

LARGE INDUSTRIAL ESTATE AND THE ENVIRONMENT - A CASE STUDY OF IKEJA INDUSTRIAL ESTATE

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Abstract

The uncontrolled discharge of industrial wastes into water bodies has led to degradation of the environment in several forms. Gaseous, liquid and solid wastes are discharged into the environment without the necessary precautions to safeguard it. In line with the National Policy on Environment, a rethink in this respect is required to ensure the environment is safe for present and future generations.

Introduction

The environment and its resources are the sources of livelihood for every living thing. It is therefore necessary that it is properly managed to meet the needs of the present and future generations.

The emergence of macro-economic growth in the country as a result of the oil boom of the early 1970s, changed the consumption pattern of the Nigerian public. This led to the rapid increase in the number of industries in the country to meet the demand for goods. According to the National Directorate of Industries, over 5000 industries (primary, secondary and tertiary industries) were established during this period (Aina, 1990). These came with their attendant problems, which is degradation of the environment.

A substantial number of the tertiary industries were established in Lagos Area. Over 70 of the industries in the Lagos Area are situated in the Ikeja Industrial Estate and this necessitates the need for the environmental assessment of this industrial estate.

At the time when many of these industries were established, not much attention was given to their eventual consequence on the environment. Governments then were more interested in creating an enabling environment for the enhancement of the production of goods. Nothing was done with respect to environmental protection. Industries were therefore built without the appropriate environmental guidance such as environmental planning, design and management consultation. The consequences of this neglect are the uncontrolled discharge of wastes by industries into the environment, which eventually served as sources of hazard to both man, animals and aquatic life.

This led to a rethink in the country's development strategy and a move towards development without environmental degradation. In order to obtain a sound environment, the *National Policy on Environment* (1989), was promulgated with the following goals:

- a. Secure for all Nigerians a quality environment adequate for health and well being.
- b. Conserve and use the environment and natural resources for the benefit of present and future generations.
- c. Restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems.
- d. Raise public awareness and promote understanding of essential linkages between environment and development and to encourage individual and community participation in environmental efforts.
- e. Cooperate with other countries, international organizations and agencies to achieve optimal use of trans-boundary natural resources and effective prevention or abatement of trans-boundary environmental pollution.

Federal and State government agencies were therefore established to set standards for the environment and monitor waste generation and pollution nationwide. It need be stated that emphasis in this paper has been placed on liquid waste and the pollution resulting from it. Other forms of pollution were also discussed.

Industrial Estates In Lagos State

The metropolitan nature of Lagos State makes it a viable location for the establishment of industries. Further encouragement is given by the availability of the necessary infrastructure. About 60 percent of the industries in the country are therefore located in the State (Longe and Salau, 1997) with a substantial number of them sited in the Ikeja Industrial Estate. These industries are scattered in the industrial estates of Apapa (No 16.), Ikeja (No 67.), Isolo/Oshodi (No 19.), Iganmu (No 12.), Ilupeju (No 9), Ijora (No 8.) and Ogba (No 7.). The Ikeja industrial estate, which has the largest number of industries, is the area of concentration of this paper. The industries in this Industrial Estate have been categorized in Table 1 below.

Table 1 - Categories of Industries in the Ikeja Industrial Area

S/No.	Category	Number
1.	Food and beverages	4
2	Breweries	2
3.	Pharmaceutical industries	9
4.	Textiles industries, foam products and bags	10
5.	Chemicals, paints, cosmetics and allied products	9
6.	Paper processing industries	3
7.	Plastic, household products, ceramic and glass wares	10
8.	Metal products	15
9.	Livestock feeds.	3
10.	Clay brick industry	1

Source: Enumeration was done by the writers.

The Ikeja Industrial Estate

Industrial waste could be liquid or solid waste and gaseous contaminants. These can be further classified as hazardous and non-hazardous ones. Available data from various environmental research works carried in the country indicated that environmental degradation and pollution are serious problems requiring urgent remedial action (Aina EOA, 1990). This scenario is not different from the Ikeja Industrial Estate. Waste treatment in majority of the industries is virtually non-existent. Only a few of the industries have the simplest pollution control facility such as sedimentation and sand filtration facility, oil and grease traps for effluent, scrubbers, particulate traps and precipitators for gaseous emissions. Where some of these facilities exist, they are grossly inadequate to cope with the volume and type of wastes generated. Furthermore, those that are functional are poorly maintained and some have even broken down.

Gaseous Contaminants And The Resultant Pollution

Pollution of the environment due to gaseous contaminants is a delicate issue particularly where emission limits have been exceeded because there is no alternative to the utilization of the air around us.

The production processes of a substantial number of the industries in the industrial estate under consideration led to the production of gaseous contaminants. This is further worsened during power failure since all the industries operate generating sets.

The emission levels of some of these industries are quite high and this was observed in some few industries. Though the emission levels were not measured, it was clear that some would not have met the required standards given in Table 3.2 of the Guidelines for Environmental Pollution in Nigeria (FEPA, 1991). This is reproduced in the Table 2 below.

Table 2 - Emission Limits for Particulates from Stationary Sources

S/No.	Source (Combustion of fuels)	Limits (mg/nr)
1.	Dark burning	250
2.	Blast furnace gas burning	200-500
3.	Central stations	100-500
4.	Coal burning	50-250

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5.	Oil burning	50-300
6.	Heavy oil burning	100-500
7.	Incineration of refuse.	150-1000
8.	Asphalt plants	70-5000
9.	Carbon black manufacture	40-60
10.	Cement production	150-500
11.	Coal processing	150
12.	Coke manufacture (metallurgical)	40-60
13.	Electrode manufacture (metallurgical)	150
14.	Furnaces	75-600
15.	Kilns (cement)	75-600
16.	Ki Ins (ceramics)	150-600
17.	Kilns (lime)	300-600

The emissions from these industrial process are gases like sulphur dioxide, carbon monoxide, nitrogen dioxides, ammonia, hydrogen sulphide among others. These gases are acidic and lead to corrosion of metal surfaces and stonewalls. Most importantly is the effect of these gases on human health. Some of these gases could lead to the susceptibility to lung cancer, bronchitis and the concentration of certain metals in the blood stream. They also affect other animals and plants.

Noise Pollution

The noise from industries can be divided into two:

- a. Noise emitting within the plant, which might give rise to damage to the hearing of employees.
- b. Noise radiating from the plant, which could cause annoyance to the local community.

Most of the industries in the Ikeja Industrial Estate do not have noise abatement facilities.

Noise is therefore generated without the application of any control measure. As a result of the noise generated in some of the industries, employees of such industries only hear when speech is made at a level beyond normal hearing of human beings. This was observed from an interaction with some employees. Table 4.2 of the Guidelines for Environmental Pollution in Nigeria provides the noise exposure limits for Nigeria. The Table is reproduced below.

S/No.	Duration per Day in hours	Permissible Exposure Limits (dB)
1	8	90
2	6	92
3	4	95
4	3	97
5	2	100
6	1.5	102
7	1	105
8	0.5	110
9	0.25 or less	115

In certain cases, employees are given noise protection devices as in the case of the Universal Steel Ltd. Despite this, however the level of noise still requires to be reduced so that it does not constitute a nuisance in the society.

Liquid Waste And The Resultant Pollution

Most Nigerian industries discharge their untreated effluents through drains or canals into the nearest water body; i.e. streams, rivers, lagoons etc. relying on dispersal by dilution thereby causing water pollution problems. The effluents contain solid inorganic matter, organic matter, toxic substances, mineral nutrients, acidic and alkaline substances. Some industries discharge hot effluents into water bodies, which is dangerous to aquatic life.

Telltale signs of water pollution arising from these disposal methods are not difficult to identify. Many of the receiving water channels do not possess adequate assimilative capacity for the effluents. As a result of this, coloured streams and drains are not uncommon in areas with concentration of industries like the Ikeja Industrial Estate. Examples are some textile mills and breweries that discharge their effluents to public drains. In 1977 however, a treatment plant known as WEMABOD treatment plant was established at the industrial area for the treatment of trade effluent. Many industries near the treatment plant subscribed to it and were discharging trade effluent into it. At the time of our visit in the year 2000, however the treatment plant had broken down.

Investigation reveals that Specomill Textiles Ltd at Awosika Avenue, Off Oba Akran Way for example has a functional effluent treatment plant, a caustic soda plant and a wax recovery plant. The caustic soda recovery tank however had several leakages while the wax recovery plant was not being properly utilized.

Information was also gathered on Robicon Aluminium Extrusion (RALEX) Ltd along Acme Road. Effluent in this industry is received in settling tanks from where it is discharged into public drains without further treatment. Spent oil is also flushed to the drains and the floor of the extrusion plant is always soaked with oil.

The scenario in most of the industries in the Ikeja Industrial Estate is not too different from the two instances sited above. The resultant effect of the release of such raw effluent is the pollution of streams and rivers. Where there is no adequate water supply in a community, the community resorts to such stream and rivers for their water supply. Though no incidence of loss of life had been reported as a result of the consumption of polluted water, it does not mean that no incident had occurred. This practices could however lead to gastrointestinal and neurological disorders, decreased fertility, cancer etc. depending on the level of toxicity (Ihie, 1990).

There are several cases of trade effluent polluting water sources. An example is the 1987 petroleum product spillage from Kaduna Refinery into Romi and Rido Rivers, which resulted in the pollution of well waters. Another example is the trade effluent from the WEMABOD Treatment Plant at Ikeja, which spilled into Idimangoro area of Agege. This resulted to pollution of drinking water in the general area (FEPA Guidelines, 1991). Several examples of pollution resulting from trade effluent abound. Serious caution therefore requires to be exercised in order to have a safe environment.

Solid Waste And The Resultant Pollution

Solid wastes resulting from industrial activities in the industrial estate are dumped at waste collection centers. These could be product containers, waste products as a result of iron and steel production, glassware production, aluminum products, marble, sanitary wares, spent chemicals and heavy metals. Most of these waste products are not dumped in an environmentally sound manner. An example of improper disposal is done by Livestock Feeds Nigeria Limited that disposes spent grains in the locality of their premises. The resultant effect is the odour that emanates from the waste. This could lead to the breeding of rodents, flies, mosquitoes and snails, which are vectors for the transmission of diseases like typhoid, malaria, cholera, diarrhea, dysentery, food poisoning and several others. There is also unsightliness because of the unsound practice. This unsound practice apart from the adverse effects listed above would eventually lead to pollution of ground water.

Treatment process for solid waste however requires establishing a sanitary landfill. This could be an expensive venture for an industry. Collectively however the industries could establish one. Some of the industries presently subscribe to the Lagos State Waste Management Authority (LAWMA) for the collection and disposal of their solid waste.

Analysis Of Effluents From Some Selected Industries

For a thorough appreciation of the subject under consideration, the effluent discharged to the environment from some industries were analyzed and tabulated in Table 4 below.

Laboratory Analysis

The laboratory analyses carried out are as follows:

PH

This was measured With a glass electrode pH meter. The pH meter used was bench CTBA corning/Kent EIL 7055 (1990). with a sensitivity of 0.01.

Nitrite/Nitrate

The nitrate-nitrogen forms were assayed using the Brucine method of Greweling and Peach (1964).

Conductivity

This was measured using a field coining portable conductivity meter (1990) with a sensitivity of 0.5%, 0.2us at 5mg/l ionic strength.

Sulphide

The sample solution was reacted with standard iodine solution. The resultant solution was acidified and titrated with standard sodium thiosulphate solution using starch indicator.

Heavy metals (Cd, Cr, Cu Fe)

A representative sample was digested in dilute nitric acid and hydrogen peroxide. The digest was then refluxed with hydrochloric acid for 3 hours. The entire digest was then made up to 50ml with distilled water and the heavy metals estimated using air-acetylene.

Sulphate

The sulphate in the sample was extracted with a 500ml solution of potassium orthophosphate and the sulphate determined by BaCl₂.2H₂O Gelatic turbidimetric method.

Total Suspended Solids

Direct reading Spectrophotometer was used. The instrument was adjusted using distilled water as blank before introducing the sample into it for reading. The amount of the suspended solids in mg/l was read from the scale.

Oil and Grease

This is determined by extraction of the waste sample with trichlorotrifluoroethane.

Biochemical Oxygen Demand

The sample is diluted with distilled water and the sample is poured into BOD bottle. The sample is allowed to incubate for 5 days at 20°C. The dissolved oxygen is measured before and after incubation and the BOD is calculated.

Chemical Oxygen Demand

The oxygen equivalent of organic matter that can be oxidized is measured using potassium dichromate. Silver sulphate is used as a catalyst to aid the oxidation process.

Alkalinity

Alkalinity was determined by titrating against H₂CO₃ and results were expressed in terms of CaCO₃.

Table 4 - Effluent Analysis of Some Selected Industries in Ikeja Industrial Area

S/N	Parameter	Specomill Textile	Cadbury Pic.	Nig.	NBC (C.Cola)	Royal Paint	Guinness Nig. Pic.	Neimeth Pharm.
1.	PH	9.3*	10.07		6.56		4.18	6.7
2.	Temp C	28.5	27		26.1	6.0	28	26
3.	Turbidity	6	21		70			

4.	(FTU) Conductivity (ms/cm)	0.44	0.33	2.18	0.12	0.55	1.06
5.	TDS (mg/l)*	220	170	1090	60	280	530
6.	Chloride (mg/l)	60	ND	ND	ND	ND	120
7.	Phosphate as PCV (mg/l)	0.02	ND	ND	ND	ND	-
8.	Sulphide, S ₂ - (mg/l)	0.012	ND	ND	ND	ND	-
9.	Alkalinity (mg/l)	36	ND	ND	ND	ND	50
10.	Oil & grease (ppm)	2	ND	ID	ND	ND	-
11.	Chromium (mg/l)	0.01	ND	ND	0.39	ND	-
12.	Copper (mg/l)	0.06	ND	0.78	ND	ND	1.82
13.	COD (mg/l)	90	130	140	ND	ND	-
14.	Iron (mg/l)	0.01	ND	0.49	ND	ND	1.36
15.	BOD (mg/l)	400	ND	310-	ND	750	240
16.	Nitrite, NO ₃ " (mg/l)	-	0.04	ND	0.092	ND	-
17.	Sulphate (mg/l)	ND	ND	17	750*	ND	-
18.	Cadmium (mg/l)	ND	ND	0.11	ND	ND	-
19.	Chlorine (mg/l)	ND	ND	0.44	ND	ND	1.2*
20.	Nitrate (mg/l)	ND	ND	0.9	ND	ND	-
21.	TSS(mg/l) **	ND	ND	596	4.3	ND	-

*TDS is Total Dissolved Solids

**TSS is Total Suspended Solids

• Parameters that do not meet the guidelines and Standards for Environmental Pollution Control

ND - Not detected

Table 1.2, Part 1 of the Guidelines and Standards for Environmental Pollution Control in Nigeria (FEPA, 1991) However give the following Interim Effluent Limitation guidelines (partly reproduced in Table 5 below) for all categories of industries.

Table 5 - Interim Effluent Limitation Guidelines for All Categories of Industries (FEPA Guidelines, 1991)

S/No.	Parameter	Limit for discharge into surface water (mg/l)	Limit for application (mg/l)
1.	Colour (Lovibond units)	7	-
2.	PH	6-9	6-9
3.	BOD at 20°C	50	500
4.	Total suspended solids	30	-
5.	Total dissolved solids	2,000	2,000
6.	Chloride (asCl ")	600	600
7.	Sulphate (SO ₄ ²⁻)	500	1000
8.	Sulphide (S ²⁻)	0.2	-
9.	Cyanide	0.1	-
10.	Oil and grease	10	30

4.	(FTU) Conductivity (ms/cm)	0.44	0.33	2.18	0.12	0.55	1.06
5.	TDS (mg/l)*	220	170	1090	60	280	530
6.	Chloride (mg/l)	60	ND	ND	ND	ND	120
7.	Phosphate as PCV (mg/l)	0.02	ND	ND	ND	ND	-
8.	Sulphide, S ₂ ⁻ (mg/l)	0.012	ND	ND	ND	ND	-
9.	Alkalinity (mg/l)	36	ND	ND	ND	ND	50
10.	Oil & grease (ppm)	2	ND	ID	ND	ND	-
11.	Chromium (mg/l)	0.01	ND	ND	0.39	ND	-
12.	Copper (mg/l)	0.06	ND	0.78	ND	ND	1.82-
13.	COD (mg/l)	90	130	140	ND	ND	-
14.	Iron (mg/l)	0.01	ND	0.49	ND	ND	1.36
15.	BOD (mg/l)	400*	ND	310-	ND	750*	240-
16.	Nitrite, NO ₂ ⁻ (mg/l)	-	0.04	ND	0.092	ND	-
17.	Sulphate (mg/l)	ND	ND	17	750*	ND	-
18.	Cadmium (mg/l)	ND	ND	0.11	ND	ND	-
19.	Chlorine (mg/l)	ND	ND	0.44	ND	ND	1.2*
20.	Nitrate (mg/l)	ND	ND	0.9	ND	ND	-
21.	TSS(mg/l) **	ND	ND	596-	4.3	ND	-

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6.	Chloride (asCl ⁻)	600	600
7.	Sulphate (SO ₄ ²⁻)	500	1000
8.	Sulphide (S ²⁻)	0.2	-
9.	Cyanide	0.1	-
10.	Oil and grease	10	30

11.	Nitrate (NO ₃)	20	-
12.	Phosphate (PO ₄ ³⁻)	5	10
13.	Iron	20	-
14.	Phenolic compounds	0.2	-
15.	Chlorine	1.0	-
16.	Cadmium	Less than 1	-
17.	Chromium	Less than 1	-
18.	Copper	Less than 1	-
19.	Lead	Less than 1	-
20.	Mercury	0.05	-
21.	Nickel	Less than 1	-
22.	Selenium	Less than 1	-
23.	Silver	0.1	-
24.	Zinc	Less than 1	-
25.	Total metal	3	-
26.	Calcium	200	-
27.	Magnesium	200	-
28.	Boron	5	5
29.	Detergent (linear alkylate sulphonate as methylene blue active substance)	15	15
30.	Arsenic	0.1	-
31.	Barium	5	5
32.	Temperature	Less than 40°C within 15m of outfall.	Less than 40°C.

The discharge shown in Table 4 is done to surface water. Comparing the two tables bring out the obvious disparity between the FEPA (now FMOE) laid down standards and the effluent discharged to watercourses by the various industries. The parameters of the various industries that do not meet FEPA guidelines are shown in the table (Table 4).

The discharge from Specomill Textile has a pH of 9.3 while FEPA guidelines limit is 6-9. This implies that the discharge from the industry has high alkalinity. The limit for oil and grease as given in the Guidelines is 10 ppm while NBC discharges 11 ppm as effluent. Grease and oil are not easily decomposed by bacteria and can interfere with biological action and cause maintenance problems. It can even block sewers and can cause unsightly floating matters and films (Tchobanoglous and Burton, 1991). The limit for discharge of copper as effluent is less than 1mg/l. This limit was exceeded by Neimelh Pharmaceuticals (1.82mg/l). Copper is toxic and could be carcinogenic. BOD has a limit of 50mg/l. NBC, Specomills Textiles, Guinness Nig. Pic and Neimeth Pharmaceuticals all exceeded these limits. The discharge of untreated BOD into the environment results in biological stabilization of the waste and consequently depletion of natural oxygen resources and the development of septic conditions (Tchobanoglous and Burton, 1991). The limit for chlorine as given in the Guidelines is 1 mg/l. Neimeth Pharmaceuticals however has an effluent of 1.2mg/l and chlorine is known to be poisonous. The Guidelines give TSS limit of 30 mg/l while NBC discharges a value of 596mg/l. This can lead to the development of sludge deposit and anaerobic conditions (Tchobanoglous and Burton, 1991). Finally the limit for sulphate is 500mg/l; Royal Paints however had an effluent of 750mg/l. This could eventually lead to the formation of sulphuric acid, which is corrosive to sewer pipes (Tchobanoglous and Burton, 1991).

It need be stressed that the effluents of most of the other industries in the Industrial Area under consideration are not too different from those analyzed above.

Ikeja Industrial Area Central Trade Effluent Treatment Facility

Observing that most industries within the Ikeja Industrial Estate cannot establish treatment plants for the treatment of trade effluent, the WEMABOD Estate Limited set up an integrated trade effluent treatment facility at Henry Carr Street, Ikeja. Industries were expected to subscribe to the

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system in order for effluent pipes to be linked to the treatment plant for the treatment of wastewater. The Plant was established in 1977, at the peak of the oil boom when a substantial number of industries were set up.

The facility was designed for an average flow of 545m³/hour and the daily total flow of 13080m³/day. The quality of the effluent to be treated at the treatment plant at full development of the Industrial Estate was expected to be (information obtained from FEPA):

- | | | | |
|----|-------|---|---------------|
| a. | BOD. | - | 400-500mg/l |
| b. | COD. | - | 1500-2000mg/l |
| c. | SS. | - | 350-400mg/l |
| d. | Temp. | - | 40-50°C |

The following industries were subscribers to the central trade system facility:

1. Guinness Nigeria Limited.
2. WAMCO
3. Berger Paint Nig. Ltd (domestic waste only)
4. Ivory Nig. Ltd.
5. Dunlop Nig. Ltd.
6. Livestock Feeds.
7. Nigeria Textile Mills.
8. SKG Pharmaceuticals
9. Neimeth Pharmaceuticals.

After commissioning, the treatment plant worked for sometime. The effluent from the treatment plant discharged into the Shasha River at Abule Egba. The system however broke down after sometime due to poor management. When the system broke down, the subscribers refused to pay their dues and this resulted to the abandonment of the treatment plant. Presently, the treatment plant is not functional. As a result of the break down some industries decided to set up own effluent treatment plants. Guinness for example established a stabilization pond. Those that could not set up any resorted to discharging their untreated effluent into public drains. This calls for the need for an appropriate agency to coordinate the activities of these industries in order to ensure environmental protection.

Recommendations

Individual noisy machines in an industry should be enclosed in acoustic rooms and barriers and screens should be erected to shield receivers from the noise.

Machines should be properly tuned to improve efficiency and reduce gaseous contaminants.

The WEMABOD treatment facility should be rehabilitated and possibly privatized for better efficiency in the treatment of wastes. FMOE should then ensure that effluent from the treatment plant meet required standards or establish an agency for that purpose.

FMOE should promote the establishment and proper management of independent waste treatment plants that can be subscribed to by the industries. Furthermore, the Ministry should analyze and monitor treated effluents for the industries that have treatment plants to ensure that the required standards are met.

FMOE should ensure the adoption of an environmentally friendly oil management strategy and prevent discharge into drains.

All the industries should be made to subscribe to LAWMA for the collection and disposal of their solid waste to ensure efficient solid waste management.

The management of the industries should be made to provide and enforce the use of protective equipment by their workers. It will also be their responsibility to enforce usage.

For better understanding of the hazards of wastes and pollution, educative and warning posters should be displayed at strategic places in industries in addition to environmental training which should be organized for their workers. All the industries should have a sustainable environmental policy.

FMOE should ensure that every industry carries out a monthly environmental audit report.