Available online www.jsaer.com

Journal of Scientific and Engineering Research, 2016, 3(6):356-365

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

An Investigative Approach on the Effects of Air and Noise Pollution in Uyo Metropolis, Akwa Ibom State, Nigeria

Antai, Raphael Eduk

Institute of Natural Resources, Environment and Sustainable Development, University of Port Harcourt, Choba, Nigeria
Inter-Environments Limited, Rumuodara, Port Harcourt, Nigeria

Abstract In Nigeria, like many developing nations, the causes of air pollution are legion: aggravated bush burning, combustion, gas flaring, improper disposal of domestic and industrial wastes; pollution through oil spillage; car exhausts, unsanitary and unsafe housing, etc. All these affect human well-being especially health and socio-economic well-being of the people of the Niger Delta in Nigeria in particular and in the world as a whole. Therefore, this paper highlights the dimensions, nature and characteristics of these phenomena and further examines the implications of air pollution on the health and socio-economic well-being of the people of Uyo in the Niger Delta.

Keywords Air and Noise Pollution, Uyo Metropolis

Introduction

The problems associated with air pollution are continuously on the rise; this is because of the alarming increase in anthropogenic activities that adversely affects the climate and environment and most importantly the health of individuals worldwide. Studies have revealed that the slightest decrease in air pollution can lead to a significant increase in the peoples' health and increase the life expectancy of individuals world-wide. According to the epidemiology journal; the U.S government and agencies have made significant improvement in reducing the incidence of air pollution and in turn; there has been a in the occurrence of respiratory diseases. However; the burning of fossils, oil spills, natural gas flares and increase in green house gases results in acid rain, cardiovascular and respiratory diseases depletion of the ozone layer and subsequently global warming.

Nature and man's activities have impacted on natural cycles, the result are atmospheric pollutants such as particulate, aerosol, noxious gases (VOCs, NO_2, SO_2, H_2S, CO, NH_3, CH_4) and mechanical noise. Pollutants can be from point sources (e.g. industrial installations) or from mobile sources (e.g. automobiles and other transport systems) [1].

Aim of the Study

The aim of this paper is to assess the effect of air pollution and the effect that pollutants have on the climate and the health of individuals. The main objectives are to find answers to some important research questions some of which include; What is the present status of air pollution monitoring/assessment programme in Uyo? What are the mitigation measures to environmental impacts of air pollution in Uyo? What are the tools to check and evaluate the effectiveness of the mitigation measures of the air pollution in Uyo

Significance of the Study

The environmental monitoring shall provide important information feedback about the environmental impacts of man's activities around and within the monitoring locations and also for more effective planning for environmental protection. The area under study were being affected with some of the under-listed noxious gasses discussed below

Sulphur Dioxide (SO_2)

Sulphur Dioxide (SO_2) is a colourless gas produced from biological decay and forest fire releases. It is also produced from the combustion of sulphur-containing fuels, smelting, irritant and is capable of aggravating asthma, bronchitis and emphysema. It can also cause acid aerosols (formed from dissolved Sulphur Dioxide) which will readily attack building materials, especially those containing carbonates such as marble, limestone, and mortar. Sulphuric acid mists can also damage cotton, linen, rayon and nylon fabrics as well as paper. Excess exposure to Sulphur Dioxide accelerates corrosion rates for many metals such as Iron, Steel, Zinc, and Copper, especially at relative humidity over 70% [2].

Hydrogen Sulphide (H_2S)

Hydrogen Sulphide (H_2S) or sour gas is a toxic, odorous (odour of rotten egg), colourless and corrosive gas, which is rapidly oxidized to SO_2 in the atmosphere. It has a specific gravity of 1.18 and slightly less lethal than Hydrogen Cyanide and more lethal than Chlorine. Its presence in the atmosphere could result from storage tank and process vents. Exposure to concentrations in excess of 500ppm can be fatal. Hydrogen Sulphide is considered a broad spectrum poison, meaning that it can poison different systems in the body (although the nervous system is usually most affected). Exposure to lower concentration of H_2S can result in eye irritation, sore throat and cough, shortness of breath and fluid in the lungs. These systems usually go away in a few weeks. Long term, low level exposure may result in fatigue, loss of appetite, headaches, irritability, poor memory and dizziness [3].

Particulate matter

High concentrations and Particulate Matter showing greater health hazards when Particulate Matter is brought into contact with pulmonary membrane by sedimentation, impaction, interception and diffusion. Sub-micro range particles (10 – 2**µm**; PM10 – PM2) pose pulmonary health problems. If the pollutants are chemically reactive or toxic, their physiological effects are more serious and lethal [1].

Noise

In addition to causing a disturbance, excessive Noise can damage health and have physiological effects. Environmental Noise concerns focus on local communities and wildlife. Effects on local residents generally relate to the annoyance/nuisance caused by both short and long term high sound levels. Also, disturbance of wildlife is of significance particularly during breeding seasons and/or when rare species are present.

Location of the study Area

Uyo lies between latitudes $4^0 59^I$ and $5^0 04^I$N and longitudes $7^0 53^I$ and $8^0 00^I$E. Uyo is said to situated on an elevation of about 60.96 meters (2090ft) above sea. The city is located at the centre of Akwa Ibom State and lies within the Tropical Rain Forest region, and enjoys the tropical wet and dry climate with two distinctive seasons (dry and wet). The location of Akwa Ibom State just north of the Equator and within the humid tropics and its proximity to the sea makes the State generally humid. On the basis of its geographical location the climate of Uyo, can be described as a tropical rainy type which experiences abundant rainfall with very high temperatures. There has been a corresponding increase in industrial activities in Uyo. Major industries in the city include small agricultural processing industries, plastic manufacturing industries, confectioneries, pharmaceutical and surgical companies, etc. On the other hand, there has been an increase in the number of vehicles for personal and commercial use in the town. Thus, traffic emission is expected to be a major source of air pollution in the town.

The Nature of Wind, Air and Temperature in the Study Area

Winds

The mean surface wind speed and direction depends on seasonal variation. Two main air masses alternate with the season. During the dry season, the northeast winds predominate while the southwest winds are dominant during the wet season [4]. The highest speed is recorded at the onset of the wet season when early rains are torrential and accompanied by squalls, lightning and thunder. The wind speeds were observed to be lower in the nights than during the days.

During the harmattan months (December to February), 15% to 40% of the winds are from the East and Northeast. Generally, the average wind speed is between 1.5m/s and 2.5m/s and hardly exceeds 2.8m/s. Squalls (wind gust greater than 15 m/s) travel in the east – west direction in the area. When the squalls arrive, an onrush of wind toward the west is experienced, followed by heavy rain (intensity up to 100 mm/hr). The most intense wind usually last up to 10 minutes. Squalls are possible anytime of the year, but in the months of March to July and October to November of the rainy season. The annual mean of daily maximum air temperature in the area ranged from 28.8 ^oC to 30.2 ^oC during this period. The hottest months are November to April (with means of maximum daily temperature by month ranging from 30.2 ^oC to 31.3 ^oC) while the coolest months are July to September (with mean maximum daily temperatures by month ranging from 27.0 ^oC to 27.5 ^oC), which coincide with the peak of the rainy season. The seasonal temperature decline has been ascribed to an expression of the overall cooling of the South Atlantic and the Gulf of Guinea during this period of the year [5].

Table 1: Uyo and Calabar Mean Monthly Wind speeds

Month	Mean Wind speed (m/s)	Mean Wind speed (m/s)	
	Uyo (1986-2007)	Uyo (1996-2008)	Calabar (1996-2008)
January	2.77	3.2	4.0
February	3.36	3.5	4.3
March	3.59	3.7	4.6
April	3.67	3.6	4.6
May	3.49	3.4	4.5
June	3.15	3.1	4.4
July	3.10	3.2	4.0
August	3.25	3.2	4.1
September	3.33	3.1	4.2
October	2.99	3.1	4.2
November	2.79	2.8	3.9
December	2.56	2.9	3.8
Mean	3.2	3.2	4.2

Source: Olayinka, 2011 and Nigerian Meteorological Agency, Lagos

Table 2: Mean Temperatures of Uyo and Calabar for the Selected Periods

Month	Uyo (1983 – 1997)	Uyo (1996 – 2008)	Calabar (1996 – 2008)
	Mean Temperature (°C)	Mean Temperature (°C)	Mean Temperature (°C)
January	26.8	27.5	27.3
February	28.4	28.4	28.2
March	2.3	28.1	27.2
April	27.9	27.5	27.3
May	27.3	27.0	27.0
June	26.8	26.0	26.1
July	26.0	25.4	25.2
August	25.3	25.1	24.9
September	25.7	25.5	25.1
October	26.2	26.2	25.8
November	26.9	26.7	26.7
December	26.7	27.0	27.1
Mean	26.9	26.7	26.7

Source: University of Uyo Meteorological Station and Nigerian Meteorological Agency, Lagos

National Ambient Air Quality Standard

The Federal Ministry of Environment adopted the WHO standards as the national standards for gaseous emissions against which air quality parameters monitored are compared in order to ascertain its "cleanliness".

Air Quality Monitoring Programme in Nigeria

From the research and the environmental studies history in Nigeria, there is no proper Air Quality Impact Assessment (AQIA) or Air Quality Baseline data for all our cities and local areas by the regulatory agencies such as Federal Ministry of Environment (FMENV), National Environmental Standard Regulatory Enforcement Agency (NESREA), etc. However, some of the air quality monitoring that has been carrying out in most cases in our country Nigeria are projects specific and of course it is not for public consumption because the data are not always accessible by the public. The inability of these regulatory agencies that cannot afford the high cost of modern technology, equipment, instrument, calibration, maintenance and training program for their personnel are the big challenges the agencies are facing. Because the approved budget for these agencies by the Government is very low.

Nigeria environmental laws and policies are another big problem in environmental management in the country. In Nigeria, to show evidence of Best Available Techniques (BAT), the principle which implies that anyone creating an environmental impact of either pollution or resources depletion should employ state of the art processes, facilities or methods of operation to either minimize the likelihood of occurrence or ensure appropriate control and mitigation, the NESREA Act and its subsidiary regulations prohibit the discharge of hazardous substances into the air. No industry or individual can release any gaseous waste into the atmosphere without proper monitoring and authorization from the relevant government agencies responsible for environmental protection. These industries must install anti-pollution equipment for detoxification of their gaseous effluent and chemical discharges and the anti – pollution equipment installed must meet the best available technology (BAT), or best practical technology (BPT) or the uniform effluent standard (UES) [6]. The polluter pay principle of the article 16 of the Rio declaration which provides that states "should endeavour to promote the internalization of environmental costs and the use of economic instruments. This principle which takes into the account the approach that the polluter should, in principle bear the cost of pollution with due regard to the public interest and without unduly distorting international trade and investment", is also the basis for the Nigeria National Policy on the Environment.

Literature Review

Efe (2006) used a total number of 102 high-volume (HV) samplers in 17 Nigerian cities to draw a known volume of ambient air at a constant flow rate through a size selective inlet and through filters [7]. The study was done over a six-year period (2001-2006) to determine distribution of ambient particulate matter pollution. The study also determined the associated health implications in the cities of Nigeria. The daily average ambient PM_{10} were sampled on the filter during a 24-hour sampling period. The methods of data analysis were paired t-test, ANOVA and multiple regression statistical analyses. The results obtained revealed that the urban corridors of over 70% of Nigerian cities are sites with a high rate of daily mean/annual mean ambient PM_{10} of over $120µg/m^3$, while < 30% of Nigerian urban centres had mean annual ambient PM_{10} value of $119.2µg/m^3$. Similarly, significant differences exist in PM_{10} concentrations across different land-use types, between the built-up areas and those of the surrounding rural areas were also obtained. The associated health implications showed that the high concentrations of PM_{10} in most Nigerian urban environments have attributed in significant prevalence of cough, catarrh, eye infection, asthma, chronic bronchitis, etc. From the study, the following recommendations were made: The emissions standard should be introduced; road pricing for automobiles during the hours of 7.45 am- 9.45am; 1.45- 2.45pm and 3.45- 5pm; industries involved in ambient particles pollution should use best available technology or technique to control emissions from industrial sites; that there should be no more incineration of refuse in an open areas or market areas. The government approved dump sites which are far from residential areas should be used to dump all wastes collection and processing; the flaring of gas in our refineries should be stopped because of the increased ambient PM_{10} (> $139µg/m^3$) values that was obtained within the foci of gas flaring areas.

Jimmy *et al.*, (2013) in their study on "The Environmental Health Implications of Motorcycle Emitted Gases in Uyo metropolis" examined two hundred commercial motorcycles [8]. The motorcycles were drawn from 7 motorcycle parks for the study. The air pollutants monitored during the study were carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ammonia (NH_4), hydrogen sulphite (H_2S) and chlorine gas. The data obtained revealed wide different between the highest value recorded and the lowest recorded value. The values showed that ammonia (NH_4), and carbon monoxide (CO) were relatively low at one source which was within the Federal Ministry of Environment (FMENV) limit / standard. Other sources showed values relatively high and far above the Federal Ministry of Environment (FMENV) limit / standard. Carbon monoxide (CO) value of 66ppm was the highest value recorded during the study. It was revealed by the study through result obtained, that motorcycles attributed relatively high percentage of pollutants on the daily into the ambient air in Uyo which cause air pollution in Uyo metropolis. The significant contribution of air pollutants from older motorcycles were rated higher than newer motorcycles. The reason could because by incomplete combustion of fuel. The high levels of the emission they released into the air which compounded the air pollution revealed lack proper maintenance culture by owners of the motorcycles. The report confirmed that motorcycles are not environmentally friendly to be used as primary means of transportation in Uyo and by extension any part of the world, when the health and other implications are put into consideration.

The literature review as earlier outlined revealed that various researchers have monitored and reported air and noise pollution in Uyo. The data reported by some were relatively high and above both national and international acceptable limits/standards with associated health risk. However, the various studies have shown methods for monitoring air quality and mitigation measures. Several previous studies did not really broaden the scope of the researches in terms of numbers of air pollutants to monitor and the sampling points to cover all the increasing traffic / congestion in the city. Uyo is a developing city, hence the daily influx of people into Uyo leads to increase in population growth, commercial activities, vehicular movement and industrial activities, and thus the need for this study.

Methodology

The sampling of the air quality and noise pollution was carried out on hourly basis for three (3) hours per sampling station (morning, afternoon and evening – peak, off peak and peak period). This was done in-situ by determining the air pollutants and noise level using a series of hand held (portable) air quality and noise level monitoring equipment of different sensor for each air pollutant. The sensors were held at a height of about two meters in the direction of the prevailing wind. Short exposure of limits of three minutes were applied per single reading/monitoring of each air pollutant for all the air pollutants that were logged in, and the reading was recorded at stability

Methods of Data Collection/Instrumentation

Sampling Equipment

The sampling equipments used were portable digital hand held air quality and noise metersto monitor air pollutants and noise pollution. The portable meters used in the study is the Aerocet 531S is a small, handheld, battery operated, and completely portable meter with detection limit of 1.0µg/m^3that measures$PM_{10,}$ $PM_{7,}$ PM_4, $PM_{2.5,}$ PM_1andTSP. The portable meter provides both particle counts and mass PM measurements as stored data logged values, real-time networked data, or printed result. Here, a known volume of ambient air is drawn through a glass fibre filter (20 x 25cm) of known weight under a fixed roof by means of a heavy duty turbine blower at a constant flow rate ranging from 1.1-1.7 m^3/min. Re-weighing of the filter after sampling under controlled condition gives a direct measurement of particulate mass. Particulate matter having diameters (stoke's equivalent diameter) between 0.1 and 100µm are removed from the air stream by filtration on the glass fibre filter [9]. The concentration of the particulate is determined by dividing the mass of the SPM by the volume of air sampled [10-11].

Figure 1: Mass Particle Counter (Aerocet-531S) used for investigation of Particulate Matter

Results and Discussion

Gaseous Pollutants

Variation of the Volatile Organic Compounds (VOCs) mean data were between 308.2-514.5 ppm. This was higher than the mean value of 192.37 ppm recorded at the control. The individual data for VOCs ranged from 147.8 ppm - 841.0 ppm. The individual site data was relatively higher than the control point. However, all the readings were below the FMENV permissible limit of 6000ppm. The highest mean concentration of VOCs was recorded at the Nwaniba Roundabout by Oron Road.

There was a noticeable variation in nitrogen dioxide (NO_2) mean concentration across the study locations, it varied between 0.13-0.56 ppm. However, the individual concentrations at the study locations varied from < 0.001-0.7 ppm across the monitoring sites. The highest ambient concentration of nitrogen dioxide was noticed at the Itam Market by Goodluck Jonathan Flyover.

Mean concentration of sulphur dioxide (SO_2) varied between <0.01-0.3 ppm. This was higher than the mean value of 0.03ppm recorded at the control point. The individual data for SO_2 ranged from <0.01 ppm-0.4ppm. The individual site data was relatively higher than the control. However, the concentrations of SO_2 in four (4) sampling locations were below the detectable limit of the equipment used. The highest mean concentration of SO_2 was recorded at the Akpan Andem Market by Udoumana.

Hydrogen sulphide (H_2S) was less than the detectable limit <0.01 ppm of the instrument used at all the sampling sites. This is an indication of the low level of the gas in the study location.

The mean concentration of ammonia (NH_3) ranged from <0.01-2.7 ppm. Sampling point 11 (Itam Market by Goodluck Jonathan Flyover) recorded the highest mean value of NH_3. The individual concentrations of ammonia in the study location varied from <0.01 to 3.1 ppm. The mean concentration of the control was 0.66 ppm.

Methane (CH_4) concentration in the study area varied from individually from <1.0-18.0 ppm. The highest individual value was recorded within sampling point 1 (Four Lane Roundabout by Nwaniba Road). The mean concentration of methane varied from <1.0-7.0 ppm. The highest mean value was again recorded in sampling point 1 (Four Lane Roundabout by Nwaniba Road). The value recorded was higher than the control point which had <1.0 ppm concentration of methane.

Noise

Mean variation of Noise was between 68.8- 84.9 dB and was higher than the value in the control point which was 52.13 dB. The highest mean value was recorded at Itam Market by Goodluck Jonathan Flyover. The individual noise levels measured at the study locations ranged from 60.2 – 88.7dB. The highest individual noise measurement was observed at the Itam Market by Goodluck Jonathan Flyover.

Table 3: Daily mean values of atmospheric parameters

PM_{10} (ug/m^3)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
SP-1	3	67.8667	25.02665	14.44914	5.6970	130.0363	42.20	92.20
SP-2	3	1.2387E2	36.37050	20.99852	33.5173	214.2160	83.80	154.80
SP-3	3	82.6667	47.10354	27.19524	-34.3450	199.6783	48.50	136.40
SP-4	3	1.2447E2	30.34754	17.52116	49.0792	199.8541	96.60	156.80
SP-5	3	1.4223E2	45.40268	26.21325	29.4468	255.0198	90.20	173.80
SP-6	3	1.1707E2	51.06019	29.47962	-9.7739	243.9072	68.50	170.30
SP-7	3	1.5087E2	43.15847	24.91755	43.6551	258.0782	116.80	199.40
SP-8	3	1.0877E2	17.77986	10.26521	64.5991	152.9343	88.30	120.40
SP-9	3	1.2263E2	51.29370	29.61443	-4.7873	250.0539	68.70	170.80
SP-10	3	56.0667	18.97085	10.95283	8.9405	103.1929	35.00	71.80
SP-11	3	2.7977E2	208.88912	1.20602E2	-239.1427	798.6760	149.40	520.70
SP-12	3	2.7103E2	136.62541	78.88072	-68.3630	610.4297	117.40	378.90
SP-13	3	70.5667	40.29322	23.26330	-29.5272	170.6606	44.80	117.00
SP-14	3	2.4417E2	170.22413	98.27895	-178.6935	667.0268	81.30	420.90
CTR	3	50.7333	10.90382	6.29532	23.6467	77.8199	40.00	61.80
Total	45	1.3418E2	101.05068	15.06375	103.8255	164.5434	35.00	520.70

Air Quality Index of the Study Area for Uyo Metropolis

The air quality index of the sampling points in Uyo metropolis showing the USEPA index interpretation describe the concentration of the air pollutants of PM_{10}, $PM_{2.5}$, CO, SO_2 and NO_2 with associated health effect statement and cautionary statements so that the sensitive groups would be aware of the quality of air in the sampling study area.

Number of Tricycles and Vehicles at Traffic Points

The number of vehicles and tricycles at heavy traffic and road intersection where long vehicles waiting was observed for about 10 minutes interval and counted at the time of monitoring during morning, afternoon and evening (peak, off peak and peak) periods which could be attributed to be the primary source of air pollution in this study area.

The results of respirable particulate matter (RPM) PM_{10}, PM_7, PM_4, $PM_{2.5}$ and PM_1. Total Suspended Particulate (TSP) including gaseous air pollutants and noise level that were monitored in Uyo metropolis are presented for discussion.

Table 4: Number of Tricycles and Vehicles at Traffic Points at the Time of Monitoring for 10 Minutes Interval

S/N	Sampling Points	Morning hours (peak period)		Afternoon hours (off peak period)		Evening hours (peak period)	
		Tricycles	Vehicles	Tricycles	Vehicles	Tricycles	Vehicles
1.	SP1	51	40	30	20	68	55
2.	SP2	34	38	21	23	40	46

3.	SP3	50	71	45	53	80	67
4.	SP4	60	62	28	40	50	54
5.	SP5	62	43	30	26	68	48
6.	SP6	30	40	20	30	41	58
7.	SP7	40	65	19	31	48	75
8.	SP8	35	36	20	16	40	58
9.	SP9	40	30	20	20	31	47
10.	SP10	50	110	41	70	60	90
11.	SP11	50	60	39	35	55	70
12.	SP12	40	61	30	28	56	65
13.	SP13	42	30	27	14	50	46
14.	SP14	48	25	34	16	41	26
15.	CTR	15	20	9	10	10	12

Effects of Meteorological Variables on Air Quality Parameters

The effect of the meteorological variables such as temperature **(^oC),** wind speed **(m/s)** and humidity **(%)** on each of the air pollutants monitored at the study area during this research is calculated using regression analysis as presented below.

i. Effects of Temperature (^oC), Wind speed (m/s) and Humidity (%) on PM_{10}

PM_{10} = 1719.246 + 9.763(T) - 71.088(W/S) - 23.142(H)

R=0.728, R^2 = 0.530 (53%), Adj. R^2 = 0.402 (40.2%), p-value = 0.034.

Because the calculated p-value (0.034) is less than the critical p-value (0.05), i.e. p_{cal} (0.034)<p_{crit} (0.05), it is concluded that the meteorological variables (temperature, wind speed and humidity) has significant effect on PM_{10}.

ii. Effects of Temperature (^oC), Wind speed (m/s) and Humidity (%) on PM_7

PM_7 = 870.91 + 9.005(T) – 45.793(W/S) – 12.765 (H)

R=0.730, R^2 = 0.533 (53.3%), Adj. R^2 = 0.406 (40.6%), p-value = 0.033.

Because the calculated p-value (0.033) is less than the critical p-value (0.05), i.e. p_{cal} (0.033)<p_{crit} (0.05), it is concluded that the meteorological variables (temperature, wind speed and humidity) has significant effect on PM_7.

iii. Effects of Temperature (^oC), Wind speed (m/s) and Humidity (%) on CO

CO = -1.291 + 0.092(T) – 0.194(W/S) – 0.010(H)

R=0.746, R^2 = 0.557 (55.7%), Adj.R^2 = 0.436 (43.6%), p-value = 0.025.

Because the calculated p-value (0.025) is less than the critical p-value (0.05), i.e. p_{cal}(0.025)<p_{crit}(0.05), it is concluded that the meteorological variables (temperature, wind speed and humidity) has significant effect on CO

iv. Effects of Temperature (^oC), Wind speed (m/s) and Humidity (%) on NH_3

NH_3= 10.850 + 0.072(T) – 0.361(W/S) – 0.145(H)

R=0.444, R^2 = 0.197 (19.7%), Adj.R^2 = -0.022 (-2.2%), p-value = 0.573.

Because the calculated p-value (0.113) is greater than the critical p-value (0.472), i.e. p_{cal}(0.472)>p_{crit}(0.05), it is concluded that the meteorological variables (temperature, wind speed and humidity) do not have significant effect on NH_3.

Total Suspended Particulate (TSP)

Itam Market by Goodluck Jonathan Flyover recorded the highest value of TSP in the study location. This could be attributed to the vehicular and pedestal traffic witnessed around this sampling point. The heavy traffic within this place would likely produced dust and other particulates that may increase the value of TSP. The reason for the high value recorded could also be attributed to heavy traffic congestion and road intersection where long vehicular waiting was observed at the time of monitoring. The trend of relatively high values was recorded during the peak periods (morning and evening) where a lot of people were rushing out and in from works and different businesses. Several researches in literature Efe, (2006), Akpan, (2014) and Gobo *et al.,* (2012) have revealed meaningful relationship between heavy traffic vehicle emission and air pollution concentrations.

Hence, the findings that high concentration levels of TSP is as a result of heavy traffic with high densely clustered people with commercial activities around the study location is in agreement with the previous studies [7, 12-13].

Gases

The highest concentration of VOCs recorded at Nwaniba Roundabout by Oron Road could be attributed to the volume of diesel engines as a result of ongoing construction works at the study point. However, the concentrations were generally lower than the FMENV permissible limit of 6000.0 ppm. Low concentrations of VOCs at a study site indicate the combustion engine is working in normal condition. VOCs are hydrocarbons used for fuelling of the generator. A smoking diesel engine indicates that more fuel is being injected into the cylinder than is being burnt and some of the fuels are only partially burnt; resulting in the emissions of unburnt carbon. The presence of VOCs in all the sampling sites was primarily due to congestion with people of different classes of business busy with their commercial activities and commercial vehicles including heavy trucks traffic at the of time monitoring could be attributed to detection of VOCs.. Many studies including Ewona *et al.*, (2013) and Gobo *et al.*, (2012) also confirmed the possible presence of VOCs during heavy traffic. Hence this study is in agreement that high concentration levels VOCs are as a result of heavy traffic with high densely clustered people with commercial activities around the study location. This trend of relatively high values was observed during the peak periods (morning and evening) when many people were going and coming back from offices and other businesses [13-14].

Itam Market by Goodluck Jonathan Flyover recorded the highest concentration of NO_2 because of the presence of the relatively high volume of combustion activities from both diesel and PMS engines due to heavy traffic congestion and road intersection where long vehicular waiting was observed at the time of monitoring . These values were lower than the FMENV permissible limit of 500ppm. NO_2 is a product of the combustion of fossil fuels at high temperature. Both NO and NO_2 participate in the ozone layer depletion; it should therefore not be above the allowable limit. Various studies including Mmom *et al.*, (2014), Udontong, (2015), Jimmy *et al.*, (2013) also reported the same high values of NO_2during peak traffic period [8, 15-16]. Hence, this research is in agreement that high concentration levels of $NO_2$are as a result of heavy traffic with high densely clustered people with commercial activities around the study location. This trend of relatively high values was observed during the peak periods (morning and evening) when many people were going and coming back from offices and other businesses.

The VOCs recorded the highest value at Nwaniba Roundabout by Oron Road, NO_2 highest value was at Itam Market by Goodluck Jonathan Flyover, SO_2 mean highest value was recorded at Akpan Andem Market by Udoumana. The H_2S value was less than instrument detection limit of 0.01 ppm while CO recorded the highest value atAkpan Andem Market by Udoumana. The NH_3 highest value recorded was at Itam Market by Goodluck Jonathan Flyover, the highest value for CH_4 was obtained at Four Lane Roundabout by Nwaniba Road, while Itam Market by Goodluck Jonathan Flyover recorded the highest noise level. The heavy traffic, congestion, dense population, road intersection, generator power plants, rotten wastes, agricultural and urban runoff could be attributed to the sources of the air and noise pollution. The research evaluated the variations of the air pollutions in relationship with sampling locations.

Conclusion

Air pollution is something that we cannot really ignore now-a-days. This is evident from the moment we step out of our house and are greeted with black coloured smog that hits us directly reminding us that breathing clean air is more of a distant dream. It is so easy for us to endlessly rant and rave about the causes of air pollution and its ill effects, but little do we realize that each person is responsible for all the causes of air pollution and the situation that we face today. Take a look around you at the dismal state of affairs. The thick smog that is seen in the morning hours is not really due to somebody else but rather due to each and every one of us. Air pollution is one of the major environmental problems confronting the Uyo city, yet information regarding this is very scanty. Aside from data collected by a few individuals and corporate organizations at scattered locations, there is no comprehensive and empirical database on the magnitude of the hazard and its deleterious effects on the ecosystems and people in the region. Also the existing network of meteorological stations is too coarse to provide data covering the whole of the region. The Niger Delta is Nigeria's most endowed region in terms of oil mineral reserves and one of the most industrialized. The operations of these industries especially the upstream and downstream petroleum sectors as well as a variety of other anthropogenic related activities including biomass combustion, refuse burning and traffic emissions releases a barrage of substances like volatile organics, oxides of carbon, nitrogen, sulphur, particulate matter, heavy metals and other toxics at levels that most times exceed both the national and international guidelines.

References

[1]. Narayanan, P. (2009). Environmental Pollution Principles, Analysis and Control Published by Satish Kumar Jain Darya Ganj, new Delhi, Ijia

[2]. Peavey, H.S., Donald R.R. and George T.(1985). Environmental Engineering part two. Air Mc Graw-Hill book Company.

[3]. Wikipedia Encyclopedia.(2006). Air Pollution.

[4]. Folorunsho, R. and Awosika, L.F. (1995). Meteorological Induced Changes Along the Nigerian Coastal Zone and Implications for Integrated coastal Zone Management Plan.

[5]. Longhurst, J. (2005).Creating an Air Quality Index in Pittsburg. Environment Monitoring Assess, 106: 27-42.

[6]. Okere, U. (2015). IEMA Associate Learning Outcome Manual, Aecogren International U.K.

[7]. Efe, S.I., (2006). Particulate Pollution and its Health Implications in Warri Metropolis. Delta State Nigeria. Env Anal. 11, 1339-1351.

[8]. Jimmy, E.O.I, Solomon, M.S, Peter, A.I. and Asuquo, C. (2013). Environmental Health Implications of Motorcycles Emitted Gases in a Metropolitan Nigeria. American Journal of Environmental Protection(2014) 2. 7-10.

[9]. Stoker, H.S. and Seager, L.S. (1975). Environmental Chemistry, Air and Water Pollution. 2nd Edn. Scott Foresman and Co. Clean view.

[10]. World Health Organisation. (2005). Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen dioxide and Sulfur dioxide. Global Update.

[11]. WHO.(2005). Selected Methods of Measuring Air Pollutants. WHO offset publication No. 24E, World Health Organisation, Geneva.

[12]. Akpan, P.E, Usip, E.E and Jeremiah, U.O (2014).Impacts of Traffics Volumes on Air Quality in Uyo Urban, Akwa Ibom State, Nigeria. Journal of environment and earth science vol. no. 21 P. 189 – 2000.

[13]. Gobo, A.E., Ideriah, T.J.K., Francis, T.E. and Stanley, H.O. (2012). Assessment of Air Quality and Noise around Okrika Communities, Rivers State, Nigeria. Journal of Applied Science, Environmental Management (March 2012), 16: 75-83.

[14]. Ewona, I.O., Osang, I.E., Obi, E.O., Udoimuk, A.B., Ushie, P.O. (2013). Air Quality and Environmental Health in Calabar, Cros River State, Nigeria. Journal of Environmental Science, Toxicology and Food Technology. IOSR JESTFT: 2319-2402. 6(6). 55-65.

[15]. Udotong, J.I.R. (2015). Air quality Assessment at Traffic Control Points in Uyo Metropolis, Nigeria – International Journal of Engineering and Technical Research (IJETR) vol. 3, p. 325-331.

[16]. Mmom, P.C. and Essiet U. (2014). Spatio - Temporal Variations in Urban Vehicular Emissions in Uyo City, Akwa Ibom State, Nigeria. Journal of Sustainable Development vol. 7, No4 p.-272 – 280.