CARD International Journal of Environmental Studies and Safety Research (IJESSR)
ISSN: 2536-7277 (Print) : 2536-7285 (Online)
Volume 1, Number 2, September 2016
http://www.casirmediapublishing.com

Analysis of the Atmospheric Compositions at Traffic Intersections on the selected Major Roads in Imo State, Nigeria

[1]Ubuoh E. A. & [2]Ogbuji S. I.
[1]Department of Environmental Management and Toxicology
College of Natural Resources and Environmental Management
Michael Okpara University of Agriculture, Umudike, Nigeria
[2]Department of Geography and Environmental Management
Imo State University, Owerri, Imo State Nigeria
Email: attahubuoh@gmail.com

ABSTRACT
The study was aimed at Assessing Ambient Air Chemistry at Some Traffic Intersection Points in Owerri Urban due to incessant traffic jam which has become the most recognized air quality issue in recent times. Air quality sampled for 8hours duration include: sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter (PM_{10}), carbon monoxide (CO), carbon-dioxide (CO_2) and lead (Pb) alongside meteorological variables viz: wind speed, temperature, and relative humidity. The results of the sampled air quality at the selected traffic routes were compared with FMENV/WHO standards which summarized the health implications of each of the parameters using Pollutant Standards Index (PSI) according to USEPA. The mean results of the air quality showed that in the morning and evening hours except the mean of PM_{10}, all other parameters exceeded the limits set by FEMENV/WHO with the mean wind speed values of 1.7m/s^2, temperature 31.16^{o}C, and relative humidity 79.1% in the morning, and in the evening, the mean wind speed values of1.4 m/s^2 , temperature 30.81^{o}C, and relative humidity 62.7%were recorded which affects the dispersion of the atmospheric pollutants. Using Air Quality index to assess human effects, all other parameters shown good health implications with CO_2 showing unhealthy effects.
Keywords: *Ambient Air, Traffic Intersection, Pollutant Standards Index*

INTRODUCTION
Transport plays a fundamental role in the lives of societies and individuals: how people interact, work, play, organize production,

develop cities, and get access to services, amenities and goods is inextricably linked with the development of mobility and the choices people make about it (Buron et al., 2004;WHO,2005). In societies that rely heavily and increasingly on private motorized transport, vehicles are expected to become safer, more luxurious and powerful, and to be driven more frequently. These expectations, however, often do not take account of the ensuing consequences: increased fuel consumption, greater emissions of air pollutants and greater exposure of people to hazardous pollution that causes serious health problems.

The amount of pollutant emissions from motor vehicles are dependent on the vehicle population, age of the vehicles, the technologies used for emission control for in-use vehicles (i.e. the resultant composite emission factors of the fleet), and the mileage driven by each category of vehicle (Mmom and Essiet, 2014).

In Nigeria, much attention is given to general industrial pollution and pollution in oil industries, with little reference on damage of pollution caused by mobile transportation sources of air pollution (Iyoha, 2000; Magbabeola, 2001).In recent years, there has been considerable research on vehicle emissions and fumes (Ababio, 2003; Cadle et al, 2001, 2003 and 2004). Indeed, motor vehicles produce more air pollution than any other single human activity (WRI 1992).The impacts of motor vehicle emissions extend far beyond the local area. The transportation sector is the most rapidly growing source of greenhouse gas emissions, that is, emissions of chemicals that have the potential to contribute to global warming, hence risks to man and his environment (IPCC, 1995).

Evidence from epidemiological and toxicological studies on the effects of transport-related air pollution on health has increased substantially, although it is only a fraction of the total evidence on the effects of urban air pollution on health. A review of this evidence indicates that transport-related air pollution affects a number of health outcomes, including mortality, non- allergic respiratory morbidity, allergic illness and symptoms (such as asthma), cardiovascular, morbidity, cancer, pregnancy, birth outcomes and male fertility. The situation of increased pollution from mobile transportation source is on the increase in per capital vehicle ownership, thus resulting to high congestion on Nigeria city road and increase in the concentration of pollutants in the air, consequently, increasing health risk on human population (Okunola et al, 2014). Research in recent decades consistently indicates the adverse effects of outdoor air pollution on human health, and the evidence points to air pollution stemming from transport as an important contributor to these effects. This research therefore is focused on the effect of vehicular emission on ambient air chemistry and its contribution to climate change that affect man and his environment.

MATERIALS AND METHODS

Study Area: Owerri (Owèrrè) is an important regional centre and the capital of Imo State in Nigeria, set in the heart of the Igboland. The city is located on coordinates 5.485°N, 7.035°E.Owerri consists of three Local Government Areas (LGAs)including Owerri Municipal (176,334), Owerri North(101,754) and Owerri West (125,337), it has a population of about 403,425 as of 2008 and is approximately 40 square miles (100 km^2) in area(Uzondu and Ikeogu,2013). Owerri is bordered by the Otamiri River to the east and the Nworie River to the south. The city encompasses other smaller towns and villages like Orji, Nekede, Mbieri, Egbu, Amakohia, Akwakuma etc. For years now, Owerri metropolis as the capital of the state is usually locked up in traffic especially any time it rains heavily, as the traffic grinds to a complete halt with vehicles and passengers trapped for up to 4 hours in the unprecedented chaotic traffic jams. It is on this background that this study is carried out to look into urban transportation problems with particular attention on its effects on ambient air composition.

Transportation Development in Owerri: The total urban population of Owerri has been rising continuously over the last few years. Population of the city in the year 2006 was around 403,425 (NPC, 2005).Over the years, there has been increasing ownership of vehicle/cars by individuals whereby one family has more than one car; the number of tricycles (Keke Napep) has also increased. There is inadequate transport infrastructure to serve the new suburban developments and residences and this has caused enormous pressure on public transport system. Most of the streets in Owerri are currently suffering from traffic congestion, various parking problems, poor public transport system etc. The operators and passengers have converted most of the road junctions to motor parks and bus stops and most of these road side motor parks like the Mbaise road, school road by Douglas Park, Wetheral by Douglas Road Park in front of Emmanuel College and Ama J.K have all given rise to traffic congestion.

Air Sampling Procedures: The study measured air pollutant concentrations and levels from automobiles at road intersections with high volume and frequent traffic congestion at some selected roads, and compared the values obtained with periods where the traffic is less congested regarded as off-peak periods. Also, the assessment of all the sampling points was carried out in association with the atmospheric conditions of these points. The measurement of air pollutants from the selected sites were carried out three (3) times per day for the duration of ten working days of the week Viz; 7:30am-9:30am (Morning peak hours). 1:00pm-3:00pm (Off-peak hours) and 5:00pm-7:00pm (Evening peak hours) respectively.

Air Quality Sampled: The air pollutants measured are: Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Carbon monoxide (CO), Carbondioxide CO_2), particulate matter (PM10),)and lead These were measured with the Testo 350XL Emission Analyzer.A sample of eight roundabouts with designation Air Quality Sample Point (AQSP) noted for heavy traffic congestion in the city were selected as the focus of this study : Assumpta Roundabout (AQSP- 1), Akwakuma Roundabout (AQSP-2), Fire Service Roundabout (AQSP-3), Amakohia Roundabout (AQSP-4), IMSU Roundabout (AQSP -5), Government House Roundabout (AQSP-6),Warehouse Roundabout (AQSP-7), and Emmanuel College Roundabout (AQSP-8).Chosen air Quality parameters were compared with WHO (2000) and FEPA, now Federal Ministry of Environment, FEPA (1991) air quality guidelines which are designed to offer guidance in reducing the health impacts of air pollution. Above all, the final results were compared to Pollution Standard Index (PSI).

Table 4: Pollutant Standards Index Values, Descriptors, and General Health Effects

PSI	DESCRIPTOR	GENERAL HEALTH EFFECT
0-50	**Good**	None for the general public
51-100	**Moderate**	Few or none for the general public
101-199	**Unhealthy**	Unhealthful Mild aggravation of symptoms among susceptible people, with irritation symptoms in the healthy population
200-299	**Very unhealthy**	very Unhealthful Significant aggravation and decreased exercise tolerance in persons with heart or lung
≥300	**Hazardous**	Hazardous Significant aggravation of symptoms in healthy persons; early onset of certain diseases; above 400, premature death of ill and elderly

Source: USEPA (1994b).

Meteorological Parameters: Also, the climatic elements sampled include wind velocity(m/s), ambient temperature (°C) and relative humidity also measured with the same instrument, while relative humidity data was derived using the kestrel 4000 weather tracker. The co-ordinates of the sampling points within the period were recorded with a hand-held Geographic Positioning Systems (GPS).

RESULTS AND DISCUSSION

Table 2-4summarized the results of Air quality (AQ) and climatic variables during morning, afternoon and evening hours in the study locations based on GPS readings, while Table 5 signifies the comparison of the Summary of Atmospheric Air Pollutants in all Point of Intersection to FMENV Standards.

Table 2: Results of Global Positioning System, Ambient Air Quality and Climatic Elements during Morning Peak Hour at Intersection Point

LONG.	LAT.	Designation	Roundabout	SO_2 ,ppm	NO_2 ,ppm	PM_{10}, mg/m³	CO ppm	CO_2 ppm	Pb ppm	Wind Speed (m/s²)	Temp. (°C)	RH (%)
7° 1.045′	5° 29.353′	AQSP- 1	Assumpta roundabout	3.90	0.80	11.10	16.00	618.00	0.00	1.40	31.70	61.00
7° 1.577′	5° 29.433′	AQSP- 2	Orlu Rd. roundabout.	5.50	0.90	13.20	13.00	666.00	0.50	2.00	31.20	63.20
7° 2.395′	5° 28.800′	AQSP- 3	Fire Service roundabout	7.60	1.20	12.30	19.00	641.00	0.50	1.40	30.80	61.20
7° 5.072′	5° 29.160′	AQSP- 4	Amakohia roundabout	0.65	0.15	13.80	11.00	629.00	0.00	1.00	30.70	65.50
7° 2.300′	5° 30.463′	AQSP- 5	Imsu roundabout.	4.60	1.10	10.46	31.00	633.00	0.00	2.70	31.20	60.10
7° 4.292′	5° 28.257′	AQSP- 6	Wetheral roundabout	0.58	0.09	10.13	13.75	638.00	8.50	1.58	31.10	64.33
7° 1.421′	5° 26.340′	AQSP- 7	Warehouse roundabout	1.25	0.11	10.93	12.50	632.00	15.75	2.10	31.40	64.25
7° 2.279′	5° 28.066′	AQSP- 8	Aba Rd. roundabout	1.70	0.11	10.75	14.00	656.25	7.50	1.80	31.23	61.93
Mean				**3.2 2**	**0.55**	**10.08**	**16.28**	**639.15**	**4.1**	**1.7**	**31.16**	**62.7**

From Table 2, sulphur dioxide (SO_2) ranged between 0.38 – 7.60 ppm having the mean value of 3.22 ppm, with AQSP-3 having the highest concentration and AQSP-6 having the lowest concentration. Nitrogen dioxide (NO_2) ranged between 0.11-1.20ppm having the mean value of 0.55ppm, with AQSP-3 having the highest concentration that AQSP-7 and 8 being the lowest values respectively. Particulate Matter (PM_{10}) ranged between 10.13-13.20 $\mu m/m^3$ having mean value of 10.1 $\mu m/m^3$, with AQSP-2 having the highest value than AQSP-6 with the lowest value. Carbon monoxide (CO) ranged between 11.00-31ppm having the mean value of 16.28ppm, with AQSP-5 recorded highest concentration that AQSP-7 with the lowest value. Carbon dioxide (CO_2) ranged between 618.00-656ppm having the mean value of 639.15ppm, with AQSP-2 having the highest concentration that AQSP-6 with the lowest value. Lead (Pb) ranged between 1.00-15.75ppm having the mean value of 4.1ppm, with AQSP-6 having the highest value than AQSP-1,4-5 having the no values respectively. Wind speed record ranged between 1.0-2.70 m/s^2, having the mean value of 1.7 m/s^2, with AQSP-7 having the highest value than AQSP-4.Temperature ranged between 30.70-31-40°C having the mean value of 31.16°C with AQSP1 with the highest temperature than AQSP-4. Relative humidity ranging from 60.10% to 65.50 %, having the mean value of 62.7% with AQSP-4 with the highest temperature greater than AQSP-5 being the lowest.

Table 3: Results of Global Positioning System, Ambient Air Quality and Climatic Elements during afternoon Hour at Intersection Points

LONG.	LAT.	Designation	Roundabout	SO_2, ppm	NO_2, ppm	PM_{10}, mg/m³	CO, ppm	CO_2, Ppm	Lead Ppm	Wind Speed (m/s²)	Temp. (°C)	RH %
7° 1.045′	5° 29.353′	AQSP- 1	Assumpta roundabout	2.31	0.45	6.20	10.07	100.01	0.00	1.23	33.70	45.01
7° 1.577′	5° 29.433′	AQSP- 2	Orlu Rd. roundabout	3.00	0.25	8.21	7.00	90.00	0.21	0.09	32.21	41.20
7° 2.395′	5° 28.800′	AQSP- 3	Fire Service roundabout	5.01	0.09	1.00	7.03	61.00	0.50	1.21	33.10	52.21
7° 5.072′	5° 29.160′	AQSP- 4	Amakohia roundabout	0.44	0.10	1.20	5.00	121.00	0.00	0.06	35.10	45.20
7° 2.300′	5° 30.463′	AQSP- 5	Imsu roundabout.	2.20	1.00	4.12	9.03	98.01	0.00	1.23	34.40	51.00
7° 4.292′	5° 28.257′	AQSP- 6	Wetheral roundabout	0.38	0.04	6.11	8.05	200.00	6.01	1.01	32.00	56.02
7° 1.421′	5° 26.340′	AQSP- 7	Warehouse roundabout	1.08	0.09	7.12	10.13	120.01	11.32	1.21	33.21	43.10
7° 2.279′	5° 28.066′	AQSP- 8	Aba Rd. roundabout	1.35	0.08	5.50	9.00	98.22	4.00	1.01	35.00	51.30
MEAN				**2.00**	**0.3**	**5.06**	**8.3**	**111.03**	192.2	**0.88**	**33.6**	**48.1**

From Table 3, the results obtained showed that Suphur dioxide ranged between 0.38-5.01ppm having the mean value of 2.00ppm with AQSP-3 having the highest value than AQSP-6 with the lowest. Nitrogen dioxide ranged between 0.04-0.45ppm having the mean value of 0.3ppm, with AQSP-5 recorded the highest value than AQSP-6 with the lowest value. Particulate matter ranged between 1.00-8.21 mg/m^3 having the mean value of 5.06 mg/m^3, with AQSP-2 having the highest value than AQSP-3 that recorded the lowest.Carbon monoxide ranged between 5.00-10.13ppm having mean value of 8.3ppm, with AQSP-7 with highest value than AQSP-4. Carbon dioxide ranged between 61.00 -200.00ppm with the mean value of 111.03ppm and AQSP-6 being the highest value than AQSP-3.Lead ranged between 0.00-11.32ppm having the mean value of 192.4, with AQSP-7 with the highest concentration than AQSP-1, 4,5 respectively. Climatic elements like wind speed ranged between 0.09-1.23 m/s^2 with the mean value of 0.88m/s^2, having AQSP-1, 5 with highest values respectively. Temperature ranged between 32.00-35.10^{o}C and recorded the mean value of 33.6 ^{o}C, with AQSP-4 with the highest value than AQSP-6 being the lowest. Relative humidity ranged between 41.20-56.02% having the mean value of 48.1%, with AQSP-6 being the highest than AQSP-2.

Table 4: Results of Global Positioning System, Air Quality, Elevation and Climatic Elements During Evening Peak Hours at Intersection Points.

LONG	LAT	Designation	Roundabout	SO_2, ppm	NO_2, ppm	PM_{10}, mg/m^3	CO, ppm	CO_2, ppm	Lead ppm	Wind Speed (m/s^2)	Temp. (°C)	R H(%)
7°1.045'	5°29.353'	AQSP- 1	Assumpta roundabout	4.80	0.90	10.70	21.00	740.00	2.00	1.40	30.20	90.40
7°1.577'	5°29.433'	AQSP- 2	Orlu Rd. roundabout	5.30	1.20	11.60	30.00	761.00	1.00	0.90b	31.10	89.60
7°2.395'	5°28.800'	AQSP- 3	Fire Service roundabout	5.20	1.30	9.40	48.00	689.00	0.00	1.40	30.90	84.30
7°5.072'	5°29.160'	AQSP- 4	Amakohia roundabout	0.36	0.60	2.10	13.00	605.00	0.00	0.90	30.90	83.40
7°2.300'	5°30.463'	AQSP- 5	Imsu roundabout .	4.40	1.00	15.10	20.00	611.00	0.00	1.30	29.80	87.10
7°4.292'	5°28.257'	AQSP- 6	Wetheral roundabout	0.48	0.32	10.40	14.25	654.50	1.75	1.18	30.90	64.60
7°1.421'	5°26.340'	AQSP- 7	Warehouse roundabout	0.62	0.23	10.88	13.00	648.00	1.00	1.75	32.10	65.40
7°2.279'	5°28.066'	AQSP- 8	Aba Rd. roundabout	0.55	0.27	11.85	14.75	668.00	1.75	1.20	30.83	67.95
Mean				**2.71**	**0.72**	**10.3**	**21.8**	**672.1**	**0.93**	**1.40**	**30.8**	**79.1**

Table 4 recorded SO_2 that ranged between 0.36-5.30ppm having the mean value of 2.71ppm with the highest concentration in AQSP2 with the lowest being AQSP-4 . NO_2 ranged between 0.23-1.30ppm having the mean value of 0.72ppm with the highest value in AQSP3 with the lowest AQSP-7. PM_{10} ranged between 2.10-15.10 $\mu m/m^3$ having the mean value of 10.3 $\mu m/m^3$ with highest concentration in AQSP5 and the lowest AQSP-4, CO ranged between13.00-48.00ppm having the mean value of 21.8ppm with AQSP3 recorded the highest value, with AQSP-7 being the lowest. CO_2 ranged between 605.00-761.00ppm having the mean value of 672.1ppm and AQSP2 recorded the highest value and AQSP-4 being the lowest, lead ranged between 00.00-2.00ppm having the mean value of 0.93ppm and AQSP1 recorded the highest value, and AQSP-3-5 with lowest values respectively. Wind speed ranged between 0.90-1.75 $m/s^2$with$_{AQSP-7}$ having the highest value than AQSP-2 having the lowest. Temperature ranged between30.20-32.10°C having the mean value of 30.8°C with AQSP7 having highest values of wind speed and temperature respectively, with AQSP-2, AQSP-1 having the lowest values accordingly. Relative humidity ranged between 64.60-90.40% with the mean value of 79.1% and AQSP1 having the highest value, with AQSP-6 with the lowest value.

Table 5: Comparison of the Summary of Atmospheric Air Pollutants in all Point of Intersection to FMENV Standards

Time	Atmospheric Air Pollutants						Climatic Variables		
	SO_2 (PPM)	NO_2 (PPM)	PM_{10} (µg/m3)	CO (ppm)	CO_2 (ppm)	Pb (ppm)	WIND	Temp oC	R/H (%)
Morning	3.22	0.55	10.08	16.28	639.15	4.1	1.7	31.16	62.7
Afternoon	2.00	0.3	5.06	8.3	111.03	4.01	0.88	33.6	48.1
Evening	2.71	0.72	10.3	21.8	672.1	0.93	1.40	30.8	79.1
FMENV standard	**0.05**	**0.053**	**150**	**10.00**	**208**	NA			

(a) **Variation Sulphur dioxide (SO_2):** From Table. The mean result obtained from the study locations between morning- evening hours indicated that the mean values ranged between 2.71 -3.22ppm with morning hour having the highest values followed by evening and then afternoon all above the 0.05ppm FMENV STD for sustainable air quality. Furthermore the concentration of SO_2 is lower than ranges of 3.21 – 5.18 ppm, 7.4 – 15.5 ppm, and 16 – 64 ppm reported by Ayodele and Abubakar (2010), Ettouney *et al*. (2010), and Kalabokas *et al*. (1999), respectively. The reason for the high value could be due to traffic congestion, road intersection, and older vehicles with incomplete combustion of sulfur dioxide due to long waiting time for vehicles. The largest single anthropogenic source of sulpur dioxide is the combustion of sulphur-containing fossil fuel (Akuro, 2012). Thus, our finding is in agreement that high concentration of air pollutants is associated with heavy traffic, especially areas with heavy traffic congestions.

(b) **Variation of Nitrogen dioxide (NO_2):** Nitrogen dioxide ranged between the mean values of 0.3-0.72ppm with evening having the highest mean value followed by morning hour, with all the periods above the 0.053ppm FEMENV limit for ambient air quality. This high concentration is suspected to be the result of heavy traffic congestion within the roundabout. This result is in line with the observation of Atubi (2015) who explained that .motor vehicles are usually the major sources of nitrogen oxides in urban areas.NO_2 was found lower than 35 – 108 ppm reported in Athens, Greece (Kalabokas *et al.,* 1999), and HIGHER than 0.20 – 0.521 ppm reported for Calabar metropolis, Nigeria (Okafor *et al.,* 2009) but quite high when compared with the limits set by FMENV for NO_2 which is 0.06 ppm.

(c) **Variation of Particulate Matter (PM_{10})**: Particulate matter in all the routes ranged between the mean values 5.06-10.03 $\mu m/m^3$, with evening having the highest followed by morning hour and the three periods above the 0.25 $\mu m/m^3$. FMENV STD for sustainable air quality. This increase is due to the release of pollutants from vehicular exhaust. Human activities, such as the burning of fossil fuels in vehicles, generate significant amounts of aerosols (Ukemenam, 2014).Particulates inhaled through the respiratory tract may damage health. Increased levels of fine particles in the air are linked to health hazards such as heart disease (Molles, 2005), altered lung function and lung cancer. Persistent free radicals connected to airborne fine particles could cause cardiopulmonary disease (Bronwen, 1999). Ana et al (2005) reported that the high concentrations of PM_{10} in most Nigerian urban environments have resulted in significant prevalence of cough, catarrh, eye infection, asthma, chronic bronchitis etc.

(d) **Variation of Carbon monoxide (CO):** The mean concentration of carbon monoxide in the overall study locations ranged between 8.3-21.8ppm with evening having the highest value followed by morning rush hour. The atmospheric CO along the roads roundabout when compared with values reported in literature was found to be higher than 1.6 – 3.8 ppm, an average range of atmospheric concentration of urban air pollutants in Athens, Greece (Kalabokas *et al.*, 1999).Also, the values reported in this study were higher than range of 0.7 – 1.9 ppm in Jahara, Kuwait (Ettouney *et al.*, 2010).This increase may be due to the fact that Carbon monoxide is present in the exhaust emitted into the atmosphere by cars, trucks, lories . CO is a major component of motor vehicle exhaust fumes. Except afternoon, the rest recorded values above the 10ppm FMENV STD for air quality which is detrimental to man and his environment. For example, Greiner (1991) stated that CO is a slow poison that kills by reducing the oxygen supply in the body. In the human body, CO can cause oxygen deprivation (hypoxia), displacing oxygen in bonding with hemoglobin(Carboxy-haemoglobin (COHb) complex reduces the oxygen carrying capacity of the blood cells. But some studies show effects of CO even at very low concentrations (Schwela et al. 1999). An amount, as low as 10mg/m^3 has effect on the central nervous system. (Concawe, 1999) WHO 2000;. Carbon monoxide (CO) is only a very weak direct greenhouse gas, but has important indirect effects on global warming. Carbon monoxide reacts with hydroxyl (OH) radicals in the atmosphere, reducing their abundance. As OH radicals help to reduce the lifetimes of strong greenhouse gases, like methane, carbon monoxide indirectly increases the global warming potential of these gases (Graham, 2002)

(e) **Variation of Carbon Dioxide (CO_2):** Mean carbon dioxide in all the routes ranged between 111.03-672.1ppm with evening hour recording the highest concentration followed by morning hour. The result is suggested to be due to combustion of fossil fuels such as gasoline and diesel to the atmosphere. Compared with the World Health Organization (WHO) Standards for 24-hour exposure (25 ppm), the results generally conformed to the Standards in all the sampling locations. Although the result of 1-hour measurement was higher in most of the locations, it however fell above the maximum limit of 100 ppm set by WHO. Carbon dioxide is the most important of the greenhouse gases, accounting for half of the annual increase in average global temperatures. It is also the predominant greenhouse gas emitted by motor vehicles.

(f) **Variation of Lead (Pb)**: Mean lead concentration in all the routes ranged between 0.91-4.1ppm with the morning having the highest concentration followed by afternoon with no air quality standard. This increase is suggested to come from the emission from the burning of waste, and dust particles in the atmosphere in the area. This has been confirmed by Daily and Zaneti, 2007), and gasoline. However, the costs to society in terms of negative health effects from lead are clear and well-documented. The largest source of Pb in the atmosphere has been from leaded gasoline combustion, but with the gradual elimination worldwide of lead in gasoline, air Pb Levels have decreased considerably.

PSI stipulated by USEPA, especially during the evening and morning periods implies that traffic CO_2 emission in all the roundabouts in the study routes is not within the safe limits, revealing that transport-related pollution can be potentially hazardous to health. During the afternoon period, the mean CO^2 was above PSI which reveals the moderate health implication

(g) **Meteorological Parameters:** The mean wind in the study location ranged between 0.88-1.7m/s, with the evening period having the highest wind speed followed by morning hour. The mean value of temperature ranged between 30.8-31.16°C.The highest mean ambient temperatures was in the afternoon followed by morning hour. The higher temperature value in the afternoon than morning and evening was not unexpected. The differences in ambient temperature at the different location was due to differences in the time of the day measurement was made. This was also observed by Okunola et al (2012) who explained that, the variations of temperature may be attributed to the dynamics of the atmospheric boundary layer and associated convective turbulence, which extensively mixed and redistributed pollutants to a greater vertical extent. The observed temperature values are opposed to Alagoaand Derefaka (2002) who stated that temperature is fairly constant throughout the state with a maximum value. The mean levels of relative humidity ranged between 48.1-79.1% with evening having the highest value than morning and afternoon attributing to the high moisture content of the air in the study locations. The results obtained in this study conform to the report by Alagoa and Derefaka (2002).

Ultimately, the results showed that vehicular flows around the major roundabouts in Owerri urban have resulted to the emission of pollutants likeSO_2,NO_2,CO, CO_2 to the ambient air quality. Also lead was discovered due to dust in the atmosphere. The concentrations of the SO_2,NO_2,CO, $CO_2$and SO_2 measured, with few exceptions in the afternoon in the study locations were above the FMENV STDs for sustainable air quality.

Using AQI stipulated by USEPA, mean CO_2 during the three periods of the day implies that traffic emission is not within the safe limits. Hence, the results reveal that mean CO_2 from vehicular flow in the study locations is significant with potentially unhealthy and hazardous health consequences. This was observed by Olukayode (2012).The high levels of carbon dioxide concentrations obtained show that with increase in congestion and number of vehicles passing a given area at any time, there would be an increase in the quantity of carbon dioxide emitted, due to the combustion of fossil fuels. Carbon dioxide is likely to bring about increase in atmospheric temperature resulting to heat stress. The devastating impacts of this increase in temperature will lead to changes in the pattern of rainfall leading to increasing frequency of severe rainstorms, hence flooding that destroys lives and properties, especially agriculture, hence food insecurity and hunger. A combination of high ambient temperature and relative is known to exacerbated heat –related morbidity and mortality among the urban dwellers. This was observed by Golden et al (2008).Higher air temperature also increase the concentration of ozone at the ground level that can damage lung tissues and cause problems for people with asthmas and other lung diseases (Oluwatuyi andAmen,2009).

CONCLUSION

It is then concluded that around these major roundabouts where we have little or no human activities apart from vehicular flows and traffic congestions, it is confirmed that pollution of the ambient air is caused by vehicles applying the routes. Based on these findings, the following recommendations are advanced to improve air quality in the city:

- There is need for government to adopt sustainable emission control technologies aimed at reducing pollutants and enforcing the legislation on the maximum age of imported used vehicles into the country through Customs, Vehicle Inspection Officers (VIO) and Federal Road Safety Corps (FRSC).
- Government should improve the conditions of ring routes and link roads to reduce the number of vehicles at intersections, will lead to the thorough flow of vehicles in the city.
- Urban afforestation should be promoted through tree planting for gaseous exchange and
- There is need to disperse traffic at road intersection through the multiple freeways or over- head bridges in order to reduce emission.

REFERENCES

Akuro, A. 2012. Air Quality Survey of somelocations in the Niger Delta Area. J.Appl. Sci. Environ. Manage. Vol. 16(1) 125 – 134

Ana, G.R.E.E., Sridharl, M.K.C. and Olawuyi J.F.(2005). Pollution in a Chemical Fertilizer Complex inNigeria: The Impact on the Health of the Workers J. Public Heal. Epidemiol, Volume:4 Issue:2

Atubi, A.O.(2015): Transport and the Environment: Towards Reducing Road Traffic Emissions in Nigeria. International Journal of Science and Technology, Vol.4(1) pp1—15.

Alagoa, E.J. and Derefaka A.A (2002). The land andpeople pf Rivers State: Eastern Niger Delta. OnyomaResearch Publication. Pp 19-42.

Ayodele, J. T. and Abubakar, F. (2010), "Sulphur dioxide as indoor pollutant in Kano Municipality Kano-Nigeria", *Journal of Environmental Chemistry and Ecotoxicology*, Vol. 2 No. 1, pp. 9 – 13.

Bailey PD (1995). Modelling future vehicle exhaust emission in Europe. Water, Air and Soil Pollution. 85 (4): 1879-1884.

Bronwen, M., (1999). The Price of Oil Human Rights Watch. Perception and Reality: Assessing Priorities for Sustainable Development in the Niger River Delta Retrieved October 3, 2011. 8)

Cadle S.H, Croes B.E, Minassian F, Natarajan M, Tierney EJ, Lawson D.R. (2004). Real-world vehicle emissions: A summary of the Thirteenth Coordinating Research Council on-road Vehicle Emissions Workshop. Journal of the Air and Waste Management Association. 54(1): 18-23.

Cadle S.H, Gorse Jr. R.A, Bailey B,K, Lawson D,R. (2003). Real-world vehicle emissions: A summary of the twelfth Coordinating Research Council on-road vehicle emissions workshop. Journal of the Air and Waste Management Association. 53(2): 152-167..

Cadle S.H, Gorse R.A Jr., Bailey B,K, Lawson D,R. (2001). Real-world vehicle emissions: a summary of the tenth coordinating research councilon-road vehicle emissions workshop. Journal of the Air and Waste Management Association. 51(2): 236-249.

CONCAWE (1999). The health effects of PM2.5(including ultrafine particles). Concawa report no.99/60, P.34

Ettouney, R. S., Zaki, J. G., El-Rifiai, M. A. and Ettouney, H. M. (2010), An assessment of the air pollution data from two monitoring stations in Kuwait, *Toxicology and Environmental Chemistry*, Vol. 92 No. 4, pp. 655 – 668.

Faiz, A., Weaver, S.W., & Walsh, M.P. (1996). *Air pollution from motor vehicles: Standards and technologies for controlling emissions*. Washington, D.C.: The World Bank.

Faboya, O. (1997), "Industrial pollution and waste management", In Osuntokun, A. (ed.), *Dimensions of Environmental Problems in Nigeria*, Ibadan Davidson Press, Nigeria, pp. 26 -35

FMEnv (1991). (Federal Ministry of Environmental) National Interim Guidelines and Standards forIndustrial Effluents, Gaseous Emissions andHazardous Waste Management in Nigeria. 91-110.

Golden,J.S., Hartz D., Brazel A.,Luber G.,Phelan P.(2008):A Biometeorology study of climate and heat-related mortality in Phoenix From 2001-2006. Int J.Biometeorol.2008 Jan 25 (Epub ahead of print-PubMed.

Kalabokas, P. O., Viras, L. G. and Repapis, C. (1999), "Analysis of the 11 – years record (1987 - 1997) of air pollution measurements in Athens, Greece, Part I: primary air pollutants", *Global Nest Journal*, Vol. 1 No. 3, pp. 157 – 167

Gorham, R. (2002). Air Pollution from groundTransportation;an assessment of causes, strategiesand tactics, and proposed actions forthe international community: The Global Initiative on Transport EmissionsA Partnership of the United Nations and the World BankDivision for Sustainable

DevelopmentDepartment of Economic and Social AffairsUnited Nations (2002).

IPCC. (1995). IPCC Synthesis Report of WorldMeteorological Organization, IntergovernmentalPanel on Climate Change. UNEP,Geneva, Switzerland.

Iyoha, M.A. (2009). The Environmental effects of oil industry activities on the Nigerian economy: A Theoretical analysis: paper presented at national conference on the management of Nigeria's petroleum resources, organized by the department of Economic, Delta State University.

Lilley LC. (2000). A new approach to emissions inventory modelling – Assessing fuel and vehicle impacts on air quality. Advances in AirPollution. 8: 389-398

Magbagbeola, N.O., (2001). The use of economic instruments for industrial pollution abatement in Nigeria: Application to the Lagos Lagoon. Proceeding of Annual Conferences of the Nigerian Economic Society Held in Port-Harcourt.

Marshall J.D, Riley W.J, McKone, T.E, Nazarott W.E. (2003). Intake fraction of primary pollutants: motor vehicle emission in the South Coast AirBasin. Atmospheric Environment. 37(24): 3455-3468.

Mmom P. C. and Essiet U. (2014). Spatio-Temporal Variations in Urban Vehicular Emissions in Uyo City, Journal of Sustainable Development; Vol. 7, No. 4; 2014

Okunola, O. J., Uzairu, A., Gimba C. E. and[b]Ndukwe, G. I(2012): Assessment of Gaseous Pollutants along High Traffic Roads in Kano, Nigeria. International Journal of Environment and Sustainability, Vol. 1No.pp 45-4.7.

Oluwatuyi O., and Amen J.,(2009). Environmental Implications of Global Warming: A Overview. Conference Proceeding on Climate Change and Nigerian Environment,Princess Alex Auditorium, UNN, 29TH June -2nd July,2009, Pp 553-580.

Ukemenam ,O. S.(2014): Causes and Consequences of air pollution in Nigeria South American Journal of Public Health, Volume-2, Issue-2, 2014 293.

Utang, P. B., & Peterside, K. S. (2011). Spatio-temporal variations in Urban Vehicular Emissions inPort-Harcourt City, Nigeria. *Ethiopian Journal of Environmental Studies and Management, 4*(2).

World Health Organization (WHO) (2005).Air quality guidelines for particulatematter, ozone, nitrogen dioxide andsulfur dioxide, Global update

WRI. (1992). World Resources. World Resources Institute, in collaboration with the United Nations Environment Programme and the United NationsDevelopment Programme. Oxford University Press, New York, NY, USA.