ANALYSIS OF ENVIRONMENTAL VIOLATIONS BY SOME TEXTILE INDUSTRIES IN NIGERIA.

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ABSTRACT

An evaluation is presented of the state of compliance with environmental pollution control regulations by a sample of six textile industries located in Northern Nigeria. The evaluation is based on the results of the monthly analysis of the effluents of the sample industries over a six month period. The average values for the selected parameters were compared with the permissible values as a basis for highlighting either compliance or violation. Only one industry in the sample, the only one that operated a functional effluent treatment facility, complied reasonably with the regulated standards while the other five consistently violated the set standards. The parameters monitored included pH, alkalinity, colour, conductivity, coliform, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Dissolved Oxygen, solid content, metals and anions like chloride and sulphide, oil and grease and phenols. Most of the effluents were in violation of the Federal Environmental Protection Agency standards and guidelines and they account for extensive environmental pollution in their areas of operation. Urgency in enforcement of the regulations is recommended.

INTRODUCTION

The development of technology is pursued with increasing intensity as a way of healing ailing economies. In Nigeria in particular, new industries are emerging from the effort to either survive or reverse current unpleasant trends in the economy[1,2]. The growing intensity of industrialisation inevitably imposes an increasing burden on the environment as both the source of raw materials and the depository of all effluents[3]. The wide range of new processes, raw materials and wastes rejected in association with emergent technologies and industries renders the environment and society increasingly vulnerable to contamination and related hazards[3]. There is a progressive contraction in the free-space available for comfort and safe occupation. The intensity of both real and potential contamination of land, water, food and air is progressive and imposes new and intensifying demands on the management of resources and services. The ultimate danger posed by either an unmanaged or a poorly managed industrialising society is cummulative, emerging as the sum of contributions from individual types of industries. The efficiency of the management of the environment and risks thereto has as a reference point the rules and regulations of the agency of government charged with responsibility for the same. In Nigeria, issues of environmental protection and pollution control belong within the responsibilities of the Federal Environmental Protection Agency (FEPA) and the assessment of the efficiency of any environmental management effort must be in the context of the rules and regulations of this agency[4]. The operations of FEPA are, however, still hindered by its rather infantile state of establishment; an immediate consequence is that environmental protection and pollution control efforts and schemes are also referenced to standards enacted outside Nigeria. Such references are to laws of the United States Environmental Protection Agency (USEPA)[5], guidelines of United Nations organs like the World Health Organisation (WHO)[6], United Nations Environment Programme (UNEP)[7] and the United Nations Industrial Development Organisation (UNIDO)[8,9,10]. Violations of these standards are satisfactory causes for raising alarm to save the environment and society. The textile industry is a very important component of the Nigerian industrial scene[1] and contributes very considerably to the pollution problem in Nigeria; it must also consume an important part of effort, resources and funds expended on environmental protection and pollution control in Nigeria. This article examines violations of environmental standards by analysing the properties of effluents discharged by selected textile companies into their surroundings. It is believed that

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the picture indicated by this set of companies may be extrapolated to reflect the Nigerian situation.

EXPERIMENTAL

Methodology.

A selection was made of six textile manufacturing industries located in northern Nigeria: four of these are located in Kaduna capital city, one in Zaria, a major city in Kaduna State, while the sixth industry is located in the capital city of Kano. The effluents discharged by these industries were described and analysed at monthly intervals over a period of six months. Certain parameters of the effluents were compared between months and different companies and the results applied to determine the extent of compliance with or violations of safe standards and pollution control regulations and laws. All results reported are averages of three determinations.

The Sample Industries.

The textile manufacturing industries sampled in this work were identified as in Table 1 by letter codes A - F. While industries A - D are located in Kaduna, industry E is located in Zaria and industry F in Kano. All of these industries produce cotton cloth and carry out wet processes including dyeing and printing after scouring, bleaching and washing and produce effluent streams of various volumes as indicated in Table 1.

Table 1: Description of Industries in Sample

Industry	Location	Effluent volume per week (x 10^6 dm^3)	No. of Effluent Streams
A	Kaduna	35	7
B	Kaduna	12	2
C	Kaduna	30	3
D	Kaduna	13	3
E	Zaria	5	1
F	Kano	3	3

Table 2: Separation of Effluent stream Channels in Industry A

Channel No	Source of effluent	Typical effluent colour	Typical pH (units)	Typical conductance (μmhos)	Associated nuisance
1	Wax Recovery	Green	8	570	odour
2	Engraving	Orange	3	1300	high acidity
3	Treatment Plant	Green	10	2450	high solid
4	General Outlet	Green	12	9200	high solid
5	Indigo Dyeing	Blue	10	4200	high solid & odour
6	Pretreatment	Grey	13	16800	high solid
7	Printing & Dyeing	Blue	12	5400	high solid

Effluent Characteristics

All industries in this sample operate multiple effluent streams which have characteristic colours. A typical separation of effluent streams for discharge is presented for industry A in Table 2. The characteristics of the effluent streams which were measured in this work and applied in assessing environmental violations included pH, alkalinity, colour, conductivity, coliform, Chemical Oxygen Demand (COD), 5-day Biochemical Oxygen Demand (BOD_5), Dissolved Oxygen, solid content, metals and anions like chloride and sulphide, oil and grease and phenols.

Sampling

For each effluent stream, a 2.5 dm^3 sample was taken from the drain at hourly intervals over a six hour production period. The six samples were mixed in a plastic bucket and one 2.5 dm^3 sample scooped from the mixture while still stirring. Analyses were conducted on portions of this final sample stirring each time a portion was taken.

Assessment of Effluent by pH.

The pH of each effluent stream was determined once a month for six months using a Griffin pH meter. The values obtained for the sample industries are summarised in Table 3 and assessed in comparison with the FEPA regulated limits of 6 - 9. It was the effluent stream that had the most objectionable value for each sample industry that was applied in the assessment included in Table 3 each month.

Table 3: Trends in pH values

Industry	Monthly range (units)	Monthly average (units)	Monthly average / FEPA values	Rating
A	12.5 -13.0	12.8	1.42	highly polluting
B	10.6 - 13.0	12.5	1.39	highly polluting
C	11.5 - 13.0	12.4	1.38	highly polluting
D	8.0 - 12.0	9.9	1.10	polluting
E	7.5 - 8.0	7.7	0.86	acceptable
F	11.0 - 12.5	11.9	1.32	highly polluting

Table 4: Trends in conductivity (μmhos) between industries.

Industry	Monthly range (x 10^3 units)	Monthly average (units)	Monthly average / sample minimum	Rating
A	13.0 - 30.0	18917	6.64	excessive
B	1.25 - 13.9	7590	2.66	excessive
C	10.0 - 16.8	14633	5.13	excessive
D	3.25 - 6.5	4325	1.52	excessive
E	2.05 - 3.7	2850	1.0	high
F	7.0 - 24.0	20170	7.08	excessive

Table 4a :Conductivity distribution in various effluent streams within Industry

Effluent source	Monthly range (μmhos)	Monthly average (μmhos)	Rating
Wax recovery	450 - 630	522	moderate
Engraving	225 - 23000	7165	excessive
Treatment plant	2450 - 4300	3525	excessive
General outlet	5500 - 9200	7608	excessive
Indigo dyeing	3000 - 8250	5390	excessive
Pretreatment	13000 - 30000	18917	excessive
Printing & dyeing	2500 - 5400	4280	excessive

Assessment of Effluent by Conductivity.

The effluent conductivity was determined with an Electronic Switchgear Ltd. (London) conductimeter: the values obtained for the most offensive effluent streams are compared in Table 4 for the sample industries. Values are also presented in Table 4a for different effluent streams within industry A to illustrate a typical variation within each industry.

Evaluation by Colour and Solid Content.

The colour of each effluent stream was determined using a Lovibond Comparator 1000 and the result applied to evaluate compliance with FEPA standards as presented in Table 5. Total solid was determined by evaporating to dryness 100 cm^3 of the effluent in a preweighed platinum evaporating dish over a steam bath and drying the residue to constant weight in an oven at 180°C; the solid residue was weighed after cooling in a desiccator[5]; total solid was calculated as the increase in weight over the the empty dish. To determine dissolved solid, a portion of each sample was filtered through a Whatman ashless filter paper. 100 cm^3 of the filtrate was evaporated to dryness in a preweighed platinum evaporating dish on a steam bath and the residue dried to constant weight at 180°C as in the determination of total solids above. The residue was cooled in a desiccator and weighed as before and dissolved solids calculated as mg dm^{-3} weight increase over the empty dish. Suspended solid was calculated as the difference between the determined values of total solids and dissolved solids. The results are presented for the most objectionable effluent stream of each sample industry in Table 5a.

Table 5 : Assessment by effluent colour

Industry	Monthly range (Hazen units)	Monthly average (Hazen units)	Monthly average / FEPA limit	Rating
A	216 - 4320	1235	176.4	extremely offensive
B	900 - 6600	2890	412.9	extremely offensive
C	450 - 6200	1603	229.0	extremely offensive
D	100 - 840	387	55.3	very offensive
E	5 - 30	21.7	3.1	offensive
F	280 - 1296	667	95.3	very offensive

Table 5a : Assessment by solid content

Industry	Monthly range (mg dm^{-3})			Monthly average (mg dm^{-3})			Rating
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	
A	4287-25265	353-21233	7142-19075	11900	4537	9732	Offensive
B	993 -6322	28 - 420	780 - 6294	6085	380	6014	Offensive
C	4600- 144642	1184-3059	1740-142899	32028	2039	31351	Offensive
D	3948-6437	471 -1063	3254-5472	4763	796	4055	Offensive
E	273 - 2396	20.9-150	252.9-2246	987.3	67.6	920.3	nearly acceptable
F	6044-16272	1080-2720	4657-15521	10062	1628	2587	Offensive

Dissolved Oxygen and Coliform

Dissolved oxygen was determined using the azide modified Winkler iodometric method[5] on each effluent. The oxygen levels in the effluents most deplete of oxygen are compared and evaluated against FEPA standards in Table 6. Also presented in Table 6 are the values for coliform count in the most objectionable effluent stream of each sample industry.

Table 6 : *Dissolved Oxygen and Coliform*

Industry	Monthly range		Monthly average		Average oxygen depletion		Rating
	Oxygen (ppm)	Coliform (cm^{-3})	Oxygen (ppm)	Coliform (cm^{-3})	(ppm)	(%)	
A	0.0-7.2	18-TNTC	2.5	(1679)	5.78	69.6	Polluting
B	10.2-12.5	30-19800	10.5	45**	-2.22	-26.7	*
C	2.0-3.2	18	2.3	18	5.98	72.0	Polluting
D	0.8-3.2	0-TNTC	2.4	(1844)	5.88	70.8	Polluting
E	6.4-9.6	0-0.05	7.7	0.0	0.58	7.0	Good
F	1.0-2.0	18	1.5	3 .0	6.78	81.7	Polluting

* *highly oxidising components in effluents complicated results*

** the one rare high value was excluded to facilitate decision

( ) TNTC- Too Numerous To Count - values were excluded.

Table 7: *Effluent assessment by BOD_5 measurements.*

Industry	Monthly range (mg dm^{-3})	Monthly average (mg dm^{-3})	Average / FEPA limit	Rating
A	12.0 - 153.0	59.1	1.18	Excessive
B	9.6 - 316.0	87.9	1.76	highly polluting
C	9.6 - 153.0	37.9	0.76	acceptable
D	14.4 - 108.0	42.6	0.85	acceptable
E	4.8 - 12.0	8.8	0.18	acceptable
F	9.6 - 16.8	12.4	0.25	acceptable

Table 7a: BOD_5 Distribution within industry A

Effluent source	Monthly range (ppm)	Monthly average (ppm)	Rating
Wax Recovery	2.4 -67.2	23.0	acceptable
Engraving	2.4 - 24.4	11.4	acceptable
Treatment plant	7.2 - 79.4	34.9	acceptable
General outlet	12.0 - 153.0	59.1	excessive
Indigo dyeing	2.4 - 117.0	38.3	acceptable
Pretreatment	4.8 - 108.0	38.4	acceptable
Printing & dyeing	7.2- 117.0	39.7	acceptable

Biochemical Oxygen Demand (BOD).

The five-day BOD was determined by the dilution method[5] and rendered as the corrected dissolved oxygen depletion following a five-day incubation at 20°C. Results presented in Table 7 relate to the most offensive effluent streams of the sample industries. A typical pattern within the same industry is presented in Table 7a for industry A.

Chemical Oxygen Demand (COD).

Effluent COD was determined using 10 cm^3 of 0.04 M potassium dichromate solution acidified with 20 cm^3 sulphuric acid to reflux 20 cm^3 of sample for two hours and titrating the excess dichromate with 0.1 M ferrous ammonium sulphate solution using ferroin indicator[5]. Chloride and nitrite interferences were allowed for by adding mercuric sulphate (0.5g) and sulfamic acid (0.2g) to the mixture before refluxing. The highest values in the sample industries are compared in Table 8 while the variation within industry A is illustrated in Table 8a.

Table 8: Effluent assessment by COD measurements.

Industry	Monthly range (mg dm^{-3})	Monthly average (mg dm^{-3})	Average sample minimum	Rating
A	104 - 454	305	6.0	excessive
B	192 - 344	246.6	4.9	excessive
C	240 - 336	266.7	5.3	excessive
D	40 - 213.6	137.4	2.7	polluting
E	24 - 64	[illegible]3.7	1.0	moderate
F	224 - 272	241.3	4.8	excessive

Table 8a: COD distribution within industry A.

Effluent source	Monthly range (ppm)	Monthly average (ppm)	Rating
Wax Recovery	29.6 -56	37.9	moderate
Engraving	0 - 454	108.5	polluting
Treatment plant	72 - 120	97.3	moderate
General outlet	88 - 336	166	polluting
Indigo dyeing	144 - 448	262.4	excesive
Pretreatment	256 - 456	332.8	excessive
Printing & dyeing	56 - 136	92.8	moderate

Table 9 : Effluent assessment by metal content.

Element	Industry	Monthly range (ppm)	Monthly average (ppm)	Average FEPA maximum	Rating
Ca	A	0.6-90	25.3	0.13	acceptable
	B	15-130	61.3	0.31	acceptable
	C	17-67	32.9	0.16	acceptable
	D	13-20	17.7	0.09	acceptable
	E	67-128	91.7	0.46	acceptable
	F	14.6-50	34.3	0.17	acceptable
Cu	A	8.2-140	47.7	47.7	offensive
	B	0.7-10.2	1.2	1.2	offensive
	C	11-18500	3419	3419	extremely offensive
	D	0.1-10.7	2.9	2.9	offensive
	E	0.02-0.17	0.1	0.1	acceptable
	F	1.5-1500	315.3	315.3	very offensive
Fe	A	26.5-2000	709.1	35.5	very offensive
	B	0.1-1.6	0.6	0.03	acceptable
	C	45-25000	5116.7	255.8	extremely offensive
	D	3.8-45	20.3	1.0	nearly acceptable
	E	3.0-3.6	3.0	0.2	acceptable
	F	5.0-5000	923.8	46.2	very offensive
Pb	A	0.4-2.5	0.97	0.97	acceptable
	B	0.9-1.0	0.9	0.9	acceptable
	C	0.3-0.8	0.5	0.5	acceptable
	D	0.2-2.3	0.8	0.8	acceptable
	E	0.1-0.2	0.17	0.17	acceptable
	F	0.3-0.5	0.39	0.39	acceptable

Metal Content

100 cm^3 of effluent sample was evaporated to dryness over a steam bath and the residue digested in aqua regia[11] and made up to 100 cm^3. This clear solution was analysed for arsenic, cadmium, calcium, copper, iron and lead by flame atomic absorption spectrophotometry using the Perkin Elmer Model 306 spectrophotometer operated on the air-acetylene flame and appropriate single element hollow cathode lamps. The values for various elements derived from the effluent stream of each sample industry most objectionable with respect to the respective elements are presented in Table 9.

Other Inorganic Components

Alkalinity was determined by reacting 10 cm^3 of the filtered hot effluent sample with 20 cm^3 of 0.05 M sulphuric acid and back-titrating the excess acid with 0.1 M sodium hydroxide solution; results were calculated as the equivalent amount of calcium carbonate[5]. Chloride was determined by titrating 100 cm^3 of sample with 0.02 M silver nitrate solution after treating the sample aliquot to reduce colour and remove sulphite, sulphide and thiosulphate using $Al(OH)_3$ and H_2O_2 with pH control respectively[12].

Sulphide was determined in 500 cm^3 of the effluent by reaction with 10 cm^3 of concentrated sulphuric acid to liberate the sulphide. The sulphide was flushed in a stream of carbon dioxide and dissolved in 100 cm^3 of 0.05 M zinc acetate solution. This mixture was acidified with 5 cm^3 HCl and reacted with excess of 0.025 M iodine solution which was back-titrated with 0.025 M sodium thiosulphate solution using starch indicator[5]. These results are presented in Table 10 for the effluent stream which was most divergent with respect to each parameter in each sample industry.

Table 10: Effluent assessment by other inorganic components.

Parameter	Industry	Monthly range (mg dm^{-3})	Monthly average (mg dm^{-3})	Average FEPA maximum or *sample minimum	Rating
Alkalinity	A	390 - 1292	752.5	26.9	excessive
	B	320 - 2440	2020.0	72.1	excessive
	C	464 - 1292	792.7	28.3	excessive
	D	170 - 844	518.5	18.5	excessive
	E	12 - 40	28.0	1.0	moderate
	F	396 - 736	558.7	20.0	excessive
Chloride	A	241.1-2025	788.5	1.3	polluting
	B	120.0-620.0	426.0	0.7	acceptable
	C	224.0-628.0	364.3	0.6	acceptable
	D	56.7 - 725.0	326.1	0.5	acceptable
	E	64.0 - 66.8	66.4	0.1	acceptable
	F	304.8-648.0	466.0	0.8	acceptable
Sulphide	A	100.4-800.0	350.1	1750	excessive
	B	0.2 - 7100	600.0	3000	excessive
	C	120-1160	653.7	3269	excessive
	D	0 - 180	75.0	375	excessive
	E	ND	-	-	good
	F	360 - 1440	933.3	4667	excessive

ND = not detected

Table 11: Effluent assesment by phenolic content.

Industry	Monthly range (μg dm^{-3})	Monthly average (μg dm^{-3})	Average FEPA limit	Rating
A	160 -324	254.7	1.3	excessive
B	100 - 260	155.0	0.8	acceptable
C	27 - 340	224.3	1.1	excessive
D	125- 225	166.7	0.8	acceptable
E	8 - 142	81.0	0.4	acceptable
F	8 - 280	101.5	0.5	acceptable

Table 12: Effluent assessment by oil and grease content

Industry	Monthly range (mg dm^{-3})	Monthly average (mg dm^{-3})	Average FEPA limit	Rating
A	1320-1600	1473.3	147.3	very offensive
B	68.9-200.1	182.7	18.3	offensive
C	580-2250	1165.0	116.5	very offensive
D	450-1620	1034.0	103.4	very offensive
E	36 - 40	37.3	3.7	offensive
F	0.4 - 590	271.7	27.2	offensive

Phenols.

Phenolic content was determined using the aminoantipyrene method[5]. The effluent sample was distilled and 500 cm^3 of the distillate reacted with 3 cm^3 of 2% aminoantipyrene and 3 cm^3 of 8% potassium ferricyanide solutions at a pH adjusted to 10.0 with NH_4OH. The phenol complex was extracted with 50 cm^3 of chloroform and measured spectrophotometrically at 460 nm. Phenol levels were obtained as presented in Table 11 for the most offensive effluent stream of each industry.

Oil and Grease.

1 dm^3 of the effluent sample was acidified with 5 cm^3 H_2SO_4 and extracted twice with 40 cm^3 portions of petroleum ether. The combined extract was evaporated on a steam bath to remove the solvent and the oil and grease left as residue was weighed after drying in a desiccator[5]. The results are presented in Table 12 for the most oily/greasy effluents of each sample industry.

RESULTS AND DISCUSSION

Effluent pH

The results presented in Table 3 show that pH values were outside the regulated limits of 6 - 9 in all except industry E. A general threat to the water quality and aquatic life in the receiving waters is indicated. Other than the most offensive pH values recorded in Table 3, there were offensive values outside both the upper and lower limits; values as low as 1 or 2 were consistently observed in effluents released from electrolytic baths in industries where acid engraving takes place.

Effluent Conductivity.

Conductivity values were generally large and showed a trend that correlated with solid contents of effluents. Values varied widely between and within industries as indicated in Tables 4 and 4a and suggest that heavy chemical burden is imposed on the receiving environment. FEPA has apparently not stipulated a limit for this parameter.

Colour and Solid Content

When compared to the FEPA limit of 7 Hazen units, all the effluents metered as in Table 5 were extremely objectionable. These effluents impose a very heavy load of colourants on the receiving waters. The intensity of effluent colours indicate lack of treatment in most industries. Even the best industry with respect to this parameter required further treatment to remove colour. From the results in Table 5a, only industry E showed acceptable levels of total and dissolved solids; it still had unacceptable levels of suspended solids. All other industries in the sample were outside the FEPA limits of 2,030, 30 and 2,000 mg dm^{-3} for total, suspended and dissolved solids respectively. Only industry E had a functional effluent treatment plant during the period covered in this work.

Dissolved Oxygen and Coliform.

As shown in Table 6, considering that the saturation concentration of oxygen at 25°C is 8.28 ppm[12,13] and a critical dissolved oxygen level of 4 ppm in the receiving waters, large depletion of dissolved oxygen occurred in all but one effluent. The coliform limit of 4 cm^{-3} was exceeded also in all but one effluent. These results highlight a lack of management in all the sample industries except industry E. The receiving waters run the risk of extreme depletion of dissolved oxygen and microbiological contamination.

BOD_5

The results in Table 7 show that industries A and B produced effluents of higher BOD values than the FEPA limit of 50 ppm; in other industries average values were within this stipulated limit including industries E and F that were consistently within accepted limits throughout the period of this investigation. Typical variations within industry A, as presented in Table 7a show that one bad effluent stream like the general outlet effluent may so dominate others as to render the combined effluent stream too polluting overall.

COD.

The monthly average load of reducing or potentially oxygen consuming chemicals, as presented in Table 8 is high for all sample industries except industry E. A typical distribution within the same industry is noted as in Table 8a. The entries in Tables 7 and 8 as also Tables 7a and 8a allow the relative contributions of BOD and COD to total dissolved oxygen depletion to be observed.

Metal Content.

As indicated in Table 9, only industry E was within the FEPA limits for all six metals monitored. All sample industries were within limits (1 mg dm^{-3}, 1 mg dm^{-3}, 200 mg dm^{-3} and 1 mg dm^{-3}) for As, Cd, Ca and Pb respectively. Other than E, all other sample industries exceeded the FEPA standards for Cu (1 mg dm^{-3}) to various extents. Like E, industry B was within FEPA limit of 20 mg dm^{-3} for Fe while all other sample industries exceeded this limit to various extents from slight to extremely offensive excesses. In most of the sample industries it was just fortuitous that the limits for hazardous metals like As, Cd and Pb were not exceeded; the levels for other metals could be drastically reduced by simple available technology.

Other Inorganic Components.

As indicated in Table 10, only industry E was within the FEPA limits of 600 and 0.2 mg dm^{-3} for chloride and sulphide respectively with a much lower alkalinity than other sample industries; there is no FEPA limit for alkalinity. All other sample industries were excessively outside FEPA limits for both chloride and sulphide with similarly excessive alkalinity values. Lack of effluent treatment is appropriately reflected in the measured values. The high sulphide values are particularly disturbing for the related potential to pollute the air both within the factory and outside in the area containing the receiving water basin. Excessive alkalinity in the receiving water enhances corrosion of structures and wares in its course.

Phenols.

The phenols results of Table 11 were within the FEPA limits of 200 mg dm^{-3} for four sample industries out of six; they exceeded the limits for industries A and C.

Oil and Grease.

The results presented in Table 12 show that effluents were excessively oily and greasy compared to the FEPA limit of 10 mg dm^{-3}.

Implications of Results.

The results presented in this article imply a large-scale environmental pollution by most of the textile industries included in this study. Only one of the industries operated a functional effluent treatment system during the work reported. The pollutant load could be reduced drastically if industries operated even a primary effluent treatment before discharging their effluents. Although the technology required to achieve this appears to be familiar to the industries, concern for environmental preservation is inadequate for stimulating necessary action within industries. A very hazardous environmental attitude prevails in the cities included in this work and may represent a general Nigerian situation.

CONCLUSION

Most of the industries covered in this work produce and discharge objectionable levels of pollutants. Most parameters measured were excessive relative to the standards set for them. Only the one industry that operated an effluent treatment obtained effluents within acceptable quality limits. The attitude of industries to environmental protection does not stimulate appropriate action for maintaining a safe industrial environment. The picture that emerges from this work may highlight the general Nigerian situation. The need to enforce environmental regulations is urgent in order to protect the environment from industrial pollutants.

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