

Environmental Evaluation of Dangote Cement Plant, Ibese, Ogun State, Nigeria

Adebisi, Evelyn Ufuoma and Omoyeni, Oluwatobi Cynthia

Federal Polytechnic Ilaro, Ogun State, Nigeria

Emails: Evelyn.iroidoro@federalpolyilaro.edu.ng;

Cynthia.keshinro@federalpolyilaro.edu.ng

Abstract

Industrialization though has improved the economy of Nigeria, but the threat posed by the development of these industries to the environment and its habitants cannot be left out. Cement plants are known for emitting suspended particulate matter and toxic gases to the environment. This study assessed the environmental impact of Dangote cement plant at Ibese. Experimental and survey methods were employed in the assessment. The air was analyzed to determine the suspended particulate matter, noise level, carbon monoxide, oxides of nitrogen and sulphur dioxide. The alkalinity, acidity, pH, total solids, dissolved solids, suspended solids, oil and grease, dissolved oxygen, biochemical oxygen demand, chloride, hardness, nitrate, phosphate, sulphate and total metals determinations were carried out on the cement plant wastewater. pH, organic carbon and total metals were analyzed on the cement plant soil and the community soil. Questionnaires were administered to the employees of the cement plant and the inhabitants of the host community and the data collected was analyzed using descriptive analysis and Chi-Square in SPSS. Result showed that the suspended particulate matter $41.36 \pm 7.44 \mu\text{g/l}$ and the noise level of $74.30 \pm 0.50 \text{dB}$ were below the standards recommended by Federal Environmental Protection Agency (FEPA). Carbon monoxide (CO), oxides of nitrogen (NO_x) and sulphur dioxide (SO_2) were not detected except at the entrance of the cement plant where CO was determined to be 1ppm. Physicochemical parameters of the wastewater were within the safe limits approved by FEPA (pH: 7.53 ± 0.075 , total dissolved solids: $719.67 \pm 0.577 \text{ mg/l}$, chloride: $134.33 \pm 1.528 \text{ mg/l}$, nitrate: $8.83 \pm 0.113 \text{ mg/l}$, sulphate: $35.31 \pm 0.350 \text{ mg/l}$, phosphate: 0.44 ± 0.182 and biochemical oxygen demand: $36.40 \pm 0.353 \text{ mg/l}$) except total suspended solids ($294.33 \pm 4.509 \text{ mg/l}$) and chemical oxygen demand ($138.47 \pm 1.118 \text{ mg/l}$). Oil and grease, chromium, copper, lead and nickel were not detected in wastewater. The pH of the soil obtained from the cement plant was slightly alkaline (7.53 ± 0.076) when compared to the value from the community which was slightly acidic (6.47 ± 0.157). This study showed that the cement plant put preventive measures to avert the environmental problems caused by cement production though the cement plant needs to improve its corporate social responsibilities to the host community.

Keywords: Dangote Cement Plant, Environmental, Air; Water and Soil Quality Analysis and Noise level.

INTRODUCTION

Man is an important part of the biotic component of the environment and also an important factor of the environment (Horsfall and Spiff, 1998). Thus, man plays important roles in the natural environmental system in different capacities such as biologically, physically, socially, economically and technologically. All the natural functions of human beings such as birth, growth and death are affected and determined by the natural environment in the same manner as the cases of other organisms but man being most developed and advanced animals, physically, mentally and technologically, is capable of making substantial changes in natural environment so as to make it suitable for his own living. As the skills and technologies of man developed with cultural development, his roles towards natural environment also changed progressively such as from user through modifier and change to destroyer of the environment. So it is the technology of man which drastically changed the man-environment relationship from pre-historic period to the present most advanced industrial period, modern technological man intoxicated by highly advanced technology and materialistic viewpoint has changed and is changing the environment for his vested interest to such an extent that even the very existence is threatened (Bhatia, 2006).

Development is an important necessity for mankind. However, every developmental activity and system involves interactions with the environment. Infrastructural development, road construction, food production and population control, all involve the environment. These developmental activities could affect the environment either positively or negatively. While developmental activities impact the environment and ecology negatively most times, these activities are inevitable, if man must grow and survive on this earth (Yusuf and Sonibare, 2004). Green House Gases emission occurs globally and they mainly result from industrial processes. Hence, if this activity that affects the environment negatively must not be allowed to extinguish our planet, then man must develop systems that will ensure that the drive for economic and industrial growth does not exhaust the earth's resources. The development of such control systems, started as far back as 1960s when the world started realizing the fact that the earth resources were dwindling and yet human population was increasing (Adejumo *et al.*, 1994). In 1968, the issue of global climatic changes sensitized the world, which eventually instigated through the United Nations, "the Brundtland Commission" on development and environment. The Brundtland Commission was to examine strategies that man would establish in order to enable the world to avoid actions that may make man totally consume the entire earth resources, thereby carelessly destroying us in the process of development. After several meetings, the commission identified the need for the concept; Sustainable Development (Asubiojo *et al.*, 1991).

The concept is involved with development that will be guided carefully in order not to destroy the ecosystem permanently. The Brundtland Commission in its report entitled "Our Common Future" 1987, defined Sustainable development as, development that meets the needs of the present generation without compromising the future generations to meet their own needs (Oladipo, 2006). The Brundtland Commission report has advanced our understanding of global interdependence and the relationship between economic development and the environment.

The Brundtland Commission report led the world to propagate the necessary steps to be taken to ensure that all developmental activities are carried out without destroying the means of existence of future generations. The most important strategy with sustainable development is to achieve zero waste from every production systems by utilizing only required resources. In actualizing the tenets of sustainable development concept, various tools have been developed to achieve sustainable development and these tools include; environmental impact assessment, post project commissioning assessment and environmental audit (Addo *et al.*, 2013).

Environmental Pollution in its broadest sense is the unfavorable alteration of our surroundings wholly or largely as a by-product of man's actions through direct or indirect effects of changes in energy patterns, radiation level, chemical and physical constitution and abundance of organisms. These changes may affect man directly or indirectly through his supplies of water, agricultural and other biological products, his physical objects or possessions, or his opportunity for recreation and appreciation of nature (Tubonimi and Herbert, 2008). Environmental contamination of air, water, soil and food has become a threat to continuous existence of many plant and animal communities of ecosystem and ultimately threatens the very survival of the human race (Abdulkareem, 2005). Air pollution has long been recognized as a lethal form of pollution. Much of the problems of societal concern today are the heavy metals associated with air pollution (Addo *et al.*, 2012). Pollution of the natural environment by heavy metals is a worldwide problem because these metals are indestructible and most of them have toxic effects on living organisms when they exceed a certain concentration (Ghrefat and Yusuf, 2006).

Cement industries were first established in Nigeria in response to the increased wave of construction after independence and during the oil boom era of the seventies (Oyedele *et al.*, 1990). It has been shown that cement factories constitute one of the worst polluters in Nigeria today (Akeredolu *et al.*, 1994). Establishment of these plants pre-dates strict industrial zoning regulations and hence their proximity to residential areas is now issues of major concern. The main inputs of cement activity on the environment are the broadcasts of dust and gases (Bilen, 2010). Cement dust spreads along large areas through wind, rain etc and accumulated in and on air, soils, water, plants and animals and can affect human health badly (Bayhan and Ozbay, 1992). In the process of production, dust and some metal pollutants such as mercury, cadmium, iron, calcium and potassium are released into the atmosphere (Salami *et al.*, 2002). The dust escaping from cement factories is often transported by wind and deposited in areas close and far away from the factory. These include ground water, surface water, agricultural lands, natural vegetation etc. Such depositions of particulate matter and other pollutants interfere with normal metabolic activities of human beings and plants. It causes direct injury and impairment of growth and quality and may ultimately lead to decrease in plant yield. They also cause diseases such as cardio-respiratory disease, low birth-weight, and exacerbation of asthma especially in children or death (Nkwocha and Ejejuru, 2008).

Dangote cement Plc Ibese plant (formerly Dangote cement work ltd), a subsidiary of the Dangote Group has a 2 x 6000MTD cement plant in Ibese, near Ilaro, Yewa North Local Government Area. The cement factory is located at about 8km from Ilaro town in Ogun state and centrally located between Lagos and Abeokuta. The plant is spread over

274 acres of land and has world class technology and modern Safety and Operating Systems from world renowned manufacturers. Its main product is Portland cement. The plant was commissioned on February 14, 2012 and since then it has been in operation. It has about 1000 people in its workforce.

The increased activities in these cement industries as well as the continuous emissions of these pollutants over the years have not been properly examined especially in the context of their impacts on the ambient air, soil and water quality. It is in this context that this study was carried out on the Dangote cement plant, Ibese, Ogun state. This study determined the pollutants from a cement production plant through air, soil and water analyses, assessed the impact of the pollutants on man, plants, animals and the environment in general and proffered mitigation measures to eradicate or reduce the impact of the pollutants and create awareness of environmental management by industries through monitoring of pollution in the locality.

METHODOLOGY

Air analysis

Air samples were collected from the study area, which was Dangote cement plant, Ibese. Eight sampling points were used in the study site. These points includes the Entrance of the facility, the Workshop, the Vertical Royal Mill, the Stockpile, the Kiln, the Industrial Cooler, the Cement Mill and the Packaging and Loading section. The analysis was done using air volume sampler. The suspended particle matter (SPM) was recorded in microgram per litre ($\mu\text{g/L}$), Noise was recorded in decibel (dB), the Global Positioning System (GPS) was recorded, the carbon monoxide (CO), sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) were recorded in part per million (ppm).

Wastewater analysis

Triplicate sample of the wastewater was carried out by obtaining grab sample of the wastewater in 1 litre plastic keg at a stable temperature and moved to the laboratory immediately for analysis. The alkalinity, acidity, pH, total solids, oil and grease, dissolved oxygen, biochemical oxygen demand (BOD), chloride, hardness, chemical oxygen demand (COD), nitrate, phosphate and sulphate determination were carried out.

Soil analysis

Soil samples were collected from the facility premises and 5 kilometers away from the facility in the community using a plastic cup and transferred into clean polyethylene bags and taken to the laboratory. The soil pH, organic carbon and total metals analysis were carried out.

Survey method

For the purpose of this study, two questionnaires were designed. The population of the study is the staff of Dangote cement plant, Ibese and the occupants of Ibese and Ilaro community. Stratified random sampling technique was used in selecting 200 respondents. 100 from staffs of Dangote cement plant Ibese and 100 from the occupants

of Ibese and Ilaro community, making a total of 200 sample sizes. Descriptive statistics and chi square were carried out on the data in SPSS.

RESULT AND DISCUSSION

Air analysis

The air quality parameters such as suspended particulate matter (SPM) indicated in Table 1 was observed to be below the emission limit for particulates from a stationary source for cement production recommended by FEPA of Nigeria which is 150 - 500µg/L, and the observed value for SPM is 41.36µg/L. The health of the citizens of Ibese community and its environ will not be seriously affected by the risk associated with the settled dust. The prolonged operation of the cement plant; and the quest to increase the installed capacity of the plant could lead to additional emission of the air pollutants which in the long run could lead to severe impacts on the host environment and its surrounding settlements. The noise recorded is 74.30±0.50 decibel which is below the standard noise level (90dB) according to FEPA. The oxides of sulphur and nitrogen were not detected around the vicinity of the cement plant. The carbon monoxide was only found in Point 1 which is the gate area and this could be due to the exhaust from the trucks. The suspended particulate matter and the carbon monoxide observed in this study is lower than the findings carried out in the Dangote Cement plant in Gboko, Benue State in Nigeria by Agber and Iorgirim, 2013. This is an improvement of the implementation of best global techniques to protect the environment.

Table 1: Air analysis result

Location	Parameters measured with units					
	SPM (µg/L)	Noise(dB)	GPS(195-elevation)	Sulphur dioxide (ppm)	Oxides of nitrogen (ppm)	Carbon monoxide (ppm)
Point 1	27.9	75.5	N07°00'37.2" E003°02'36.2"	Nd	Nd	1
Point 2	40.6	74.2	N07°00'30.3" E003°02'40.0"	Nd	Nd	Nd
Point 3	39.4	74.2	N07°00'28.8" E003°02'59.9"	Nd	Nd	Nd
Point 4	40.4	74.3	N07°00'22.4" E003°02'00.7"	Nd	Nd	Nd
Point 5	43.2	74.2	N07°00'22.9" E003°02'54.5"	Nd	Nd	Nd
Point 6	53.5	74.0	N07°00'24.5" E003°02'51.1"	Nd	Nd	Nd
Point 7	47.7	74.0	N07°00'26.2" E003°02'45.3"	Nd	Nd	Nd
Point 8	38.2	74.0	N07°00'28.0" E003°02'37.9"	Nd	Nd	Nd

Nd = Not detected

Wastewater analysis

The waste water analysis result is reported in Table 2. The average pH value of the waste water is 7.53 which is within the normal limit. Conductivity, Total Suspended Solids, Total Dissolved Solids and Total Solids gave 948.67 μ S/cm, 294.33mg/l, 719.67mg/l and 1012.33mg/l respectively in which only Total Suspended Solids exceeded FEPA limits. All other parameters ranging from chloride test to Biochemical Oxygen Demand test fell within the FEPA limit. However, the Chemical Oxygen Demand (138.47mg/l) exceeded FEPA limit indicating a higher amount of oxidizable pollutants in the wastewater. Based on Federal Ministry of Environment recommendation, adequate treatment is necessary before the waste water is discharged into the environment.

Table 2: Wastewater analysis result

Parameter	Result	FEPA Standard (FEPA, 1991)
pH	7.53 $\pm$ 0.075	6-9
Conductivity, μ S/cm	948.67 $\pm$ 0.577	Ns
Total Suspended Solids, mg/l	294.33 $\pm$ 4.509	30
Total Dissolved Solids, mg/l	719.67 $\pm$ 0.577	2000
Total Solids, mg/l	1012.33 $\pm$ 2.517	Ns
Chloride, mg/l	134.33 $\pm$ 1.528	600
Total Hardness (as CaCO ₃), mg/l	231.67 $\pm$ 2.082	Ns
Total Alkalinity, mg/l	26.33 $\pm$ 2.082	Ns
Total Acidity, mg/l	16.67 $\pm$ 1.528	Ns
Nitrate, mg/l	8.83 $\pm$ 0.113	20
Sulphate, mg/l	35.31 $\pm$ 0.350	500
Phosphate, mg/l	0.44 $\pm$ 0.182	5
Dissolved oxygen, mg/l	1.81 $\pm$ 0.099	$\geq$ 2.0
Chemical Oxygen Demand, mg/l	138.47 $\pm$ 1.118	80
Oil & Grease, mg/l	Nd	10
Biochemical Oxygen Demand, mg/l	36.40 $\pm$ 0.353	50
Chromium, mg/l	Nd	< 1
Copper mg/l	Nd	< 1
Lead mg/l	Nd	< 1
nickel mg/l	Nd	< 1

Nd = Not detected

Ns = No specification

Soil analysis

Table 3 shows the result of soil parameters analyzed. The pH value of the soil obtained from the cement plant was slightly alkaline compared to the value from the community which was slightly acidic. The difference between the cement plant soil and the community soil is understood as the direct effect of cement dust which is alkalinization of the ecosystem and the changing composition of soils (Giine *et al*, 2004). The total organic carbon of the cement plant was slightly lower (0.45%) than that of the community (0.48%). The Chromium found in the soil of the community was significantly higher (37.35mg/l) than the Chromium found in the soil of the cement

plant (19.26mg/l) and the copper of the soil from the cement plant was found to be lower (5.63mg/l) than the copper found in the soil from the community. This could be as a result of some pesticides applied on the soil during farming though further investigation was not made on the soil. The correlation test showed the significant difference between the parameters measured in the cement plant and the host community which is positively correlated except Total Organic Carbon in which the cement plant decreases as that of the community increases.

Table 3: Soil analysis result

Parameter	Cement plant	Community	Paired Sample test	
			Correlation	Signi.
pH	7.53±0.076	6.47±0.157	0.883	0.311
Total organic carbon %	0.45±0.010	0.48±0.015	-0.982	0.121
Chromium mg/kg	19.26±0.213	37.35±0.090	0.954	0.194
Copper mg/kg	5.63±0.275	7.26±0.235	0.824	0.383
Lead mg/kg	Nd	Nd		
nickel mg/kg	Nd	Nd		

Nd = Not detected

Survey Analysis

The raw material is mined from some parts in the community and oral investigation by some of the staffs in the mining department showed that sand filling is always carried out to fill where the raw material has been mined from. This is to enable the land users still be able to use their land for other activities like farming. The raw material is majorly processed in the cement plant, which enables monitoring of discharge of dust particle during crushing of the raw material and reduction of air pollution. The method of transporting the raw material was analyzed and it was reported that 87.8% of the materials were transported by conveyor belt while 12.2% was by truck. During a pre-visit to the cement plant, observer was shown the conveyor belt that transports the raw material to be processed from mines. Respondents result of the company's end product emitted into the environment revealed 2.0% carbon monoxide is emitted, 36.0% reveals that carbon dioxide is released into the atmosphere while 62.0% reveals that oil is spilled into the environment but result from the air analysis shown above in Table 1 showed that carbon monoxide was not detected except at the entrance and the result from the wastewater analysis in Table 2 showed that oil was not detected. Therefore the respondent's result is nullified by experimental results. Method of disposing waste generated in the company also showed that the company does not have a good waste disposal system, thereby leading to emission of unwanted waste into the environment. Report also showed the safety department in the plant needs to put more effort in attaining an accident free condition during manufacturing and more safety measures should be put in place in the plant. The organization has to improve the salary structure of its employees, increase interpersonal relationship between the management of the plant and the employees and ensures there is no ethnic or religious crisis within the plant, since the plant comprises of staffs of diversified ethnicity and religion.

Data analyzed revealed there are proactive measures like the internal surveillance camera and access control measures taken by the company towards industrial security.

Table 4 showed the relationship between report of security threat and the proactive measures taken by the company towards industrial security using chi-square of independence, the result showed there is 0.001 significance in the proactive measures taken by the company against the security threat made on the company. The community has expectations from the management of the cement plant which they are aware of, but due efforts are yet to be made.

Table 4: Relationship between security report and proactive measures taken by the company towards industrial security.

	Report of security threat	Proactive measures taken by the company toward industrial security
Chi-Square	24.471 ^a	60.118 ^a
Df	2	2
Asymp. Sig	0.001	0.001

The social economic effect of the cement plant on the community is as a result of social infrastructure put in place before the arrival of the cement plant which are no longer in place or out of use was also studied. For example, the good road network before the arrival of the cement plant that is now bad due to the presence of the company. There has been an increase in the cost of living in the community and there is more immigration of people in the community, which could increase the economic value of the community.

Study also showed there has been illegal acquisition of lands and natural resources from the host community by the cement company which led to a riot between the company and the community some years back.

CONCLUSION AND RECOMMENDATIONS

Although, environmental pollution is a prominent feature in Nigerian towns and cities, most Nigerians are unaware of the related health hazards of environmental pollution probably due to unawareness and ignorance. Cement is a major component used in Nigeria, the release of dust from cement into the atmosphere and its surrounding vegetation is a serious concern as cement dust from its production can affect man, its surrounding and vegetation. Most cement plants do not consider the environmental implication of releasing dust particles into the environment. This study showed that Dangote cement plant Ibese, Ogun State has been able to harness the release of dust particles from its production to a considerable extent probably due to the fact that production commenced not quite long ago. This study commend the effort of the Management of the cement plant in monitoring and putting in place the necessary measures to safeguard the environment. The following recommendations from this study are;

- Good waste disposal system.
- Proper maintenance and adequate training in the use of the machines.
- Adequate supply of personal protective equipment and ensure proper training.
- Increment of staff salary structure and interpersonal relationship between management of the plant and employees.

- The corporate social responsibility of the cement plant should be improved in the community.
- Periodic and continuous monitoring of the plant should not be undermined.

The establishment of some organizations does not benefit the development of the host community due to the fact that the host community may not be aware of the organization's duty to them. The study recommends that laws should be put in place for organization to develop their host community and public awareness should be made in rural communities on their expectation from organizations establishing in their community.

This study has conclusively confirmed that there are no major environmental pollutants from the production of cement in Dangote Cement Plant, Ibese, Ogun State.

REFERENCES

- Abdulkareem, A.S., (2005). Evaluation of Ground Level Concentration of Pollutant due to Gas Flaring by Computer Simulation: A Case Study of Niger - Delta Area of Nigeria. *Journal of Practices and Technologies*, 6, 29-42.
- Addo M. A., Darko E. O., Gordon C., Nyarko B. J. B., (2013). Contamination of Soils and Loss of Productivity of Cowpea (*Vigna Unguiculata* L.) Caused by Cement Dust Pollution. *International Journal of Research in Chemistry and Environment*, 3 (1), 272-282.
- Addo, M.A., Darko, E.O., Gordon, C., Nyarko, B. J. B., Gbadago, J. K., Nyarko, E., Affum, H. A. and Botwe, B. O., (2012). Evaluation of Heavy Metals Contamination of Soil and Vegetation in the Vicinity of a Cement Factory in the Volta Region. *Ghana International Journal of Science and Technology*, 2 (1), 40-50.
- Adejumo, J.A., Obioh, I.B., Ogunsola, O.J., Akeredolu, F.A., Olaniyi, H.B., Asubiojo, O.I., Oluwole, A.F., Akanle, O.A. and Spyrou, N.M., (1994). The Atmospheric Deposition of Major, Minor and Trace Elements Within and Around Three Cement Factories. *Journal of Radioanalytical Nuclear Chemistry*, 179, 195-204.
- Agber, T. and Iorgirim, S. M. (2013). Assessment of Air Quality around Dangote Cement Company, Tse-Kucha, Gboko, Benue State, Nigeria. Proceedings of the 13th International Conference of Environmental Science and Technology, Athens, Greece 5th – 7th September, 2013.
- Akeredolu, F.A., Olaniyi, H.B., Adejumo, J.A., Obioh, I.B., Asubiojo, O.I. and Oluwole, A.F., (1994). Determination of Elemental Composition of TSP from Cement Industries in Nigeria Using EXDRF Techniques. *Nuclear Instrument and Methods in Physics Research*, 353, 542-545.
- Asubiojo, O. I., Aina, P. O., Oluwole, A. F., Arshed, W., Akanle, O. A. and Spyrou, N. M., (1991). Effect of Cement Production on the Elemental Composition of Soils in the Neighbourhood of Two Cement Factories. *Journal of Water, Air and Soil*, 57-58, 819-828.
- Bayhan, Y. k. and Özbay, O., (1992). In: Isikli et al, 2006, Cadmium Exposure From the Cement Dust Emissions: A Field Study in a Rural Residence. *Journal of Chemosphere*, 63, 1546-1552.
- Bhatia, S. C., (2006). Environmental chemistry. CBS Publisher, New Delhi, India, 3rd edition. 80-84.
- Bilen S., (2010). Effect of Cement Dust Pollution on Microbial Properties and Enzyme Activities in Cultivated and No-Till Soils. *African Journal of Microbiology Research*, 4 (22), 2418-2425.
- FEPA, (1991); National Guidelines and Standards For Industrial Effluents, Gaseous. Federal Environmental Protection Agency (FEPA), Decree 59, 1992. Emissions And Hazardous Waste Management In Nigeria. 59-66.
- Ghrefat, H. And Yusuf, N., (2006). Assessing Mn, Fe, Cu, Zn and Cd Pollution in Bottom Sediments of Wadi Al-Arab Dam, Jordan. *Journal of Chemosphere*, 1, 1-8.
- Giine, A., Alpaslan, M. And Inal, A., (2004). Plant Growth and Fertilizer. Ankara University of Agriculture Publication. No: 1539, Ankara, Turkey.
- Horsfall, M.J. and Spiff, A.I., (1998). Principles of Environmental Chemistry. Metroprints Ltd, 236.
- Nkwocha, E.E. And Egejuru, R.O., (2008). Effects of Industrial Air Pollution on the Respiratory Health of Children. *International Journal of Environmental Science*. 5 (4), 509-516.
- Oladipo, E. O., (2006). Sustainable Development: Concepts and Practice of Environmental Management in Nigeria. Mattivi Production, Ibadan, Nigeria, 1st Edition, 9-41.

- Oyedele, D.J., Aina, P.O., Oluwole, F. And Asubiojo, I.O., (1990). Preliminary Assessment Of Pollution Effect Of Cement Dust On Soil And Biomass Production. A Seminar Paper Delivered At The 18th Annual Conference Of Nigerian Soil Society, University Of Maiduguri, Maiduguri, Nigeria.
- Salami, A. T. and Farounbi, A. I., (2002). Effect of Cement Production on Vegetation in a Part of Southwestern Nigeria. *Tanzania Journal of Science*, 28 (2), 69-72.
- Tubonimi. J.K. Ideriah and Herbert O. Stanley, (2008). Air Quality around some Cement Industries in Port Harcourt, Nigeria. *Journal of Scientia Africana*, 7 (2), 27-34.
- Yusuf, R.O. and Sonibare, J.A., (2004). Characterization of Textile Industries Effluent in Kaduna, Nigeria and Pollution Implications. *Globalnest International Journal*, 6 (3), 212-221.