added.

Observation: there was a color change from purple to green

Formula = $\{10 - \chi \times 0.93\} \times 96.01464$ (mg/L)

Where χ = Titre value (ml)

2) Chloride Determination

10ml of water sample (wastewater) was measured into a conical flask, 3 drops of potassium chromate indicator was added and titrated with 0.1M silver nitrate (AgNO_3). The end point shows a brown colour

Formula = $\text{Tv} \times 0.003546 \times 10^6$ (mg/L)

Where Tv = Titer value (ml)

3) Calcium Determination

10ml of the sample was measured into a conical flask, a pinch of hydroxylamine hydrochloride was added then potassium cyanide was also added.

5ml of 8 Molar potassium hydroxide (KOH) was added and titrated with 0.01 molar Ethylenediamine tetra-acetic and (EDTA).

III. PRESENTATION OF RESULTS, ANALYSIS AND DISCUSSION

A. Results on Physical and Chemical Parameters Of Ikpoba River

The results of the quality parameters of the Ikpoba River obtained during the sampling period are presented for all the parameters analyzed, electrical conductivity (range = 1364.00 $\mu\text{S}/\text{cm}$), total hardness (TH) (range = 191.52mg/l), total solids (TS) (range = 2566.00mg/l), total dissolved solids (TDS) (range=823.00MG/l), total suspended solids (TSS) (range= 2850.00mg/l), and chloride ions (range = 129.00mg/l) recorded comparatively wide ranges.

pH and colour varied from 26.00-29.00 (27.65 ± 0.14) $^\circ\text{C}$, 35.39-706(6.09 ± 0.51) and 10.00-20.00 (14.07 ± 0.65) TCU respectively.

Hardness carried between 3.48 and 195.00(7.21 ± 9.45)mg/l, TS varied between 65.00 and 2631.00 (386.00 ± 85.60)mg/l while TDS varied between 3.00 and 826.00 (221.49 ± 39.44)mg/l.

B. Levels of the Physicochemical Parameters

The levels of sulphate, chloride, calcium and magnesium ions varied from 600.00 – 900.00 (761.60 ± 54.12) mg/l, 70.90 – 180.00(125.38 ± 18.98) mg/l, 0.07 – 1.02 – (0.4980 ± 0.189) mg/l and 5.00 – 8.20 (6.6500 ± 0.514) mg/l respectively (Table 1).

Chemical oxygen demand (COD) varied from 263.00 – 294.00 (279.10 ± 5.71) mg/l, dissolved oxygen (DO) varied from 2.25 – 3.34 (2.75 ± 0.24) mg/l, total alkalinity varied from 650.00 – 845.00 (727.54 ± 33.69) mg/l and total solid varied from 1240.00 – 1490.00(1372.00 ± 42.59) mg/l.

TABLE I. PHYSICOCHEMICAL PARAMETERS OF THE IKPOBA RIVER, EDO STATE ACROSS THE SAMPLING POINTS

Mg/l	SP1	SP2	SP3	SP4	SP5	Effluent
Sulphate(mg/l)	200.00	250.00	400.00	77.00	280.00	6. 052
Chloride (mg/l)	70.90	100.00	180.00	126.00	150.00	2. 021
Calcium (mg/l)	1.02	0.08	0.07	0.50	0.10	4. 03
Magnesium (mg/l)	8.20	7.00	5.00	6.60	6.45	6.62
COD (mg/l)	294.00	288.50	263.00	280.00	270.00	301.60
DO (mg/l)	3.34	3.15	2.25	2.75	2.25	2. 00
Alkalinity (mg/l)	845.20	750.00	650.00	710.10	682.40	2. 02
TS (mg/l)	1207.40	1273.00	1418.62	1337.7	1346.08	2076.60
TSS(mg/l)	7.40	8.00	8.62	7. 57	8.08	21.60
TH (mg/l)	9.22	7.80	5.07	7.10	6.55	5. 50
TDS(mg/l)	1200.00	1265.00	1410.00	1330.00	1338.00	2055. 00
BOD (mg/l)	197.04	191.65	165.25	182.75	172.50	240.20
Conductivity(μ s/cm)	0.06 \times 10	087 \times 10	1.70 \times 10	1.14 \times 10	1.34 \times 10	5.01
Colour (Pt-co)	3.00	3.10	3.45	3.35	3.37	2.40
TURD(NTU)	7.40	8.00	8.62	7.75	8.08	118.50
pH	7.50	8.00	11.00	8.70	9.00	11.70
Iron (mg/l)	3.04	3.00	4.01	3.07	4.01	2.06
Copper (mg/l)	8.00	7.80	8.04	7.78	8.03	4.21
Chromium (mg/l)	1.00	1.45	1.47	1.40	1.48	3.91
Zinc (mg/l)	10.00	10.00	11.00	10.02	10.06	2. 04

C. Discussion

The current study clearly indicates the possible impacts of human and industrial activities on the Ikpoba River. Several studies in Nigeria inland water bodies have also indicated anthropogenic impacts on both the physicochemical and biological attributes of the ecosystem (Osibanjo and Adie, 2007; Okoye et al., 2010; Andem et al., 2013).

According to Adakole et al., (2003), the quality of any water body is governed mainly by its physicochemical factors and the knowledge of extent of impacts on the factors is useful in limnological studies. The observed marked variations in the levels of Total Suspended Solids (TSS), Electrical Conductivity and Total Dissolved Solids (TDS) across the sampling point is a reflection of different anthropogenic activities ranging from industrial discharges, abattoir activities, dyeing, domestic and agricultural runoffs that take place along the banks of the river.

The commercial city Edo houses many industries, including the plastics, breweries, and other industries that obviously generate effluents from their production line. Many of these effluents are not properly treated before discharge into the repository Ikpoba River. Also, the many significantly correlating physicochemical parameters indicate the relatedness of variables in aquatic ecosystem.

Temperature is a measure of the average energy (kinetic) of water molecules (Andem et al., 2012). Most aquatic organisms are sensitive to changes in temperature. The temperature of any given water determines the rate of metabolism of aquatic organisms and the concentration of dissolved gases (Atulegwu,

2005). The high temperature recorded in SP E when compared to the control location SP A might be as a result of runoffs from the abattoir located

IV. CONCLUSION

This research was based on experiments which followed the knowledge from the academic community, regulatory agencies, practicing engineers and scientists. The contaminants found in the wastewater which are harmful to the fauna and flora and the environment at large were reduced in concentration using several treatment methods to conform to environmental regulatory body standard before disposal.

Some of the laboratory equipment used for the experiments need replacement, upgrading so as to minimize errors when characterizing effects of brewery effluent on water quality.

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