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THE IMPACT OF INDUSTRIAL EFFLUENT DISCHARGE ON PHYSICO-CHEMICAL AND MICROBIAL PARAMETERS OF OROGODO RIVER, AGBOR, NIGERIA.

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ABSTRACT

The microbiological and physico-chemical analysess of water samples obtained from the Orogodo River, Agbor, at point of industrial effluent discharge (Location 2) and at 100m before (Location 1) and 100m after (Location 3), were carried out using standard methods to determine the impact of the discharge on the water quality. While the temperature, conductivity, biological oxygen demand, and coliform counts increased from Stations 1 to 3 and pH, hardness, alkalinity and dissolved oxygen decrease from Stations 1 to 3, the solid (Total, suspended and dissolved) and nitrates increased from Station 1 to 2 and 3 and sulphate, which was equal for Station 1 and 2, decreased in Station 3. Most of the parameters were above set limits by regulatory bodies. Thus, the industrial effluents contained much solids and oxygen-demanding materials with deleterious effects on the water quality, to extent that it may not be potable without treatment. There is the paramount need to treat these industrial effluents prior to discharge into the River Orogodo.
Keywords: Water, Analyses, Effluent, Treatment, Discharge, Potable.

INTRODUCTION

Water is one of the most important chemical substances for the maintenance of life, it constitute about 70% of the earth surface. Water is indispensable for man's activities herice many ancient cities and towns were built around water bodies (Ukpong, 2008). Orogodo River is located between latitudes 5° 43'N and 5°30'N and longitudes 6° 20E and 6° 12'E, and takes its sources from Mbiri village at an elevation of 150 m above sea level. It joins the River Epthiope at Urhuoka near Abraka in Delta State. It covers a total distance of about 75km. the climate of the area is marked by two distinct season the rainy season. The river serves as a major sources of water for drinking, bathing, fishing, washing, Orogodo River, aside being source of drinking water, serves other purposes which include fishing, swimming or bathing, washing of vehicles, cloth, and household utensils at various locations. Some of these activities, including abattoir effluent discharges, cloud result in contamination and subsequent pollution of the water (Okonkwo and Odeymi, 1985), The Agbor and Owa Communities through which the Orogodo River traverses, are mainly peasant farmers whose products include food stuff such as yams, corn, vegetables, cassava, plantain and fruits. Agricultural activities in the area are mostly carried out along the bank of the Orogodo River, and agricultural wastes are discharged directly into the rive or as runoffs into the river after rainfalls (Puyate et al. 2007).

In Agbor metropolis, and many of the communities along the river Bank, proper waste disposal methods are lacking such that many of the inhabitants pass their wastes directly into the surrounding bushes, a practice common in many developing countries (Edema et al., 2006). Consequently, during the rainy seasons, faces with its load of bacteria, viruses and helminthes of public health importance are washed into the river. At Agbor, there are chemical industries that discharged their effluents, albeit without treatment, into the river. These may alter the bacteriological and physico-chemical qualities of the river (Okonkwo and Odeymic, 1985; Edema et al, 2006). The aim of this research was to determine the physico-chemical quality and microbial load of impact of industrial effluents and at 100 m before and after this location.

MATERIALS AND METHODS

Collection of samples

Samples were collected using clean 2 L plastic container that were washed with soap and allowed to air dry. The plastic containers were rinsed thrice with river water before the sample were collected. The samples were stored in ice pack and transported immediately to the laboratory for analysis.

Determination of temperature

This was carried out using a 0 to 100°c thermometer

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Determination of PH and Conductivity

The PH of the water sample was determined using a pre-standardized pocket-size PH and conductivity meters, Hanna Instruments. (Made in Italy) in accordance with the manufacture's instructions.

Determination of Solids (TSS, TDS, SS and TS)

These were carried out in accordance with the procedure reported in America public health Association (APHA, 2002). These were determined with the Roitary method using HACH DR/2010 Spectrophotometer (Made in Germany). The dry weights of two 100 ml beakers-A and B were determined. 20 ml of the unfiltered samples was added to beaker B. The weights of the two beakers were then determined. Both beakers were gently heated until completely dried, allowed to cool in a desiccator and their weight were further determine.

Total suspended Solids (TSS) = weight of residue/weight of sample x 10^6 of the unfiltered sample.

Total Dissolved Solids (TDS) weight of residue/weight of sample x 10^6 of the filtered sample.

Total Solids (TS) =TSS+TDS.

Determination of Alkalinity

This was carried out in accordance with the procedure reported in the titration method of WHO 2002), Total alkalinity was determined using the procedure of Test method A -Electrometric methods of ASTM (2002). 100ml of the sample was measures into a clean 250 ml conical flask, added either the content of one phenolphthalein indicator powder or 4 drops of phenolphthalein indicator solution, swirled to mix to form a pink color and titrated with concentrated 95% sulphuric acid (H_2SO_4) until solution became colorless.

Alkalinity (mg/1) =titer x 0.1

Determination of biochemical oxygen demand (BOD^5)

This was carried out in accordance with the procedures reported in ASTM (2002). The reduction of the DO in a water sample, which has been kept after for 5 days at a constant temperature in a totally closed vessel after sampling, was measured and calculated thus: the diluents water (aeration water) was prepared by measuring 1 L of distilled water in a winhester bottle and aerating it for 1 h. to the aerated water in the bottle were added 1 ml each of solution C (C_aCl_2 solution) and solution D (FeClj solution). The aerated water was then used for the determination of the DO before and after incubation by titrating 0.25 N Sodium Thiosulphate (Na_2S_203) solution against the sample in 400 ml beaker until a faint yellow or yellow color was obtained. Added 2inl of starch indicator to obtain a blue color and continued the titration until color disappeared. The procedure was used for both pre and post incubation samples. The DO was obtained using the following calculation:

I ml of 0.025 NNa_2S0_3 = 0.2 g of oxygen (or 0.2 g of DO).

$$\text{Do (mg/1)} = \frac{\text{Tx } 0.2\text{x}100}{\text{Volume of Winchester bottle}}$$

$$BOD^5 \text{ in (mg/1)} = \frac{\text{£D,:Di\}} \quad \text{XT}}{\text{V}}$$

Where T = titer value, Dl = DO of the sample before incubation in mg/L, D_2= Do of the sample after incubation in mg/1

Determination of total aerobic and coliform counts

These were carried out in accordance with the methods of Cowan and Steel (2004). Pour plate technique using nutrient agar and MacConkey agar was used for the determination of total aerobic and coliform counts respectively. Inoculated nutrient agar and MacConkey plates were incubate at 37°C for aerobic for aerobic and coliform counts respectively. Plats with 30 to 300 colonies were used for the determination of the microbial counts .

RESULTS AND DISCUSSION

The changes in PH values of the sampling locations are presented in Figure 1. it was observed that PH decreased from 6.44 (Station 1) to 6.18 (Station 2) and 6.17 (Station 3). The reduction in the PH of the Orogodo River Wtaer reduced from 6.44 in Station 1 to 6.17 in Station 3, a 4.19% reduction, could have been due to the discharged paint effluent which had a pH value of 6.24. This result agrees with the reports by previous scientists on many Nigeria and other Africa water bodies (Edema et al. 2006); Rim-Ruken et al. 2004; Rim Rukeh et al, 2006). The variation in surface water temperature is presented in figure 2. It was observed that the surface water

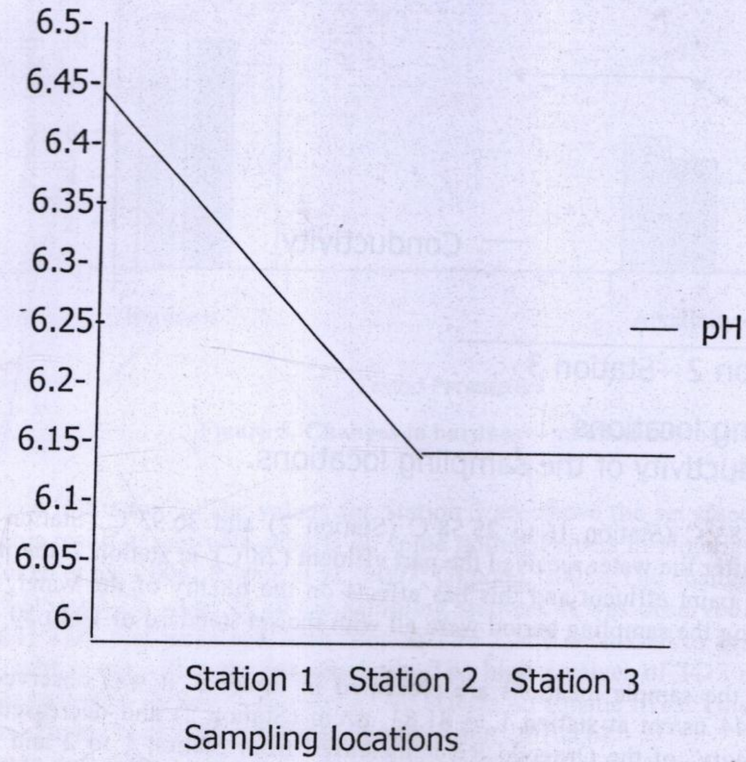

Figure 1: Changes in pH of the sampling locations.

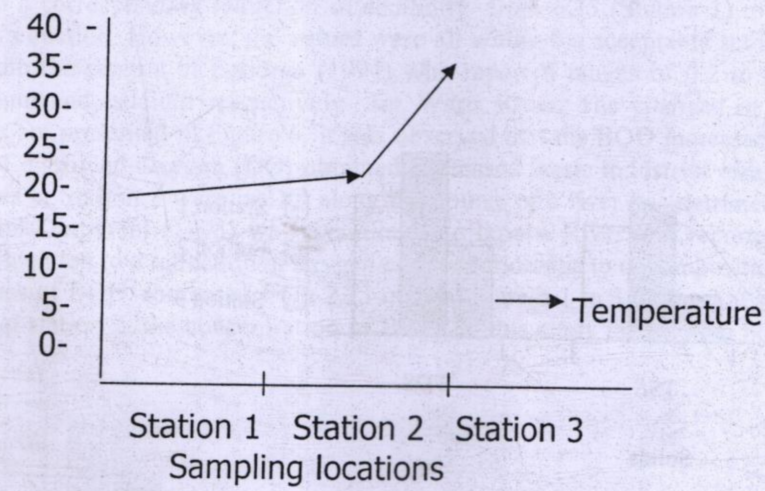

Figure 2: Changes in temperature of the sampling locations.

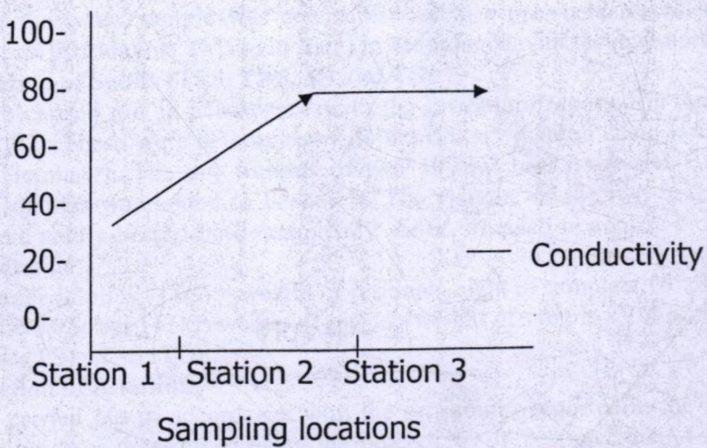

Figure 3: Changes in conductivity of the sampling locations.

Temperature increased from 25.83°C (Station 1(to 25.58°C (Station 2) and 36.93°C (Station 3). The temperature increased by 4.3%, after the water received the part effluent (28°C) at station 2. the increase in temperature could be due to the paint effluent and this has effects on the quality of the water, the water temperature values obtained during the sampling period were all with the set standard of 10 to 50°C (WHO, 2002; Anon, 2010a).

The changes in conductivity of the sample locations are presented in figure 3. it was observed that the conductivity increased from 46.44 us/cm at station 1 to 81.83 us/cm (Station 2) and decreased to 79.83 us/cm at Station 3. the conductivity of the Orogodo River increased from Station 1 to 2 and decreased thereafter to Station 3. the could have been due to the paint effluent

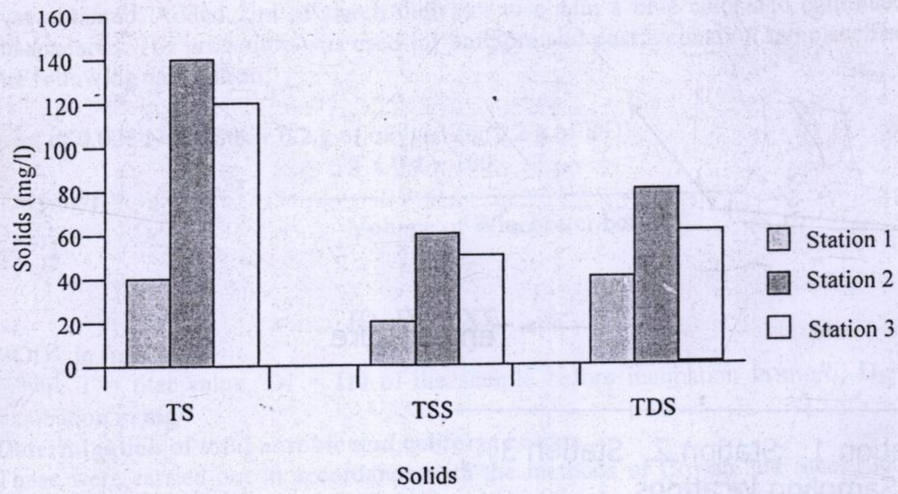

Figure 4. Changes in solids (TS, TDS, TSS) of the sampling

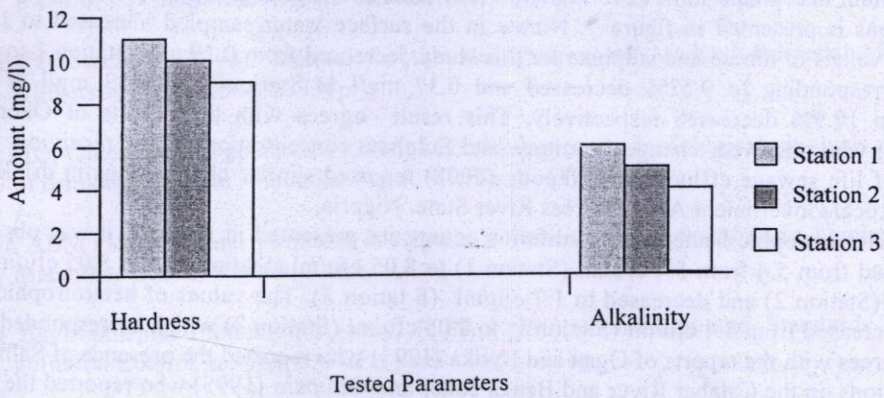

Figure 5. Changes in hardness and alkalinity of the sampling

Discharged in Station 2. The values for Station 3 are above the set standards by regulatory bodies for river water. This result agrees with reports on some polluted rivers in Nigeria and Africa by previous researchers (Rim-Rukeh et al., 2006; Puyate et al., 2007; Ukpong, 2008). The changes in solids of the sampling location are the TDS and TS value in all the sampling stations. It was observed that the TSS increased from 12.59 (Station 1) TDS that increased from Station 1 to 2 and decreased to Station 3, with the value in Station 1 being lowest, were within the set standards. The higher values of TDS at the downstream Stations 2 and 3 may be responsible for lower corresponding effects on aquatic lives. This result agrees with reports by other scientists) Puyate et al., 2007; Ukpong, 2008, Anon, 2010a,b).

The change in hardness and alkalinity of the sampling locations is presented in figure 5. it was observed that the alkalinity values were lower than the total hardness values. The alkalinity values decreased from 6.35mg/l (Station 1) to 5.64 mg/l (Station 2) to 5.12mg/l (Station 3). The hardness of the Orogodo River reduced from 11.27 (Station 1) to 9.21 (Station 3) after receiving the part effluent, a 8.46% reduction. There was also a corresponding reduction in alkalinity from 6.35 (Station 1) to 5.01 (Station 3) amounting to a 14.17% reduction. However, the values were all within the acceptable set standards of 100 mg/l. the results agree with the reports of Egborge (1994) who reported ranges of 0.2 to 98mg/l and 0.1 to 16.4 mg/l for magnesium and calcium respectively for Warri River. The changes in BOD and DO of the sampling locations are presented in Figure 6. it was observed that the BOD increased from 2.24 mg/l (Station 3). The values of dissolved Oxygen (DO) obtained decreased waste industrial effluent from industries in Station 2. the values at Station 3 were in DO along the course of a river has detrimental effects the reports of Benta-Coker and Omlimani (1995) who examined the Ikpoba River and reported high concentration of organic matter which led to a reduction in oxygen concentration due to decomposition by anaerobic bacteria.

The values of BOD^5 increased from 2.23 mg/l at Station 1 to 3.64 mg/l at station 3 after receiving the paint effluent at station 2. the concentration of BOD^5 in this study falls within both the minimum allowable limit (6)

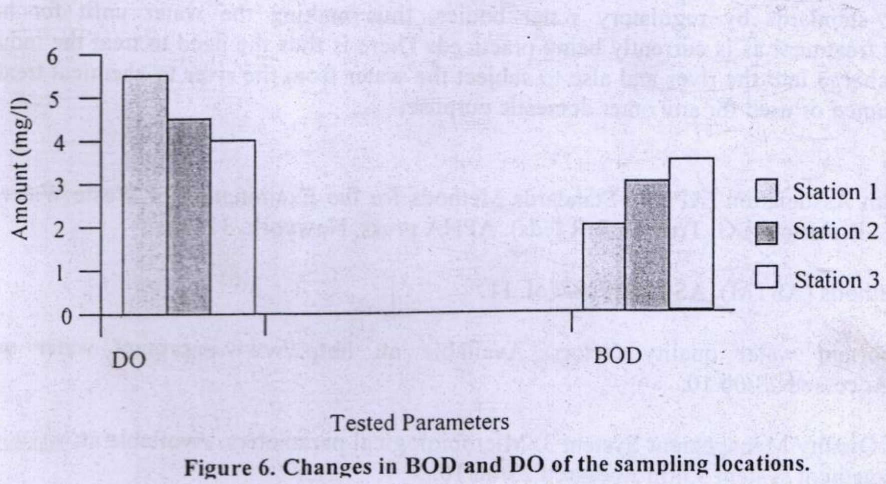

Figure 6. Changes in BOD and DO of the sampling locations.

Mg/) and maximum acceptable limit (240 mg/1) (WHO, 2002). The change in nitrate and sulphate of the sampling locations is presented in figure 7. Nitrate in the surface water sampled increased to 1.17 mg/1 (Station 3). The values of nitrate and sulphate for this study decreased from 0.19 mg/1 station 1 to 0.17 mg/1 at station 3 corresponding to 9.52% decreased and 0.37'mg/1 at Station 1 to 0.33 mg/1 at station 3 corresponding to 10.9% decreased respectively. This result agrees with the reports of Okonkwo and Odeyemi, (1985) who observed changes in nitrate and Sulphate concentrations in the receiving stream of the University of life sewage effluent and Ukpong (2008) reported similar observations in drinking water sources in Uyo Local Government Area in Cross River State, Nigeria.

The changes in Heterotrophic bacteria and coliforms counts are presented in figure 8. it was observed that the THE increased from 5.4 from 5.4 cfu/ml (Station 1) to 8.05 cfu/ml (Station 2) and 8.05 cfu/ml (Station 1) to 2.7 cfu/ml (Station 2) and decreased to 1.7 cfu/ml (S tation 3). The values of heterotrophic bacterial counts (HBC) increased from .5.4 cfu/ml (Station 1) to 8.05 cfu/ml (Station 3) which corresponded to 32.9% increase. Tim agrees with the reports of Ogan and Nwika (1993) who reported the presence of Salmonella sp at different locations on the Calabar River and Benka coker and Ohimain (1995) who reported the increased microbial load due to impact of slaughter house effluent on the water quality of Ikpoba River. The higher counts obtained in station 2 for coliforms agree with the findings of Benka-Coker and Ohimain (1995), and Rim-Rukeh (2004, 2006). The detection of coliform at these stations indicates the presence of man and animal fecal contamination. The presence of these organisms has been used as indicators of fecal pollution of water (APHA, 2002; FEPA, 1990).

While the values obtained in station 1 were within set acceptable standards, those obtained at Stations 2 and 3 were not. Thus, the water from the Orogodo River may not be acceptable for consumption and domestic needs at the stations sampled without treatment as it does not meet the set standards for potable water.

Station 1
Station 2
Station 3

Tested parameters

THB CC

Changes in bacterial and coliform counts of the sampling locations.

Figure 8:

CONCLUSION

This study revealed that the discharged of industrial effluents into the Orogodo River had negative impacts on the microbiological and physico-chemical parameters of the river water. Most of the tested parameters were above the set standards by regulatory water bodies, thus making the water unfit for human consumption without treatment as is currently being practiced. There is thus the need to treat the industrial effluents prior to discharge into the river and also to subject the water from the river to chemical treatment before it can be consumed or used for any other domestic purpose.

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