ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue I January 2024

Industrial Waste Management Techniques in Port Harcourt Rivers State Nigeria

JOHNBULL, Simeipiri Wenike[1]; PERRI, Tamunowunari[2]; IMIETE, Godspower[3]

[1]Department of Urban and Regional Planning, Rivers State University, Port Harcourt, Nigeria

[2,3]Department of Environmental Management, Rivers State University, Port Harcourt, Nigeria

DOI: https://doi.org/10.51244/IJRSI.2024.1101001

Received: 14 December 2023; Accepted: 26 December 2023; Published: 26 January 2024

ABSTRACT

The production of various types of industrial trash has expanded dramatically as a result of the industrial expansion that has been observed in Port Harcourt, Rivers State, Nigeria. This research provides a thorough analysis of the industrial waste management strategies that are currently in use in this city. The study includes a comprehensive investigation of the range of industrial waste, which includes solids, liquids, gases, and particulate matter, and which comes from different industrial sectors in Port Harcourt. The complex physical and chemical characteristics of these wastes are explored, as well as how they affect the surrounding ecosystem and public health. In addition, this research examines the current waste management approaches that are used in Rivers State and clarifies the legal frameworks controlling the disposal and treatment of industrial waste. It looks into the common ways that companies dispose of garbage, such as land filling, incineration, recycling, open dumping, and wastewater treatment. Effective waste management procedures are hindered by a number of problems, including poor disposal facilities, inadequate infrastructure, problems with regulatory compliance, and low public awareness. These problems are fully investigated. Additionally, this study promotes the use of cutting-edge waste minimization and management technology while highlighting the critical role that stakeholder and public participation play. Additionally, case studies showcasing Port Harcourt's industry-specific waste management techniques are presented. In order to reduce environmental deterioration, preserve public health, and promote sustainable industrial growth, it is important to create effective waste management systems. These findings are summarised in the conclusion of this academic study. Furthermore, it provides practical suggestions for enhancing trash management tactics in this metropolitan environment.

INTRODUCTION

Tucked away in Nigeria's Rivers State, Port Harcourt is a prime example of the energy and vibrancy of contemporary urbanization—a dynamic blend of industrialization, economic growth, and technological innovation. With its wide range of manufacturing plants, refineries, and industrial businesses, the city is a symbol of Nigeria's developing industrial might. However, the rapid expansion of industry has also brought to an increase in the production of industrial trash, which poses a serious threat to sustainable waste management techniques.

Port Harcourt's urban environment is alive with industrial vitality, a reflection of the thriving petrochemical, manufacturing, construction, and logistics industries, all of which have made substantial contributions to the city's economic expansion and revenue generation for the government. As a result, this increase in industrial activity has caused a commensurate rise in the generation of industrial waste in all of its forms,

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

compositions, and volumes.

The many types of industrial waste that are produced as byproducts of various industrial activities taking place in the city include solid residues, liquid effluents, gaseous emissions, and tiny airborne particles. Due to their distinct physical, chemical, and biological properties, these materials provide difficult management, disposal, and risk mitigation issues for the environment and public health.

In light of this, it is essential to conduct a thorough investigation of the current industrial waste management procedures in Port Harcourt. Comprehending the characteristics, makeup, and origins of industrial waste is essential for developing strong waste management plans that protect public health, minimize negative environmental effects, and support the city's path towards sustainable development.

This research project initiates a thorough investigation of the range of industrial waste produced by various industries functioning in Port Harcourt. Its goal is to examine the operational procedures, legal frameworks, and waste management systems now in use by various sectors to manage and get rid of these waste streams. In addition, it aims to pinpoint the obstacles and difficulties that stand in the way of efficient waste management procedures and to provide practical advice and insights to strengthen waste management tactics in this rapidly urbanizing environment.

Through an examination of the intricate web of industrial waste management in Port Harcourt, this study hopes to advance policy discussions, add to the growing body of knowledge on environmental sustainability, and encourage the implementation of creative, workable, and sustainable waste management strategies that balance economic development with ecological responsibility.

This revised introduction highlights the complex link between the growth in industrial waste that follows rapid industrialization and goes further into the details of Port Harcourt's industrial environment. It emphasizes how important it is to conduct a thorough investigation of waste management techniques in order to promote environmentally sound urban growth.

REVIEW OF THE LITERATURE

Waste that comes from manufacturing, production, and other industrial processes can take many different forms, including solids, liquids, gases, and particulates in the air. Sustainable environmental practices and public health depend heavily on the efficient handling of industrial waste in metropolitan areas such as Port Harcourt. Setting the scene, the introduction emphasizes how important it is to handle industrial waste and its effects on urban settings.

The industrial landscape of Port Harcourt is made up of a wide variety of industries, such as manufacturing facilities, building sites, and refineries that process petroleum. Understanding the scope and variety of industrial operations helps to determine the amount of trash produced by each industry.

Environmental Management Concepts

Managing the sustainable use of natural resources without compromising their quality or productivity is known as environmental management. The environment is no longer merely the air we breathe or the place we live in; in order to stay in business and survive in the more competitive global economy, businesses now have to take environmental issues seriously. The number of new laws pertaining to the environment is always rising, all of which benefits the environment for all of humanity.

Environmental management systems can help an organization fulfill its ever-growing responsibility for the state of the environment in the world going forward. The process of organizing the elements of the natural

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

world in which humans reside such that their intrusion and exploitation do not negatively impact the environment is known as environmental management (Uchegbu, 1998). Therefore, environmental management should be viewed as both a good and, more crucially, a positive measure of preventing disturbance for encouraging the environment's overall attractiveness. (Odemerho and Sada, 1988). According to Owolabi (2000), the United Nations damages ecosystems irreparably through its environmental initiative, Global Environmental Damage.

Industries consume a lot of energy, water, chemicals, and throwaway goods. They also produce a lot of garbage, including solid waste and wastewater. Small efficiency increases can therefore result in significant cost savings and improvements to environmental performance. Environmental management is a methodical technique to identifying workable strategies for minimizing harmful environmental effects and conserving resources including water, energy, and materials. The implementation of an environmental management system may frequently help save money and lessen environmental liabilities.

Adibe and Yassi et al. (2001) state that managing the environment sustainably in emerging nations is a very difficult task. This is because there are much too numerous, different, and complex social, economic, and cultural issues that have several facets, which translates into environmental issues. One may define the environment as the entirety of all the things that regularly impact or are influenced by humans. It presents both possibilities and constraints for human survival. Because of the environment's complexity as well as the many interactions and linkages that exist within it, managing the environment has therefore always confronted man with a number of difficulties and obstacles.

In order to jointly address environmental and socioeconomic issues affecting people and their environment, public technocrats collaborate with the organized private and voluntary sectors, civil society organizations, and other stakeholders in Environmental Planning and Management (EPM), a bottom-up participatory, interactive, and collaborative approach to urban planning and management. The method aims to improve local capacity for better planning and management while addressing the environmental issues that metropolitan areas face (Wahab, 1998).

The Handling and Elimination of Waste in Specific Industries

Breweries

Working with yeast that is grown in pure cultures, the brewing business is a part of the food sector. This calls for thorough cleaning procedures, and proper disinfection is also crucial. Breweries are batch industries that produce distinct beers that go through many treatments before being chilled and standardized. The brews are then converted into beer in various fermentation tanks and storage containers. Before the beer is poured into bottles, cans, or kegs, it must first be filtered and then run through a bright beer tank, also known as a cellar.

The following waste sources need to be disposed of at different manufacturing sections (like the beer production section):

(a) The brew house: Wasted grain, worthless raw materials, and leftover "trub" or "sludge"

(b) The department responsible for fermenting and storing: surplus yeast, gelager tank bottoms.

(c) Filtration: Initial and final runs.

(d) Stuffing:

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

(i) Cleaning freshly opened or returned bottles.

(ii) Beer lost because of excessive foaming, shattering bottles.

(iii) Placed the "remaining beer" back into the bottles.

(iv) The shift's beginning and ending (beer losses).

(v) A general clean at the conclusion of the workweek.

(e) General losses: Oil grease and other lubricants seeping out of autos and machinery, and dripping wasted grains from silos.

Waste Disposal Procedures: Waste disposal procedures used in breweries are similar. Spent grains are kept in storage silos and periodically loaded onto contract lorries to be dumped at an assumed designated dumping location. All liquid wastes are directed into a main channel by a system of manufacturing drains, where they are dumped untreated into streams or other bodies of water.

Wastes from Textiles

The grey mill, where the grey fabric is woven, and the finishing mill, where it is coloured, printed, or embroidered, are the two main sections of textile mills. Bleaching chemicals include those that contain active chlorine, including sodium chlorite, calcium or sodium hypochlorite, and bleaching lime. Bleaching also involves the use of hydrogen peroxide. Numerous additional compounds are used for various reasons.

Various bits and pieces of cotton and other solids, readily biodegradable materials like starch, non-biodegradable organic materials like oils, greases, and waxes, as well as a variety of process chemicals, organic anions like cyanides and sulphides, and other organics like phenols and pesticides used in proofing, are among the wastes coming from the textile industries. In addition, there are bases, suspended particles, phosphates, and compounds of sulphur and nitrogen.

Methods of Waste Disposal:

With one exception, the textile businesses in Lagos usually treat their liquid wastes before releasing them into public drains. The other textile industries in Lagos release their liquid wastes into the environment (or water bodies) untreated. To dispose of their solid waste, the majority of these industries used private contractors.

Wastes from the Paper Industry

The production of pulp and paper from wood is the primary focus of the paper industry. An examination of the major procedures used in the production of pulp and paper reveals that the chips acquired from milling are transferred to the digester, where they are mostly treated with NaOH and Na2S. The digester's final products are filtered and ground. The paper industry is well known for producing large amounts of trash, including spent sulphite liquor, fibre residue, waste water, and wood wastes.

Methods of Waste Disposal:

Solid waste from the processes is disposed of in front of the plants in the paper sector located in the northern region of the nation. A filthy and ugly landfill is created by piling up all types of solid waste behind the

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

plant. Untreated liquid effluent from the industry is dumped into adjacent waterways.

A well-designed effluent-treatment system for paper mills may significantly increase the industry's profitability by reusing chemicals and recirculating water, even if it requires a significant investment in facilities and capital.

Wastes from the Plastics Industry.

The technique used on this class of materials to transform them into products that are useful is the major focus of plastic processing. Melting, softening, moulding, shaping, and chilling are the primary phases in any process using thermoplastics. Studies conducted in some plastic sectors reveal that when thermoplastic material is processed, two forms of waste are produced: avoidable and unavoidable (Fig.1).

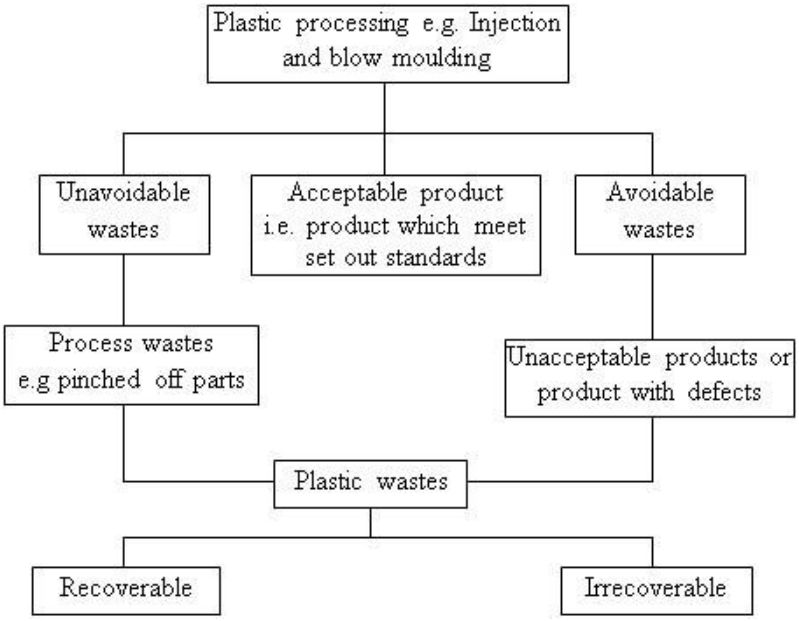

Figure. 1: Waste kinds and sources in the plastics processing industry.

Source: 2023 fieldwork by the researcher.

Methods of Waste Disposal:

It was said that the solid trash produced by the plastic businesses under observation was disposed of by private contractors, whose trucks routinely stop by their operations to pick up their rubbish. It is a common practice for certain private businesses in Port Harcourt and other metropolitan areas to gather rubbish from different industries and dump it along highways outside of the city, which is terrible for the environment. Additionally, the Ntawogba Creek receives the untreated effluent from these companies that is dumped into public sewers.

METHODOLOGY

The study included a combination of primary and secondary data types. Information was gathered about the different kinds of waste produced by the chosen industries, how it was disposed of, and the effects it had on the environment. This information covered the waste's effects on the environment, the waste management strategies used by different industries in the research area, and the environmental implications of these strategies.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

Investigation, reconnaissance survey, questionnaire distribution, in-person interviews, and direct observation were all used to get this data. The primary data supplied the essential information required for the study's empirical analysis, including the socioeconomic traits, the industries' spatial distribution, the kinds of waste produced by the industries, how it is disposed of, and the management strategies used by a few industries in the research area.

Data on waste management and disposal practices, particularly those used by industries, were gathered from both unpublished and published sources, including textbooks, journals, papers, articles, and newspapers. Additionally, data was gathered from the Rivers State Ministry of Environment, including the population number of the research region. Additionally, by using internet resources, information and resources about trash management were also obtained online.

There were one hundred and twenty (120) industries altogether in Trans-Amadi Industrial Area at the time of study. As a result, the industries were distinguished by how large they are, what they manufacture, and the kind and amount of trash they create.

DATA PRESENTATION

Large amounts of water are used by industries, and 90% of that water is wasted as wastewater. Regretfully, Nigerian enterprises dumped their raw effluent into the closest body of water. Industrial wastewater has a complex composition that includes suspended and dissolved particles, high oxygen-demanding organic pollutants, and other inorganic and organic compounds that may be hazardous to aquatic life.

Three of the businesses visited—one each from the plastic, textile, and brewing industries—had samples of their industrial effluents collected. The samples were subjected to tests to ascertain the degree of contamination in relation to the effluents' physico-chemical characteristics (pH, BOD, COD, suspended solid, and dissolved solid). Table 1 displays the findings together with suggested effluent standards.

Table 1: Physico-chemical properties of industrial effluents from selected industries and the recommended standards

No Parameter	Chemical Industry	Brewery Industry	Plastic Industry	Recommended Level
1. pH	5.2	4.8	6.8	6.0 – 9.0
2. Suspended solid (mg/litre)	486	2,287	375	30
3. Dissolved solid (mg/litre)	217	581	480	2,000
4. B.O.D (mg/litre)	89	1,340	92	50
5. C.O.D (mg/litre)	260	760	180	80

Source: Fieldwork by Researchers, 2023

The physico-chemical characteristics of industrial effluents from several industries are displayed in Table 1, along with suggested criteria. Depending on the industry, industrial effluents have different properties. When the trash is released into the environment, this is evident. Examples include coloured waste from the textile industry and white water from paper mills.

BOD and COD are two metrics that are used to assess the degree of contamination in industrial effluents.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

They provide an approximation of the concentration of organic waste by expressing the oxygen requirement of the microorganisms that stabilize the waste. The pH and suspended particles are two other crucial factors.

Companies Operating In the Study Area

Information gathered from the state ministry of environment and the Rivers State Waste Management Agency reveals that there are 162 factories and companies operating within the Trans-Amadi industrial area, which forms the study location as stated below in Table 2

Table 2: Shows types of industries in the study area

	Type of industry	**Number**
1	Food industries	23
2	Chemicals	28
3	Textiles	11
4	Metalic industries	25
5	Equipment	32
6	Construction	30
7	Wood and irons	13
	Total	162

Source: Fieldwork by Researchers, 2023

Which Kinds Of Garbage Are Produced In The Research Area?

Additionally, samples of solid trash were gathered at the Trans-Amadi Industrial Layout disposal site. Because this location is only intended for the disposal of industrial trash, it was selected. Tipping sites are locations designated specifically for disposing of solid trash. These places are occasionally situated in areas with certain physical shortcomings, such being somewhat marshy. Table 3 displays the percentage composition by weight of the six groupings (paper, plastics, metal, glass, wood, and others) from which the sampled solid wastes were sorted.

Table 3: Composition of sampled industrial solid wastes from a tipping site located at Trans-Amadi Industrial Layout

Type of Waste	**Percentage Composition (%)**
Paper	37.5
Plastic	15.9
Metal	14.6
Glass	13.4
Wood	10.3
Others	8.3
	100

Source: Researcher's field work, 2023.

What methods of disposing of trash are currently in use?

As shown in Table 4, different companies use different methods for disposing of their waste. Of these, 5%

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

claim to have disposed of their waste through open dumping, 12% claim to have had it incinerated, 17% claim to have disposed of it through bins, 7% claim to have had it collected by government agencies, and 59% claim to have disposed of their waste into drains, streams, and river bodies.

Table 4: Existing waste disposal methods in the study area

S/N	**Disposal methods**	**Number**	**%**
1	Open dumping	3	5
2	Incineration	7	12
3	Bin/storage	10	17
4	Dumping into drains, streams and river	35	59
5	Collected by government Agencies	4	7
	Total	**59**	**100**

Source: Fieldwork by Researchers, 2023

Table 5 reveals that 31% of respondents claimed their garbage is disposed of daily, 7% said it is collected hourly, and 62 stated it is disposed of weekly.

Table 5: Frequencies of waste disposal by the industries

	Disposal methods	**Number**	**%**
1	Hourly	4	7
2	Daily	18	31
3	Weekly	37	62
	Total	**59**	**100**

Source: Researcher's Field work, 2023

What consequences do the various waste types have on the environment?

According to the local government records, the various waste items might be categorised in the following ways:

Cancer-causing industrial waste, such that from the asbestos industry that is still operating close to a residential neighbourhood.

Hazardous trash that comprises heavy metals like lead, zinc, and mercury found in batteries, which can build up in the soil and affect people and agriculture.

Polluting industrial waste leads to air pollution.

Acid wastes, such as those found in textiles and cleaning supplies, can be transported by runoff and lead to soil salinization or solidity, or they can contaminate food and water, causing gastrointestinal disorders and discomfort.

The following lists zinc and manganese's specific harmful effects:

Zinc chloride

The tissue of the upper respiratory tract and membranes is severely harmed by this. If consumed by tissues

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

it would be poisonous and damaging. This chemical molecule has the potential to cause severe skin irritation, burns, and ulcers. If it comes into touch with the eyes, it might hurt and harm them.

Manganese

Individuals who live close to a waste site may inhale dust particles containing manganese from the waste site or consume greater than normal amounts of manganese found in the soil or water. This may have a negative impact on the neurological system, alter the brain, irritate the lungs, and make breathing challenging.

Burning chemical waste from pharmaceutical manufacturers covers the soil, forming a thick layer that either fragments soil particles or pollutes the soil, hindering vegetation's ability to recover and causing soil erosion. Additionally, these ashes might be carried by surface runoff and contaminate surface water, or they could leak into subterranean water and endanger human health and the food chain.

age	Health status of sick respon- dents	Kind of diseases among sick respondents			Date of diseases stated by sick respondents			Place of work stated by sick respondents		
		Respira-tory	Ingest -ion	others	Before	After	No date	Industri al area	Other place	Non
<35	27	15	3	9	7	17	3	14	8	5
36-50	15	10	3	2	5	8	2	6	5	4
>50	17	9	5	3	15	2	0	12	5	0
Total	59	44	11	14	27	27	5	32	18	9

Table 6: The effect of hazardous dumped waste on human health

Source: Researcher's Field work, 2023

The respondents' occupation and state of health are displayed in Table 6. The percentage of responders who were not in excellent health was about 59%. Roughly 44% of ill responders had respiratory conditions, 11% had conditions causing stomach discomfort, and 14% had other conditions including skin irritation.

It was shown that 27% of the unwell responders had health issues prior to visiting the affected area. By the time they started working or living near the garbage disposal plants, almost 27% had become unwell. The dates of onset of the ailments were unknown to the remaining responders. Of the ill responders, around 18% worked somewhere else and about 32% worked in the industrial region. This final group, nevertheless, resided close to the garbage disposal site. 9% of the respondents said they lived close to the dumping sites even if they did not work in the industrial area.

Table 7 presents the health state of the family, as it was anticipated that they would get diseases from contaminated surroundings. Approximately 52% of all respondents said that at least one member of their family is ill. Roughly one-third of the participants reported having a respiratory illness. Most of the people whose respiratory systems were impacted were older than 50. Approximately 6% of the ill respondents had ingesting disorders, while the remaining 9% had other diseases.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

The statistical analysis' findings indicated that around 27% of the sick respondents' population had health problems after moving into the contaminated region.

Table 7: The status of diseases among families of labourers' and residents respondents in and neighbouring industrial area.

age	Existing sick respondents families	Kind of diseases among sick people in the family			Date of diseases as stated by the sick people in the family		
		respiratory	Ingestion	others	Before	After	No date
>35	25	17	3	5	3	15	7
36-50	17	11	3	3	2	9	6
<50	10	9	0	1	1	3	6
Total	52	37	6	9	6	27	19

Source: Researcher's Field work, 2023

Roughly 90% of respondents claimed that their environment and air were contaminated by discarded rubbish, and that this had a detrimental effect on their health (Table 8). About half of the respondents (52%) reported paying a significant cost for medical and clinical therapy, whereas around 32% were able to manage their remedial costs.

Table 8: Table: views expressed by all respondents on the costs and effects of treatments.

age	Effects on health*		Cost of remedies**		
	Yes	No	high	Mid	Low cost
>35	43	2	12	10	9
36-50	27	3	15	13	4
<50	20	5	25	9	3
Total	90	10	52	32	16

Source: Researcher's Field work, 2023

*Out of all answers, 90% mentioned the consequences on health, with 10% choosing not to answer at all. ** The total number of respondents provided a response to this question.

DISCUSSION OF FINDINGS

The bulk of people living in the neighbourhood were factory workers with low wages that did not allow them to meet their basic necessities, and the area's socioeconomic condition was extremely poor. Due to their low to moderate educational attainment, many respondents could not have known enough about the subject of the research.

Based on data obtained from the Rivers State Waste Management Agency and the State Ministry of Environment, the Trans-Amadi industrial region is home to 120 manufacturers and businesses. Additionally, samples of solid trash were gathered at the Trans-Amadi Industrial Layout disposal site. Because this location is only intended for the disposal of industrial trash, it was selected. Tipping sites are locations designated specifically for disposing of solid trash. These places are occasionally situated in areas with certain physical shortcomings, such being somewhat marshy. Following the division of the sampled solid

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

wastes into six groups (paper, plastics, metal, glass, wood, and others), the percentage composition by weight of each category was compared.

Different methods of disposing of garbage are used by different firms; according to 5% of the claims, waste is disposed of by open dumping, 12% is said to be burned, 17% is disposed of through bins, 7% is collected by government agencies, and 59% is disposed of by being dumped into drains, streams, and river bodies.

On the other hand, 31% stated that garbage is disposed of daily, 37% stated that rubbish is collected hourly, and 37 stated that waste is disposed of weekly.

Despite taking measures, most people in the community suffered from respiratory illnesses, particularly after moving to the region or from working in companies that emitted gases and dust despite safety regulations (such as wheat, chemical, and textile plants).

Additionally, there have been cases of skin irritations brought on by coming into direct touch with chemicals, utilizing empty factory trash containers, or occasionally being bitten by insects brought on by the area's inadequate hygienic conditions.

Due to the many contaminants that have polluted their land, ingestion illnesses are particularly common in youngsters. Youngsters may become ill from consuming contaminated soil particles while they play and occasionally consume them. Furthermore, there were isolated instances of mental or psychiatric disorders as well as cancer.

Due to the fact that birds are extremely sensitive to the surrounding contaminated environment, poultry farms in the vicinity suffered greatly. It requires a clean environment with a reasonable temperature, which is unachievable in an environment with garbage site aromas, dust from land fill, and heat from burning.

As can be seen in Figure 2, the majority of contaminants present in the wastewater from the chosen sectors are significantly more than what is advised. With the exception of the dissolved solids amounts, which were discovered to be within the suggested level in each of the chosen industries? Additionally, Fig. 2 makes it abundantly evident that brewers' wastewater has the greatest concentration of all the contaminant groups. The ideal course of action would be to treat and detoxify industrial effluents using pollution abatement equipment installed in accordance with best practical technology (BPT) or best available technology (BAT) before releasing them into the environment. According to Figure 2, which displays the percentage composition by weight of industrial solid waste tested from a tipping site, paper makes up the majority of these wastes. This is only a sample from one place, so depending on variables like the location of nearby industrial activity, the climate, and the time of year, significant variance may be predicted later on this site or on the other tipping locations.

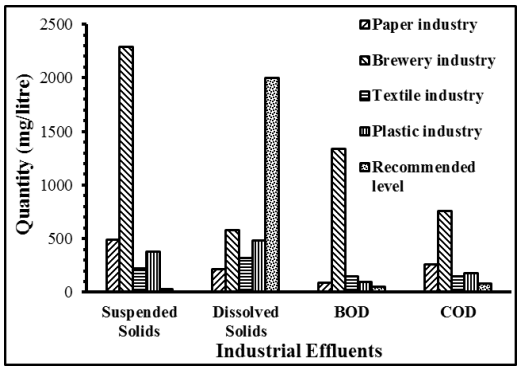

Figure 2: Pollutant concentration in selected companies' effluents

Source: Fieldwork by Researchers, 2023

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

CONCLUSION

Generally speaking, wastes are an essential component of the production process. Manufacture flaws are other sources of waste. Avoiding waste generation is essential, and this may be accomplished by rigorously testing all raw materials that enter the process to make sure they are free of contaminants and that they satisfy the appropriate quality standards.

The four industry groups under discussion have been chosen to provide a cross-section of the local industrial life together with the current waste management and disposal practices. It appears from observation that these sectors prioritize the least expensive approaches above the best ones when it comes to waste management. Sometimes they outsource the solid trash removal, feel good about themselves, and behave as though there are no more issues. Total solids, suspended solids, and dissolved solids make up a bigger share of the pollutants in wastewater released by specific businesses, according to an examination of the quantity of pollutants in the wastewater. These pollutants are readily separated and treated. Additionally, data demonstrates that of all the contaminant categories, brewers' wastewater had the greatest concentrations. The majority of companies release untreated wastewater into the environment. This behaviour is inappropriate for the environment and seriously jeopardizes public health. Paper is by far the most common solid waste, followed in that order by plastic, metal, glass, and wood, as indicated by the percentage composition by weight of solid wastes from enterprises. These abandoned solid wastes can be recycled and converted into useful resources if proper waste management is used.

RECOMMENDATION

In light of the aforementioned conclusions, the following suggestions are offered:

In order to lessen the threat that large enterprises pose to the environment, the Rivers State Government ought to enforce the requirement that polluters in highly productive industry pay taxes for their pollution near residential areas.

In order to protect the environment, the Rivers State Government, through the Ministry of Environment, should start an environmental impact auditing programme to ascertain the state of the various industries' operations and their effects on the environment. This will be done in cooperation with National Environmental Standard Regulation and Enforcement Agencies.

Before locating an enterprise in an industrial region, the Rivers State Government and other relevant parties should initiate a thorough environmental impact assessment (EIA) to evaluate the industry's acceptability based on environmental implications.

The Rivers State Ministry of Physical Planning, Urban Development, and Greater Port Harcourt City Development Authority ought to implement development control measures, such as building lines and setbacks, to prevent residential or commercial properties from being too close to industrial areas.

To lessen the impact of industrial sites on the residents of different business centers, town planning officials should stop approving residential construction projects within industrial areas.

The Rivers State Government ought to supply active chemical neutralizers to various enterprises so as to neutralize canals, drainage systems, and public areas.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

The various industries should provide Personal Protective Equipment (PPE) and other safety materials to his workers and ensure their usage.

Free medical or subsidize medicals should be provided to the workers while a secondary health facility should be provided to the residents of Trans-Amadi to tackle the health challenges that will arise as a result of the industrial activities in the neighborhood.

For the community's sustainability, an industrial waste treatment facility ought to be built and situated in every local government district and industrial park with industry.

Therefore, this study believes that there would be a significant reduction in the issue of insufficient industrial waste management in the study region if all of the following recommendations were put into practice.

REFERENCES

1. Adekoya, A.A. (2011). Effect of Sawmill Location on the Environmental Development of Ikire, An. Unpublished MSc. Housing dissertation, Department of Urban and Regional Planning, University of Ibadan
2. Adewumi, I. (2001): Waste Management in Nigeria, Issues and Prospects Conference Paper, PAEHON 2001.
3. Afon, A.O. (2005): Solid Waste Management in Selected Cities of Oyo State, Nigeria PhD Thesis, Department of Urban and Regional, Obafemi Awolowo University, Ile-Ife, Nigeria
4. Aledare, Kayode, and Adeleke, Adetunji (2007) „An Overview of Solid Waste Scavenging in Lagos Metropolis In Journal for Sustainable Development. Urban and Regional Planning Department, Yaba College of Technology, Lagos, Vol. 1, No. 2, October 2007. Pp. 8-14.
5. Aujogbo, C.A. (2012): Appraisal of the Effect of Industrial Location on the Resident of an Adjacent NeighbourhoodAnd unpublished Msc Environmental Management dissertation submitted to the Department of Environmental Science and Technology, Federal University of Agriculture Abeokuta, Ogun State, Nigeria.
6. Chukuwuemaka, E., Ugwu, J., and Igwegbe, D. (2012) Management and development implications of solid waste management in Nigeria. 4 (4): 352–358.
7. Douglas, S.E. (2004). The Politics of Nigerian Underdevelopment. J. Polic. Dev. Stud. 1(2):34-39
8. Momodu, N. S., Dimuna, K.O., and Dimuna, J.E. (2011) Mitigating the impact of solid wastes in urban centres in Nigeria, 34 (2):125–133.
9. Okoanegbete, J.F. (2009). Appraisal of the effect of land acquisition, oil exploration, and housing development on the escalation region of Delta State. An unpublished Msc Housing dissertation submitted to the department of urban and regional planning at the University of Ibadan, Nigeria.
10. Olatunbosun, G.B. (2009). Impacts of West African Portland Cement on the Housing Environment of Ewekoro. An unpublished Msc Housing dissertation was submitted to the department of urban and regional planning at the University of Ibadan, Nigeria
11. Owolabi, A. A. (2000), Environmental Disclosures in Annual Reports: The Nigerian Perspective, Economic Aziendale, 2000 Web, 1/2000. At:http//www.ea2000-it/:151-160
12. Wahab, B. (1998), „Environmental Education: A Panacea to Land Degradation in Lagos, Nigeria. in the Journal for Sustainable Development. Urban and Regional Planning Development, Yaba College of Technology Lagos, Vol. 1, No. 2, October 2007, pp. 137–146.
13. Wikipedia (2014): Waste Minimization Retrieved on May 24, 2010 from http://en.wikipedia.org/wiki/waste minimization.
14. World Bank (1997), Advancing Sustainable Development Environmentally Sustainable Development Studies and Monographs Series, No. 9

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI | Volume XI Issue I January 2024

15. Yassi, A. Kjellstion, T. Kok, and T.D. Guidotti, T.L. (2001): Basic Environmental Health. New York, Oxford University Press