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CUMULATIVE EFFECT ON TREATED SEWAGE DISCHARGE ON CHANNELED BARGE SLOOT

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ABSTRACT

A study was initiated to establish the cumulative effect of treated sewage discharge on channeled barge slot. Water and sediment samples from the barge slot were collected weekly for twelve months and physico-chemical characteristics of the samples were monitored. General characteristics of aquatic habitats of the slot were also studied. The results were compared with results of water samples and aquatic habitats collected from 500 m and 1000 m away from the barge slot. Tissue analyses results show that the fishes in the barge slot are rich in proximate and mineral content than fishes of the same species from the 500 m and 1000 m distance away from the barge slot. Physico-chemical results of the treated sewage are all within acceptable limit for discharge into water body while results of water samples from the barge slot showed no sign of pollution or distortion in fauna and floral life of the slot. However, the dissolved oxygen level was quite low when compared with samples collected from the other two sources. Coliform count and ammonia (indices of faecal contamination) were also found to be higher in the barge slot.

INTRODUCTION

With the advent of industrialization and increasing populations, the range of requirements for water have increased with greater demands for higher quality water. Water requirements have emerge for drinking and personal hygiene, fisheries, agriculture, navigation for transport of goods, industrial production processes, cooling in fossil fuel power plants, hydropower generation and recreation activities such as bathing or fishing, however, the largest demands for water quantity, such as agricultural irrigation and industrial cooling, require the least in terms of water quality. Drinking water supplies and specialized industrial manufactures exert the most sophisticated demands on water quality. In parallel with these uses water has been considered the most suitable medium to clean, disperse, transport and dispose of wastes.

In most industries much of the intake water is discharged as waste water or effluent. It is often polluted by by-products of the manufacturing process and other waste materials (Odiette, 1999). He also enumerated some of the pollutants in wastewaters to include domestic sewage, sanitary waste, farm manure, rainstorm runoff, pathogens, petroleum products, heavy metals and nutrients. The volume and concentration of this type vary with time, facility, occupancy and operational situation (DPR, 1987).

These pollutants have made water quality far more important than its availability in the Niger Delta area of Nigeria, where there is abundance of water from marine and freshwater, yet they are unfit for consumption (Efu-Effeotor, 1998). In view of the pollution problem associated with wastewater handling, a highly efficient biological sewage treatment system was installed at Forcados, Nigeria by Shell Petroleum Development Company. Other companies with sewage treatment plants include, Lever brothers Nigeria PLC, Delta Steel Company, Aladja. Warri Refinery and Petrochemical, Port Harcourt and Kaduna Refineries, National Fertilizer Company of Nigeria (NAFCON) and Abuja-Federal Capital Territory Nigeria Horsfall Jnr. 1998).

As a result, effluents from these companies undergo some form of treatment before there are discharged to the environment. This study was necessiated by the need for construction of aquacell treatment plant in communities where large volume of sewage and wastewater is being generated.

Table 2 shows the result of physico-chemcial analyses of samples from the barge slot, 500 m and 1000 m distance. Dissolved oxygen was higher at 500 m and 1000 m distance than the barge slot with concentration of 8.4 mg/l, 8.5 mg/L and 1.2 mg/L respectively. Coliform count and ammonia (indicates faecal contamination) were observed to be higher in barge slot. From table 3, the heavy metals were all within acceptable levels in the three environments.

MATERIALS AND METHODS

Sample collection and analysis

Sediment and water samples were collected weekly for 12 months and physico-chemical characteristics were monitored. All analytical procedure using titrometry, infrared spectroscopy, flame photometry, microscopy etc. proceeded in accordance with the methods of American Public Health Association (APHA). Dissolved oxygen was determined in-situ and later confirmed in the laboratory by Winkler's method.

Total microbial count was carried out using standard plate count technique by plating aliquots (0.1 ml) of appropriate dilutions of water samples in standard plate count agar and incubating at 30^0C for 48 hours. Other specific research and experimental methods employed are defined below.

Extraction of lipids for tissue analysis

Ten (10g) of the crushed organism were accurately weighed into a homogenizer flask. Ten (10) cm^3 of dichloromethane and twenty (20) cm^3 methanol were added to the tissue and homogenized for 2 mins. Ten ($10cm^3$) of dichloromethane was then added and homogenized for 30 secs and then, Ten (10 cm^3) of water was added and homogenized for another 30 secs. The mixture was filtered through a glass sinter into a separating funnel and transferred into a round bottom flask. Chemical analyses were then conducted on the extracts obtained from crushed whole organisms. Extract for analyses of heavy metals in tissues were obtained by digesting with appropriate volume of hydrogen peroxide and nitric acid.

RESULTS AND DISCUSSION

The results shows bioaccumulation of nutrients from sewage by the *Tilapia guinnensis* (Table 1). Crude fiber, crude protein and carbohydrate showed marked accumulation more than other nutrients in the fish in the barge slot than in the 500 m and 1000m distance.

The *Tilapia guineensis* (Table 1) bioaccumulated nutrients from the sewage in the three environments; barge slot. 500m and 1000m distance, crude fiber, crude protein and carbohydrate bioaccumulated markedly. It is expected that if sewage is not properly treated before discharge into a water source, the suspended solids tend to settle out in the slack water and behind weirs, forming banks of sludge. Odiette (1999) reported similarly that some aquatic organisms bioaccumulate toxic substances and nutrients, which become bioconcentrated or biomagnified in food chain. Kreger (2002) and Horsfall Jnr and Spiff (1998) also reported that increasing levels of phosphates and nitrates entering a watercourse are responsible for eutrophication occurring.

In this study (Table 2) the Dissolved oxygen of the 500 m and 1000m distance was higher than in the barge slot. This could be attributed to the fact that clean natural water in a watercourse is normally well oxygenated and contains large and varied number of life forms including protozoa, bacteria and aquatic plants and animals which are interdependent forming a complex system and keeping the stream in a healthy condition. The water obtains its dissolved oxygen mainly from the atmosphere by surface aeration and this process is assisted by the turbulence of the stream caused by velocity of its flow and its passage over rocks, stones and weirs.

The temperature of the barge slot was also observed to be high and this could be due to the naturally high temperature of feaces, heat generated during microbial activities and domestic warm water use. High levels of Total Suspended solids, Dissolved Solids, anions and metals were also observed in barge slot when compared with 500 m and 1000m distance.

The pH is an important variable in water quality assessment as it influences many biological and chemical processes associated with water supply and treatment (Chapman and Kimstach, 1992). Change in pH can indicate the presence of certain effluents, particularly when continuously measured and recorded, together with the conductivity of a water body. Water bodies display temperatures variations along with normal climatic fluctuations which may be seasonal, or in some water bodies, daily.

The observed increase in hardness of the watercourse (500 m and 1000 m) may be due to high levels of Mg and Ca often associated with coastal environment, which is associated with the study area. However the average chloride, sulphate, Ca and Mg ion concentrations in the watercourse were within the acceptable limits (WHO 1987).

Suspended solids in form of visible sludge create unsightly condition and destroy the use of water for drinking purposes. The type and concentration of suspended matter controls the turbidity and transparency of the water (Chapman and Kimstach, 1992). Suspended matter consists of clay, slit and fine particles of organic and inorganic matter, soluble organic compounds, plankton and other microscope organism.

Coliform count and ammonia (indices of faecal contamination) were also found to be higher in the barge slot and were generally above World Health Organization (WHO) Standards for drinking water of 0/100 ml coliform, but within the range of expected water for agricultural use. The coliforms present may be due to inadequate treatment of the sewage and may be of health risk to the aquatic organism and humans through food chain.

Heavy metal concentration in domestic raw sewage has been found to be high (Ayade, 1994). The concentrations of other ions have also been found to be always higher than the maximum permissible regulatory levels high (Ayade, 1996). At such high concentration heavy metals are frequently toxic to man as a result of bioaccumulation.

TABLE -1

Proximate and mineral analysis results of *Tilapia guineensis* from the barge slot, 500 m and 1000 m away from the barge slot

Nutrients %	Barge slot	500 m	1000m
Kjeldahl nitrogen	4.2	0.2	0.2
Crude protein	24	1.45	1.60
Crude fiber	32	1.2	1.1
Carbohydrate	28	2.9	2.6
Sulphur	2.18	ND	ND
Phosphorus	2.3	0.01	0.01
Magnesium	3.5	1.5	1.3
Sodium	1.4	0.02	0.01

Values are means of 3 experiments drawn from field studies.

TABLE- 2

Results of physico-chemical analysis of samples from the barge slot 500 m and 1000 m distance

Parameters	Barge slot	500m	1000m
Colour	Non-objectionable	Non-objectionable	Non-objectionable
Odour	Nil	Nil	Nil
Temp (0^0C)	30.20	29.80	29.70
pH	7.80	7.40	7.20
Turbidity (NTU)	40	38	30
Conductivity (μS)	935	745	820
Total solids	90	29	24
Suspended Solids	52	25	23
Dissolved Oxygen	265	168	124
BOD_5	24	12	12
Ammonia	14	8	7
Nitrates	4	2	2
Sulphates	120	124	122
Phosphates	6	2	2
Carbonates	260	280	275
Bicarbonates	160	98	73
Potassium	14	8	9
Sodium	28	16	12
Magnesium	42	26	23
Calcium	520	445	23
Zinc	0.06	0.05	0.03
Copper	0.1	0.07	0.02
Iron	0.2	0.1	0.10
Manganese	0.05	0.01	0.02
Coliform (MPN) org./100mL	120-106	64-106	63-106
Total bacterial counts org./100mL	110-102	72-102	62-102

The values are mean of 3 composite samples collected over a period of 12 months. Values in mg/L otherwise stated.

TABLE - 3

Result of tissue analyses

Nutrients %	Barge slot	500m	1000m
Cadmium	ND	ND	ND
Chromium	ND	ND	ND
Copper	0.002	0.001	ND
Lead	0.001	0.01	0.003
Iron	0.01	0.002	0.001
Zinc	0.02	0.01	0.01
Arsenic	ND	ND	ND
Nickel	0.001	ND	ND
Cobolt	ND	ND	ND

Values are means of 3 experiments drawn from field studies.

CONCLUSION

Sewage should be adequately treated before discharging into the channeled barge slot to avoid bioaccumulation of heavy metals and other toxicants in aquatic organisms and consequent health implication in man.

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