INVESTIGATION OF THE POLLUTION LEVEL IN RIVER OOKUN DUE TO DISCHARGE OF SOAP EFFLUENTS

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ABSTRACT

The pollution effects of effluent discharges from soap making industries into surface waters were studied over both the wet and dry seasons, using River Ookun and Global soap industries in Ilorin, Kwara state. Samples were collected at effluent discharge point (Global soap industry), River Ookun (Yidi/Irewolede Area) and at a point, about 50m away from effluent discharge. These were analysed in the water resources laboratory to determine quality from some physico- chemical parameters, which ranged as follows, for both season: Temp: 29-30^{0}C, Colour 100-500 TCu, pH: 8.5-11.31, conductivity; 0.35-300(Vmho/mg), TDS: 0.18-150(mg/l), Alkalinity: 150 - 900(mg/l), Total Hardness: 45–120(mg/l), turbidity: $N0_3$: 1.2 – 3.9(mg/l), SO_3: 0.14-0.23(mg/l), cl^-: 60-500(mg/l), $D0_5$: 4.1–0.1(mg/l), $D0_5$: 0.5 – 0.1(mg/l), BOD_5: 20.4 – 0.6(mg/l), Fe: 2-3(mg/l), Zn^{2+}: 0.1– 0.2 (mg/l).

The result of analyses as shown in the range listed above and also given in the summary, showed a direct relationship between samples of effluent and those from River Ookun. A comparison of the physico-chemical properties of the effluent (listed above) with the limit for discharges to surface waters as presented in the extract from the Federal Environmental Protection Agency (FEPA) monograph also showed non-compliance to the limit. Especially the pH, colour, chloride, iron and BOD were far beyond the limit. Likewise, a comparison of the physico- chemical properties of River Ookun for both seasons fell short of the limits for Rivers e.g. pH (6 - 9), Alkalinity (50), Iron (0.5), BOD (10 - 20), as presented in the extract from FEPA monograph.

The close relationship between the properties of samples of effluent and those from River Ookun and the comparison with the given limit implied that the river is polluted in both seasons (i.e all round the year). The river therefore, can no longer fulfill as many purposes especially domestic uses as it was previously put to before the existence of the soap making industry. The uses of River Ookun are now actually restricted to laundering and washing of vehicles, especially because it has fallen short of the limit for Potability, Recreation, Fish Culture, Industrial and Irrigation.

Keywords: Effluents, Industry, Pollution.

INTRODUCTION

The need to develop available resources by setting up many more industries may be considered a mixed blessing to mankind. As many as are the advantages of industrialization, it has also been a major source of environmental pollution, especially for surface water, where the effluents are not properly treated before discharge.

Apart from local effects on the health and immediate environment of Nigerians, some other activities in our industrial sector are posing a great threat to the global environment (1). Industrial wastes encompass a wide range of materials of varying environmental toxicity (8) hence the need for pretreatment of effluents before discharges. On the contrary, less than 10% of industries in Nigeria manage their wastes in an environmentally sound manner. The practice is to dump industrial wastes in any available space, in water or land. In Nigeria, several million litres of untreated or partially treated industrial effluents are discharged into the nearest public drains, surface waters swamp and land. Incidentally, the streams, rivers, estuaries and lagoons which are the eventual recipient of untreated or partially treated effluents are used by a large proportion of the population for drinking, washing, fishing, livestock watering and recreation (8).

This paper therefore aims at investigating the quality of the River Ookun, a recipient of soap effluents and a tributary of river Asa , While The Objectives are;

- Collection of waste water for analysis
- Compare analysis with set standards
- Make recommendation based on findings from the study.

River Ookun traverses parts of Ilorin municipal, but the portion under study lies along the Yidi/Irewodele area, off Asa dam Road. Ilorin, Kwara state, Nigeria. The stream initially served for domestic and Agricultural purposes but, not anymore. Research has shown that quality of River Asa (tributaries) was acceptable before entering the town. It becomes unacceptable as it flows across the town indicating pollution from industrial and municipal discharges (2).

Materials and Methods

Samples were collected from stations A,B, and C selected for this study which was carried out over the two seasons (Wet and Dry). Stations A represented the point of discharge at the Global soap industry (Figure 1), B was about 50m away from discharge while station C was River Ookun (Figure 2a and Figure 2b).

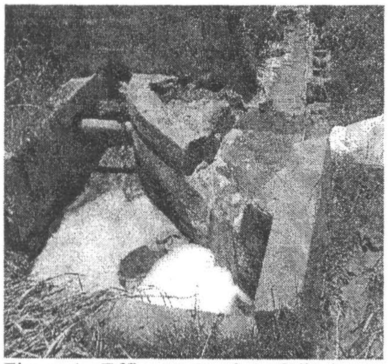

Figure 1: Effluent at point of discharge from industry

Figure 2a: River after effluent mixture

Station B was necessary in order to provide information on properties/ quality along the discharge, before the point of investigation proper.

Six (6) varying samples were collected in all, and were taken to the laboratory for analyses to determine their properties. Polyethylene bottles rinsed with distilled water and with the respective samples before collection proper were used.

Physical parameters (Table 1 and 2) were determined by physical means, (e.g.) the thermometer was used to determine temperatures, PH by the electrometric method, turbidity and conductivity by the probe method using their respective meters.

Hardness, Chloride, Iron, Alkalinity, Sulphate, and Nitrate were determined by the titric method as prescribed by APHA and dissolved oxygen and Nitrate (American Public Health Association APHA) using Hannah multipurpose ion meter and reagents.

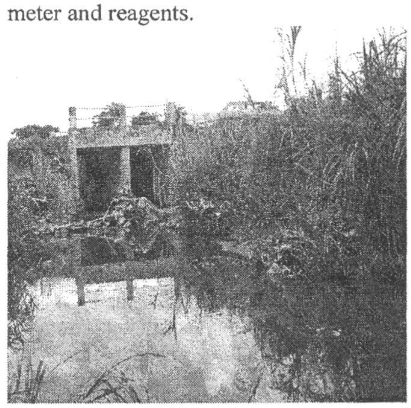

Figure .2b: River after effluent mixture

RESULTS/DISCUSSION

The results of laboratory analyses are presented in Table 1 and 2. Limits for discharge to surface waters (Table 3) and Limits for rivers (Table 4) were extracted from FEPA monograph, and used to compare the results obtained from the laboratory analyses of the samples. Results are discussed in the following subsections (values in mg/l except otherwise stated).

Temperature, pH, colour, total dissolved solids

Temperature, T (29 - 30^{0}C) and total dissolved solids TDS (0.18 –n 150) were within the limits, (<40^{0}C, 200 respectively) pH (8.57 – 11.39) indicated a high amount of hydrogen ion, which could make water difficult to treat by biological means. Effluent may have to under go chemical neutralization. The sample colour (100 - >550) also exceeded the limits (colourless).

Alkalinity, total hardness, chloride

All samples showed a high alkalinity content (150 - >900). Alkalinity helps to resist pH change thereby increasing the amount of acid required to lower pH (Metcalf and Eddy, 2003). Other parameters were reduced, which may be due to dilution along the river except hardness and chloride, which reduced from A (90, 400) to B (45, 60) and increased again at C (57, 100). It can be inferred therefore, that there are other sources of hardness and chloride.

Dissolved oxygen, BOD

The quantity of dissolved oxygen depends on temperature and concentration of impurities hence the increase in dissolved oxygen from A (0.1) to C (4.1). As effluent mixed downstream, BOD increased from A (0.6) to B (20.4) implying an increase in pollution load. BOD_5 from B to C remained the same – 20.4mg/l. The coliform content of all three samples (i.e. 4 x 10^2 – 120 x 10^2) were higher than the acceptable limits (300). Since dissolved oxygen is not up to the limit, it can be inferred that microorganisms present may be anaerobic in nature.

Iron, Sulphite

Iron decreased from A (3) to B (2) and increased again at C (4). This can be ascribed to the activities of iron welders and motor mechanics close to sample point and partly to the washing of vehicles upstream. A Summary of shortfalls of effluents is shown in Table 5.

Effect of Effluent on Stream

- Restriction of use for domestic and recreation.
- Since this stream is a tributary of River Asa, which is dammed for water supply, contamination of this stream would pose additional load on treatment plant.
- Stream becomes uncondusive for biological life due to its pH creating a 'basic' environment in the river and, dissolved oxygen deficiency, hence loss of aquatic life).
- Generally, creation of nuisance in appearance and odour.

CONCLUSION

The results of analysis showed that the river is actually polluted by the effluent from global soap industry.

Though the study was done over a period of the wet and dry seasons, and it was expected that there should be an improvement in the quality of the surface water between the dry and wet season due to dilution, the reverse was the case. The determinant factor therefore, is the operation of the factory i.e whether the factory is producing or not.

The surface water quality deteriorated when the industry is in operation and improved just a little when operations had stopped, over a period of time.

Neither the effluent nor the river, were within acceptable limits, there was simply no compliance.

Table 1: Wastewater parameter for global soaps with Standards (wet season).

PARAMETER	A	B	C	FEPA	WHO
PH	11.31	10.67	8.57	6-9	7-8.5
Temperature (°C)	30	30	29	>40°c	
Colour (TCU)	>550	>550	100	Colourless & Clear	5TCU
Conductivity	300	2.13	0.35	-	
TDS	150	1.07	0.18	200	
Alkalinity	>900	>600	150	-	100
Hardness	84	45	120	-	
Nitrate	1.2	2.0	3.9	20	
Sulphite	0.23	0.14	0.17	0.2	
Chloride	500	60	90	600	200
DO_1	0.1	3.7	4.1	>4	
DO_5	0.1	0.3	0.5		
BOD_5	0.6	20.4	20.4	50	4
Colony Counter (cfu/ml)	4×10^2	271×10^2	120×10^2	300	
Iron	3	2	4	20	0.05-0.3
Zinc	0.2	0.2	0.1	<1	5

Table 2: Wastewater parameter for global soaps with Standards (dry season)

PARAMETER	A	B	C	FEPA	WHO
PH	11.31	10.67	8.57	6-9	7-8.5
Temperature (°C)	30	30	29	>40°c	
Colour (TCU)	>550	>550	100	Colourless & Clear	5TCU
Conductivity	300	2.13	0.35	-	
TDS	150	1.07	0.18	200	
Alkalinity	>900	>600	150	-	100
Hardness	84	45	120	-	
Nitrate	1.2	2.0	3.9	20	
Sulphite	0.23	0.14	0.17	0.2	
Chloride	500	60	90	600	200
DO_1	0.1	3.7	4.1	>4	
DO_5	0.1	0.3	0.5		
BOD_5	0.6	20.4	20.4	50	4
Colony Counter (cfu/ml)	4×10^2	271×10^2	120×10^2	300	
Iron	3	2	4	20	0.05-0.3
Zinc	0.2	0.2	0.1	<1	5

Table 3.: Limits For Discharge to Surface Waters-Poland
(Values in mg/l except otherwise stated)

Pollution parameter	Potable Water	for recreation and fish Culture	for industrial uses and irrigation
pH	6.5-8.0	6.5-9.0	6.0-9.0
BOD	4	8	12
COD	40	300	400
Chlorides	250	200	250
Sulphates	150	200	250
Dissolved substance	500	1,000	1,200
Suspended matter	20	30	50
Sulphides	0	0	1.0
Phenols	0.005	2.0	3.0
Detergents	1.0	2.0	3.0
Ether Extract	5.0	15.0	40.0
Coli titre (count/100ml)	0.01	0.1	1.0
Iron	1.0	1.5	2.0
Manganese	0.1	0.3	0.8
Lead	0.1	0.1	0.1
Mercury	0.001	0.005	0.01
Copper	0.01	0.01	0.2
Zinc	0.01	0.1	0.2
Cadmium	20.005	0.03	0.1
Chromium (III)	0.5	0.5	0.5
Chromium (VI)	0.05	0.1	0.1
Nickel	1.0	1.0	1.0
Boron	1.0	1.0	1.0

Source: FEPA monograph

Table 4: Limits for rivers

(Values in mg/l except otherwise stated)

Pollution parameter	U.K	S. Africa	Australia
pH	6-9	5.5 – 9.5	6.5 – 9.5
Temperature	32-32.5	35	<30
TSS	30		
Alkalinity as $CaCO_3$	50		
Free chlorine	0.5-1.0		
Sulphide	1.0	1.0	0.5
Chloride	300		
Cyanide	0.1		
Phenols	1.0		
Formaldehyde	1.0		
Oil and grease	Nill	2.5	0.5
TKN	60		
Halogenated Hydrocarbon	Prohibited		
Radioactive Substances	None		
Cadmium	Nil		
Copper	1.0		
Lead	3.0		
Zinc	20		
Chromium (III)	20		
Chromium (IV)		0.4	
Iron		0.5	
Arsenic		2.0	
Mercuiry	0-0.5		
Clarity	Min. 225mm		
Nickel	<1		
BOD	20	10	60
COD	500	75 at least	80% removal
Free Ammonia	10	10	

Source: FEPA monograph

Table 5: Summary of short fall

Sample	Parameter	Result	FEPA	LASEPA	Implication	Treatment
WI_A	Colour	>550	Colourless and clear	5TCU	Colour impart unpleasant taste to water (Suresh, 2005)	For removal of colour adsorption process using activated carbon can be used.
	Chloride	500		200	Reduction in the reuse application of treated waste water	
	Alkalinity	>900		100	Increase in the quantity of coagulants used in treatment, impacts biter taste in water	To lower pH of effluent, chemical neutralization is carried out.
	Dissolved oxygen	0.1		>4		
	pH	11.31	6 – 9	7 – 8.5	Low dissolved oxygen implies oxygen demand exceeds available oxygen, reduction of aquatic life.	For reduction of BOD and COD, chemical oxidation which involves the use of oxidizing agent e.g ozone (O_3), chloride dioxide (ClO_2) and oxygen to bring about a change in chemical composition.
WI_B	Colour	>550	Colourless and clear	5TCU	With high pH, water becomes difficult to treat by biological means	
	Alkalinity	>600		100		
	pH	10.67	6 – 9	7 -8.5		
	Dissolved oxygen	3.7		>4		
WI_C	Alkalinity	150		100		To reduce alkalinity, water undergoes softening

REFERENCE

Abimbola, O.S. (2005): "Legal regulation and enforcement aspects of pollution control", paper presented at the international seminar on Technological innovation on pollution management for sustainable development in the millennium, Lagos, Nigeria.

Adebayo S.A, Adediran G.O (2005): "Effect of Waste discharge on the water quality of Asa iwer in Ilorin, Science focus, vol 10 No. 2 p 116-122

Aina E.O, Adedipe N.O. (1992):"FEPA Monograph 2 Towards industrial pollutional abatement in Nigeria", Lagos

Awojobi A.D, Adebayo, A.V (2002): "Effect of oil spillage on ground water quality unpublished B.Tech thesis, civil engineering department, Ladoke Akintola University of Technology, Ogbomoso.

Federal Environmental Protection Agency (FEPA), (1991): "Guidelines and standard Environmental Protection Control in Nigeria", McGraw Hill, New York.

Horan, N. J. *(1993)* "Biological Waste water treatment system", New York, John Wiley.

Metcalf and Eddy in cooperated, (2003): "Waste water engineering treatment and reuse", New York, McGraw Hill

Oladele O. (2000): "Overview of industrial pollution in Nigeria" Lagos state environmental protection agency and jutco pollutec, technological innovation on pollution management for sustainable development in this millemium, Lagos, Nigeria.

Rangwala S. C, Rangwala K. S, Rangwala P. S (2007): "Water Supply and Sanitary Engineering, India, Charotar Publishing House.

Suresh K. Dhameja, (2005): "Environmental Engineering and Management", Delhi, Sanjeev Kumar Kataria.

The United State Agency for International Development (1994) "Environment Pollution prevention assessment for a soap manufacturing and oil extraction factory EP3" retieved January 9, 2007 from http://www.p2pays.org/ref/04/03014/