

ENVIRONMENTAL PROBLEMS DUE TO INDUSTRIAL WASTE: A STUDY OF PORT-HARCOURT BLACK SOOT

Ajetunmobi David¹ & Ayanrinde Ayanniyi Wole²

Department of Mechatronics Engineering, The Federal Polytechnic Ilaro, Ogun State.¹

Department of Mechanical Engineering, Adeseun Ogundoyin Polytechnic, Eruwa, Oyo State²

Email: david.ajetunmobi@federalpolyilaro.edu.ng

Phone: 08130175184

Abstract

This paper; Environmental Problems due to Industrial Waste, involves the case study of Black Soot in Port-Harcourt. It is aimed at highlighting the problems of black soot originating from industrial waste and damages to the environment of Port-Harcourt. Black Soot is a major air pollutant which has adverse effect on the environment, made-up of carbon, produced by incomplete combustion of coal, oil, wood, or other fuels. There are many adverse environmental impacts gotten from the use of fossil fuels (e.g. oil and coal) as an energy source, such as release of pollutants and resource depletion. The continual burning of fossil fuels causes the increase in environmental pollution, due to CO₂ emission and other gases that cause global warming through greenhouse effect. This study highlights the damages to the environment through industrial waste, which pollutes the air; thereby causing air pollution. Major sources of emission from petroleum industries in the study area the implication of black soot and possible ways of surviving the adverse effect from the phenomenon is also highlighted. Results from the investigations into the composition of the pollutants load within the air in Port-Harcourt revealed that the aerosol particle within the lower, reaches of the boundary layer over the Port Harcourt region exceeds the national limits of 40-60 µg/m³ and also WHO limits of 10-25 µg/m³ for suspended particulate matter and black smoke. A concerted effort by the Rivers State Ministries of Environment and Health, as well as academia and private organizations are required.

Keywords: Black Soot, Environmental Problems, Industrial Waste, Petroleum Industries, Pollution.

Introduction

Waste produced by industrial activity is termed 'industrial waste' which includes materials that are not useful during manufacturing process such as that of factories, industries, mills and mining operations. Types of Industrial waste include dirt and gravel, masonry and concrete, scrap metal, oil, solvents, chemicals, even vegetables matter from restaurants. Industrial waste might be solid, Liquid or gaseous. It may be hazardous or non-hazardous. Hazardous waste may be toxic, ignitable, corrosive, reactive, or radioactive. Industrial waste may pollute the air, the soil, or nearby water sources, eventually still end-up in the sea. Most times, industrial mixes with municipal waste, which makes it difficult to get accurate and good assessments. (Yakubu, 2017)

Soot is a black particle, made-up of carbon, produced by incomplete combustion of coal, oil, wood, or other fuels. Soot particles sampled 3years ago, during soot pollution episode were described as black (elemental carbon) to grayish black in different particle size ranges. Gas-phase soot contains polycyclic aromatic hydrocarbons (PAHs). The PAHs in soot are known mutagens and are classified as a "known human carcinogen" by the International Agency for Research on Cancer (IARC). In present day the people of PortHarcourt are exposed to different kinds of pollutants, which cause damage to their health and environment. (Ede, 2017)

According to World Health Organization, one of the largest environmental risk, is air pollution. There is a figure of up-to 3 million deaths annually involving outdoor air pollution exposure. Six years ago, 11.6 percent of global deaths equivalents to 6.5 million deaths were air pollution-related to outdoor exposure. Figures for the quality of air in Nigeria was sourced for, from the little Green Data book (2015) in which the population is exposed to air pollution. (WHO, 2017)

Port-Harcourt is the capital of River state, it occupies approximately 1811.6km² area, with a population of about 1.5million. It constitutes the state's main city and has one of the largest seaports in Niger Delta region, thus it is the the centre of administration, commerce, and industrial activities. It is situated between latitude 4°45'N and 4°55'N, and longitude 6°55'E in the state, occupying the entrance of the Bonny river. The city is bounded in the north by Abia and Imo state; east by Akwa-Ibom state; west by Bayelsa state; and South by the Atlantic Ocean.

It's estimated mean altitude is 12km above average sea level, lying between the Dockyard creek/Bonny river and Amadi creek. (Gaidom, 2018)

Few years ago, plumes of soot in the air have affected the residents of Port-Harcourt, and the environment. According to sources, the first observation was in November 2016 when some affected residents of the area complained that there is delay in government's response concerning the pollution of air in the area. The government only showed concern when the residents were expressing themselves on social media platforms, and publicity thereby challenging their inaction. (Allan, 2017)

Air is the earth's atmosphere, the mixture of gases that surrounds the earth and that we breathe. Air becomes polluted when it carries gaseous and particulate matter at levels at which they become hazardous; which can cause harm or discomfort to the environment and living things. Based on research, Port-Harcourt is ranked high as a region of low air quality amongst the top 10 most polluted regions. Air Pollution refers to the release of pollutants or contaminants into the natural environment that can cause diverse changes in the environment and are detrimental to human health. It is characterized by an increase in the oxidizing capacity of the atmosphere, reduced atmospheric visibility, and the deterioration of air quality in a region. (Oyegun, 2016)

For the past ten years the situation suggests a step backward from progress of the current situation made in the reduction of emissions by 29%. Portharcourt residents have for many years suffered the exposure of pollution due to various industrial activities. Until recent times, they suffer environmental, health, and socioeconomic costs of the various forms of pollution, including air contamination. The current air pollution due to soot emission further worsens the existing bad air quality situation in the region, causing double air pollution on the environment and population health. (Oyegun, 2016)

Recently, cases of dry deposit pollutants otherwise known as 'black soot' have been occurring in many parts of Port Harcourt and the state at unusual levels; causing discomfort and harm to health of the citizens like respiratory ailments and aesthetic concerns. Properties that are not attended to for a few days are often coated in thick soot, thereby increasing the cost of maintaining clean and healthy households. The depositions are mostly acidic in nature, and despite the fact that it alters the pH of soils and water bodies it also causes rapid change in quality of physical amenities, such as corroding building walls, roofing sheets, other metallic structures and even cars. They are very hazardous to human health when inhaled, causing respiratory ailments, especially for infants, the aged and those with heart diseases. There is a release of substances like volatile organic compounds, oxides of carbon, nitrogen, sulphur, dioxins, furans, heavy metals, particulate matter and other toxins at levels into the environment that most times exceed national and international limits due to the operations of the oil industry as well as biomass combustion and traffic emissions. (Oyekunle, 1999)

There are many sources of air pollution; however, the intensity of air pollution within PortHarcourt city is determined by the distribution of pollution sources, air temperature, wind speed and direction, pressure, relative humidity and boundary layer structure. Air pollutants are emitted at high (ground) levels or low levels. High level emitters include numerous gas flare stacks from International Oil Companies. There are about 217 artisanal refineries within coastal communities South of Port Harcourt; whose distillation of crude oil causes the release of smoke and particulate matters into the atmosphere; While low level sources of emission include the hundreds of artisanal refineries situated in communities in the region and their security forces destruction, vehicular emissions, and all other combustion sources such as asphalt plants, tyre burning operations, abattoir combustion of animal hides and skin, etc close to ground level (0-10m). (Sokari, 2015)

In Portharcourt, petroleum industries contribute majorly to the air pollution. The production and operations of these petroleum industries, such as oil and condensate spills, gas flaring and venting, as well as transportation, constitute main sources of pollutants. Other industries such as automobile, construction, chemical and solvent, agriculture, foundries also contribute to poor air quality. (Tawari, 2012)

The major categories of emission sources in the petroleum industry are as follows:

1. **Process Emissions:** In petroleum refining and the petrochemical industries, the typical processes that take place include separations, conversions, treating processes such as cracking, reforming, isomerization, etc. The emissions from these processes are typically released from process vents, safety valves releases, sampling points etc.
2. **Combustion Emissions:** These are generated from the burning of fuels, from stationary combustion sources like furnaces, heaters and steam boilers, flare stacks, etc
3. **Auxiliary emissions:** Originate from units such as cooling towers, boilers, sulphur recovery units and wastewater treatment units.

4. **Storage and Handling Emissions:** These are emissions emanating from storage facilities and during the loading and unloading of petroleum products.
5. **Fugitive Emissions:** These include sudden leaks of vapors from equipment whose sources are mostly valves, pumps and compressors, piping flanges, leaks from seals on equipment.

Table 1: Results from the investigations into the composition of the pollutant load within the air in Port Harcourt

Pollutant Type	Concentration	Allowable Limits ($\mu\text{g}/\text{m}^3$) (WHO/EPA)
PM2.5 & PM10	0.035-396.8 ($\mu\text{g}/\text{m}^3$)	10 & 25 (Annual and 24Hr Means)
Lead (Pb)	0.01-1.17 (mg/Kg)	0.5 ($\mu\text{g}/\text{m}^3$)
Nickel (Ni)	0.01-0.15 (mg/Kg)	0.5 ($\mu\text{g}/\text{m}^3$)
PAHs	44 – 190 (ng/m^3)	1 (ng/m^3)
TPH	16.2 – 96.0 (mg/Kg)	

From the Table 1 above, the particulate load over Port Harcourt during the ‘Black Soot’ occurrences shows that the concentration of the aerosol particle ranges from 16.6-360 $\mu\text{g}/\text{m}^3$, 62-270 $\mu\text{g}/\text{m}^3$ & 0.035-180 $\mu\text{g}/\text{m}^3$, (SPDC, 2017; RSME, 2017; Ede & Edokpa, 2017) respectively. Thus, the aerosol particle within the lower reaches of the boundary layer over the Port Harcourt region exceeds the national limits of 40-60 $\mu\text{g}/\text{m}^3$ and also WHO limits of 10-25 $\mu\text{g}/\text{m}^3$ for suspended particulate matter and black smoke. Laboratory analyses of the particulate matter in Port Harcourt, has revealed them to be coming from petroleum combustion. (SPDC, 2017)

The continual burning of fossil fuels releases gases and chemicals into the air, which pollutes the atmosphere. Air pollution not only alters the climate but it also has adverse effect on the environment. The introduction of carbon dioxide together with greenhouse gases which are by-products of combustion raises the earth’s temperature thereby increasing the heat. This increasing warm weather facilitates smoky fog formation due to chain reaction in the atmosphere in the presence of more ultraviolet radiation.

The implication of Black Soot to the environment is quite varied and can be expressed in the following circumstances: (i) Through deposition of oxides of carbon, nitrogen, sulphur and volatile organic compounds in the aerosols on plant leaves, acidification of soils and water bodies, there is ecological damage to plants (crops). This situation leads to poor crop/fruit yields, fish catches, dwindling agricultural productivity and livelihoods. (ii) Causes increase in hazard to health as heightened respiratory diseases especially in children and the elderly, and the risk of developing mutations, carcinogenesis in the long term and teratogenic possibilities in developing fetuses, as a result of constant inhalation of these carbonized aerosols (iii) There is rapid deterioration of properties such as car chassis, roofing sheets and other metallic and non-metallic materials. (iv) Increased cost of house care as constant cleaning and washing of household ware is required. (v) Reduction in the Aesthetic value of our surroundings, due to the deposition of the black soot on all surfaces. (vi) Black rains (Kuenzer, 2014)

Conclusion and Recommendations

Apart from provision of amenities like electricity, good road, transportation by the government air pollution mitigation should be given top priority by all levels of government in Nigeria. While Nigeria possesses abundance of environmental laws, these laws are mostly unimplemented. The violation of such legislations by industries is evident in the soot epidemic. Another underlying cause of this situation is the negligence of the regulating bodies to carry out routine monitoring and ensure the enforcement of such laws, with such routine checks the problem would have been detected on time and curbed.

It is important to enforce Environmental Impact Assessment (EIA) as a mandatory requirement at all levels of businesses. Also, it is recommended that businesses develop environmental management system (EMS) model.

Government agencies should keep the public informed and updated on environmental surveillance results using traditional, electronic and social media to ensure effective environmental risk communication.

Irrespective of these actions; PortHarcourt residents, continuously battle with black soot. While all concerned stakeholders tackle the soot emission, residents should adopt basic measures to reduce the harm from the soot. Such measures are as follows:

- Surfaces should be cleaned daily to avoid the accumulation of black soot around the house.
- Windows and doors should be shut as often as possible to prevent the soot from filtering in.



- Hands should be washed regularly, before and after meals. Also, residents should have their bathes two to three times daily.
- Food should always be covered and avoid eating exposed food. Long/protective clothing should be worn to reduce the quantity of particulate matter inhaled.
- Gadgets, equipment, and vehicles not in use should be covered with protective materials.

References

- Allan, F. (2017, July 29). *Dangerous Air Pollution in the city of Port-Harcourt*. Retrieved from Pambazuka News: <https://www.pambazuka.org/node/96487>
- Shell Petroleum Development Company (2017). *Ambient Air Characterization of Selected Areas in Port Harcourt*. . Port Harcourt.
- Ede, P. N. (2017). Satellite Determination of Particulate Load Over PortHarcourt During Black Soot Incidents. *Journal of Atmospheric Pollution*, 55-61.
- Gaidom, F. D. (2018). The PortHarvourt Black Soot Phenomenon: Causes and Effects on Public Health and Environment. *The Port-Harcourt Clean Air Summit Conference*. Port-Harcourt.
- Kuenzer, C. V. (2014). Land Surface Dynamics and Environmental Challenges of the Niger Delta, Africa: Remote Sensing-based Analysis Spanning three decades. *Applied Geography* 53, (pp. 354-368).
- Oyegun, C. (2016, October). Petroleum Development and Environmental Quality in the Niger Delta. *In proceedings of the International Conference on Deltas in Africa, University of Port Harcourt*. Port-Harcourt.
- Oyekunle, L. (1990). Effect of gas flaring in Niger-Delta Area. . *NSChE Proceedings*, (p. pp: 13). Port-Harcour.
- Sokari, T. (2015). Silent, Sinister Effects of Gas Flaring in the Niger Delta; Worth Closer Attention. *In proceedings of the International Conference on Deltas in Africa, University of Port Harcourt*. Port Harcourt.
- Tawari, C. C. (2012). Air pollution in the Niger Delta Area of Nigeria. Port-Harcourt.
- WHO. (2017, August 1). *Air Pollution*. Retrieved from World Health Organization (WHO) : <http://www.who.int/ceh/risks/cehair/>
- Yakubu, O. (2017). Addressing Environmental Health Problems in Ogonilang through Implementation of United Nations Environmental Program Recommendations: . *Environmental Management Strategies* (pp. 4, 28). United States: Environments.