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An Assessment of Vehicle Transport-Induced Air Pollution along a Traffic Corridor in Lagos

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A B S T R A C T

Air pollution control is receiving more attention for policy support, however, in Lagos, Nigeria, this phenomenon is not being used to its fullest. Furthermore, the use of experimental data from localized field studies is dismally low, causing poor policy decisions. This work is a new initiative to collect and analyze transport-stimulated air pollution in three areas of Lagos: Iyana Ipaja, Egbeda, and Ikotun using a concentration of pollutants (CO, SO_2, and NO_2) and emission severities. At Iyana Ipaja, CO was above the safe limit stipulated by the Federal Environmental Protection Agency (FEPA) and SO_2 and NO_2 were below the safe limit. At Egbeda, NO_2 and SO_2 varied between 0.35-0.4 and 0.2-0.3 parts per million (ppm) with the highest value recorded during the PM peak while CO exceeded the maximum daily limit of 10 ppm. At Ikotun, the CO was 105.8ppm, which is above the stipulated value of 10ppm and SO_2 was below the value stipulated by FEPA while NO_2 varied between 0.15ppm and 0.45ppm, which is lower than the safe limit of 0.06 parts per million (ppm). Static and dynamic emission levels (SEL_{CO} and DEL_{CO}) for CO were most severe for Egbeda at (14.18 and 10.43 ppm/m), respectively. For SO_2, (SEL_{SO2} and DEL_{SO2}) were most severe for Iyana Ipaja at (0.08 and 1.00 ppm/m), respectively. The (SEL_{NO2} and DEL_{NO2}) for Iyana Ipaja and Ikotun were tied at (0.08 and 1.00 ppm/m), respectively. The novelty of this work is the proposal of a robust dataset and analysis on the concentration of certain pollutants (CO, SO_2 and NO_2) and emission seventies in Lagos, which serves as a cornerstone approach to developing and implementing transportation and environmental policy in Lagos. Results suggest that the obtained method and data values adequately represent the air pollution values for policy decision usage.

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1. INTRODUCTION

In recent times, many major cities of the world have experienced dramatic and unprecedented motorization with a phenomenal rise in vehicle population (Fattah and Morshed, 2021). This has resulted in increased air pollution (rapidly deteriorating air quality), noise pollution, traffic congestion, accidents, and damaged roads, among others. Transport-induced air pollution poses some health effects on humans, which include increased mortality from cardiovascular and respiratory diseases, brain and nerve damage, increased cancer risk and birth defects, and more (Ojolo *et al*., 2007; Schindler *et al*., 2021; Zundel *et al*., 2022; Giri *et al*., 2023). Studies have been conducted on the health effects of transport-induced emissions. Holguin (2008) studied the relationship between traffic, outdoor air pollution and Asthma. Mazzoli-Rocha *et al*. (2008) reported on the respiratory toxicity of particles produced by traffic and sugarcane burning. Nethery *et al*. (2008) examined the personal exposure of pregnant women to traffic-related air pollutants. Several other investigations have been conducted on vehicle transport-induced pollution (Gehrig *et al*., 2004; Bailey, 1995; Panis *et al*., 2001; Silva *et al*., 2007; Vardoulakis *et al*., 2002; Bono *et al*., 2001; He *et al*., 2007; Zdanevitch *et al*. 2001). Menz (2002) reviews policies for the control of mobile source pollution and their potential application in China. Huang *et al*. (2008) analyzed traffic-induced air pollution using computational fluid dynamics. Palli *et al*. (2008) examined PM_{10} exposure in traffic-exposed workers. Lin and Yu (2008) reported traffic-related air quality assessments for open road-tolling highway facilities. None of these studies has addressed the empirical study needs of Nigeria or developing countries.

Different conditions may induce air pollution episodes. Such include weather conditions, the age of the vehicle engine, and the duration of the vehicle on the road, among others. Vardoulakis *et al*. (2002) assessed spatial concentration gradients and identified weather conditions that might induce air pollution episodes in urban areas using different sampling and modeling techniques. Smit *et al*. (2008) established a relationship among air pollution emissions, fuel consumption in vehicles, and traffic congestion. Chang *et al*. (2001) compiled air emissions from air traffic using a methodology that takes into account various parameters such as the identification of aircraft engines, relevant taxiway duration by airport, etc. It has been reported that transport-induced emission level is affected by the important variables of vehicle modes of operation (Washington *et al*., 1998); fuel consumption (Van Aerde and Baker, 1993; Lilley, 2000); Meteorological variables (Glen *et al*., 1996). The above studies have not considered any results relating to the assessment of traffic-induced air pollution in Nigeria.

Transport-induced emissions, which could be measured by infra-red and ultraviolet spectrometers (Gibbs *et al*., 1995), have been reported to contain vast amounts of nitrogen oxides (Becker and Lorzer, 1999; Dasch, 1992; Karlsson, 2004), carbon monoxide (Ojolo *et al*., 2007) and sulfur oxides (Ojolo *et al*., 2007). Studies (Ackerman *et al*., 2002; Johnson *et al*., 2000) have used modeling approaches to the quantification of emission levels in traffic corridors. Mukhopadhyay and Roy (2006) developed a model to examine the automobile and environmental pollution concerning Kolkata city (India) along with some calculated measures. Hesek (2001) introduced an approach to evaluating air pollution arising from road traffic within an urban developed region. The method is called numerical integration of stationary bi-dimensional partial differential equations. A turbulent diffusion was identified with situations including street canyons. These studies have not addressed the peculiar problem of Nigeria.

An experimental approach to traffic-induced pollution has also been reported (i.e. Gibbs *et al*., 1995). Ojolo *et al*. (2007) determined the level of acidity, pH and the presence of dissolved substances in air-polluted environments such as the oxides of nitrogen, sulfur and, carbon with a case in Lagos. Segaar and Schildwacht (2000) utilized the Dutch air pollution model for traffic (CAR) to prevent exceeding the pollution limit values. Broderick et al. (2005) validated the use of the air pollution dispersion model CALINE 4 for road traffic emissions in Ireland. Apart from Ojolo *et al*. (2007), none of these studies has considered the developing country case. Even the study by Ojolo *et al*. (2007) focuses on the effects of vehicle emissions and does not specify maximum allowable limits.

Bono *et al*. (2001) measured Benzene, Toluene, and Xylenes (BTX) air pollution in Turin City (Italy) from 1989 to 1998. Gehrig *et al*. (2004) derived parameters representing emissions considering PM_{10} and PM_1. Heavy duty and light vehicles exposed to varying traffic situations implying diverse particle and nitrogen dioxide concentration exposure were considered. Other variants of the study include analysis in downwind and upwind ambient environments for busy roads. In addition, close background sites and kerb sites were considered. Panis *et al*. (2001) tracked air pollution based on external costs imposed on the environment by Brussels urban area road traffic. Farrel and Hecq (2001) presented a methodology for assessing the external costs of air pollution caused by road traffic in the Brussels urban area. He *et al*. (2007) delineated the problems, policies, and technical solutions for China's air pollution. These studies have not considered the developing country case such as Nigeria.

From the above review, it is noted that certain models (i.e. CALINE 4, Mukhopadhyay and Ray's model, Hesek's model of road traffic air pollution) may be adapted in Nigeria and other developing countries for monitoring the concentration of the pollutant in traffic conditions. However, the scarcity of field data for use is a great limitation. Also, we cannot understand the possible effects of transport-induced emissions on pregnant women (as reported in Nethery *et al*., 2008) without first measuring the emission levels in traffic corridors. It is unlikely that we could understand the local changes in environmental concentrations, their effects, and climatic changes without quantitative measures that describe emission levels. There is therefore a compelling need to assess various emission levels in important economic locations in Nigeria. This will thus provide an impetus to understanding the effects of traffic-induced pollutants on humans.

It thus becomes obvious that despite this seemingly growing research on traffic-induced air pollution we still know little about the relative amounts of air pollutants concentration in various locations compared to standard measures in Nigeria as a case for developing countries. The inhabitants of the Iyana-Ipaja/Ikotun traffic corridor are at risk of traffic-induced emissions, which generally include the oxides of carbon, sulfur, and nitrogen. These emissions, which significantly pollute the air require control as they affect human health, the environment, and vegetation. The current research will contribute to filling this gap by addressing the issue of how much concentration of pollutants (CO, SO_2, and NO_2) is in the environment at the Iyana Ipaja/Ikotun traffic corridor in Lagos, Nigeria. This traffic corridor is the major link out of areas including Command, Ayobo, Ipaja, Ikola, Igando, and Iyana Iba, which has led to the increase in traffic congestion. Specifically, the focus of this work includes: (1) To evaluate the level of pollution in the morning (AM) peak and afternoon inter peak; (2) Compare the level of concentration of air pollution in the study area with that of Federal Environmental Protection Agency (FEPA) standard; and (3) To examine the dominant pollutant in the corridor; and (4) Compute the static and dynamic emission levels of the locations and the severity of the emissions.

The paper is sectioned as follows: introduction, methodology, results discussion, and conclusion. The introduction motivates the study and emphasizes the urgency for an assessment of emission levels in the Iyana Ipaja-Ikotun traffic corridor. This is strongly supported by relevant literature. Section 2, methodology, describes the approach to the study while the results are analyzed and discussed in section 3. In section 4, concluding remarks are given.

2. METHODOLOGY

2.1 Method of data collection

In this research, both primary and secondary data were used. The primary data were obtained from 3 field surveys using equipment called ToxiRAE II Toxic gas and Oxygen monitors that give the volume of pollutants in direct measurement and the unit of measurement in ppm. Also, a Geographical Positioning System (GPS) was used to obtain the coordinates of the sampling point at the three locations (Iyana Ipaja roundabout, Egbeda, and Ikotun). Data was collected at intervals of 30 minutes, which comprises 15 minutes at the morning (AM) peak and the other 15 minutes at the evening (PM) peak. On the other hand, secondary data includes information obtained from Journal articles and other research papers. Some data about air pollution were also collected from the Lagos State Environmental Protection Agency (LASEPA). Statistics given by FEPA show that used vehicles (i.e. Tokunbo) are dumped into the country despite that they do not meet the environmental emission standards of Nigeria. Investigation shows that the records of pollution along the Iyana Ipaja-Ikotun traffic corridor are usually higher during the peak period (AM peak and PM peak) and reduced during the off-peak period. The sulfur, carbon, and nitrogen contents of the exhaust emissions were measured by taking some readings with Toxi ray II (sulfur, carbon dioxide, nitrogen). Descriptive statistics were used to analyze the primary data (field measurement). This gives the visual message on the rate at which various pollutants are generated and the comparison between the dominant pollutants in the study area (Iyana Ipaja-Ikotun traffic corridor). The data collected was further analyzed using static and dynamic emission levels analytical measures. These measures deflate the values of concentration/5mins, 10mins and 15mins in the AM and PM periods to concentration/min in the AM and PM periods. For static emission levels, these values are used directly while dynamic emission levels relate static emission levels in one location to another using a particular gas type. The importance of SEL and DEL is their ability to detect severe emission levels. Severity is a measurement of the degree of deviation of observed emission levels from standard emission levels stipulated by the Environmental Monitoring Agency.

2.2 Static and dynamic emission levels

A situation may arise such that the emissions of several locations are observed and recorded. While the raw score provides a good foundation for determining whether the safety limits provided by the Federal Environmental Protection Agency (FEPA) are exceeded or not, one may be interested in understanding how high or low the values are when deflated to the emission level per minute period of observation. The relative values across locations would guide in understanding which of the locations should first be addressed in terms of urgent attention to reduce emission levels and which could be delayed if a priority rating is to be applied. The dynamic emission level further helps in understanding the severity of emissions. The final values of the DEL would position the emission levels of each location according to how severe the emissions are in the location. The high values are positioned first while the low values are at the bottom of the table. However, the low values of emission are the most desired.

2.3 The approach to determining static and dynamic emission levels (SEL and DEL)

The approach to applying the framework presented in the paper is as detailed below:

Step 1: Determine all concentrations of pollutants in each location in the format presented (i.e. in AM 5mins, AM 10mins…, PM 15mins) using Toxy ray II air pollution measurement equipment.

Step 2: Develop the static emission level (SEL) table for each of CO, SO_2, and NO_2 (i.e. SEL_{CO} SEL_{SO2}, and SEL_{NO2}). This is determined by dividing the value obtained in step 1 by the period of measurement i.e. 5mins, 10mins and 15 mins.

Step 3: Develop the dynamic emission level (DEL) table for each of CO, SO_2,and NO_2 (i.e. dynamic emission leve ls (

DEL_{CO}, DEL_{SO2} and DEL_{NO2}). This is computed by dividing the values obtained in Step 2 by itself and other corresponding values in other locations. This is aided by choosing a reference location for all measurements and then comparing subsequent measurements or itself to it.

3. RESULTS AND DISCUSSION

The location of Lagos State is within the extreme of southwestern Nigeria of 6 degrees 20 minutes as well as 6 degrees 40 minutes North in latitude and longitudes 2 degrees 45 minutes and 4 degrees 20 minutes east. The coverage area of Lagos state is approximated as 3577 square kilometers. It is bounded by a state, a country, and the Atlantic Ocean by North and East, West and South respectively. The cosmopolitan characteristics of Lagos State have led to the rapid increase in population as a result of the migration of people from various parts of the country as well as from neighboring countries. The Alimosho Local Government (ALG) occupies an area of approximately 137.80 square kilometers (Lands Housing Office, Surveyor-General Office, Secretariat, Ikeja) which makes it one of the largest cosmopolitan (built-up) local governments in Nigeria. ALG is located northwest of Lagos State and separated from Ado-Odo/Ota Local Government (Ogun State) by River Owo. Lagos-Abeokuta Expressway forms the boundary between it and Ifako-Ijaiye, Agege and Ikeja Local Government Areas on the eastern side, while on its southern side, it shares boundaries with Oshodi/Isolo, Amuwo Odofin and Ojo Local Government Areas (Durosimi et al., 1998). Its administrative headquarters is located at Ikotun. ALG is residential with some commercial activities, which include hospitals, markets, servicing stations, mechanic workshops, banks and schools. The area can be easily accessed from Iyana Ipaja, Egbeda and Ikotun. ALG is a variable lowland region and has an altitude of 30-100 meters above sea level. It has a relatively flat undulating landscape stretching about 18km from east-west along the Lagos lagoon and the height increases from the coast inland. There are some notable settlements in the study area, some of which are Iyana Ipaja, Alimosho, Egbeda, Okunola, Idimu, Isheri, Council and Ikotun and so on. Most of the settlements form cluster patterns. The population of the study area as of 1991 provisional census figures is about 367,000; as of 1997, the population must have nearly doubled (NPC, 1991 – see Adelugba, 2007).

Three main pollutants (CO, SO_2, and NO_2) were detected during the peak traffic flow hour (AM & PM) at Iyana Ipaja. The concentration of CO ranges between 6.5 ppm and 44.1 ppm, and the concentration of SO_2 ranges between 0.2 ppm to 0.43 ppm. The average value of SO_2 emitted by vehicles at Iyana-Ipaja is lower than the maximum level (100ppm) stipulated by the Federal Environmental Protection Agency (FEPA) of the Federal Ministry of Environment. This indicates low sulfur content in the fuel used (Smit *et al.*, 2008; Lilley, 2000; Van Aerde and Baker, 1993). The average value of $N0_2$ every 5 minutes lies between 0.15ppm and 0.45ppm, this is low compared to the value (0.04ppm) stipulated by FEPA (Fig. 1 to 3 and Table 1).

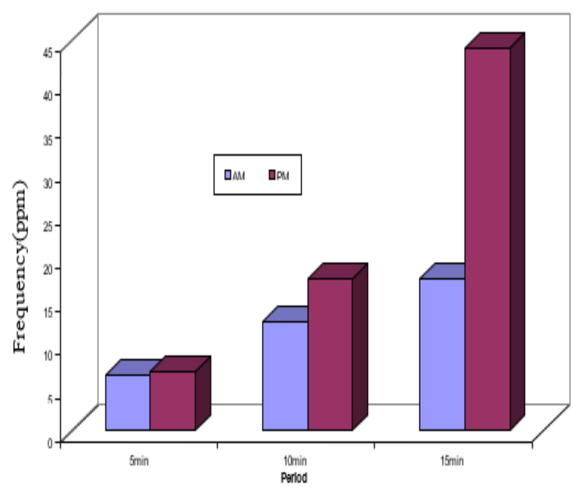

Fig. 1. Concentration of CO

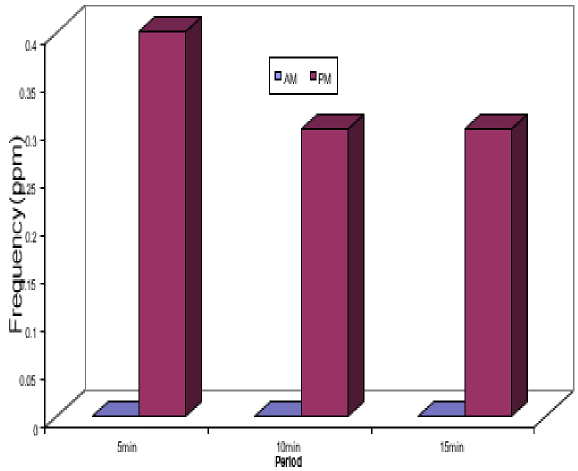

Fig. 2. Concentration of SO_2

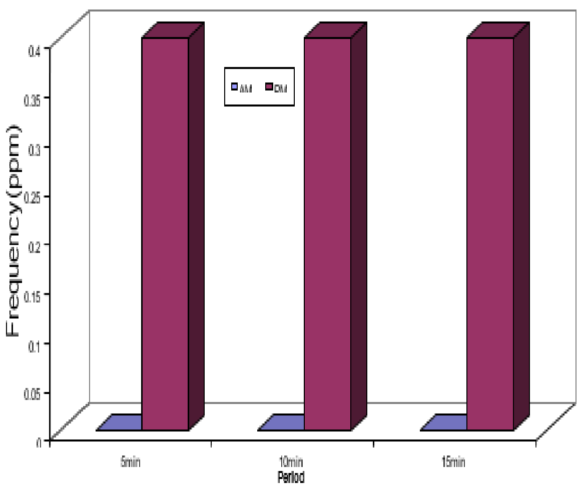

Fig. 3. Concentration of NO_2

Fig. 4 shows the variation of CO in AM peak and PM peak at Egbeda during the am peak, the concentration of CO varied between 14.8 and 50.8 ppm, while during the PM peak, the concentration of CO varied between 59.28 to 70.85 ppm. The maximum daily average value stipulated by FEPA is 10 ppm. This value was exceeded at Egbeda; this phenomenon has great health implications. For example, de-Rosa (2003) reported that young and middle-aged men serving as motorway tollgates attendants in Italy, subjected to exposure to traffic pollution have their fertility impaired. Carbon monoxide (CO) is a slow-action poison that kills by reducing the oxygen supply in the body (Fig. 4 and Table 1).

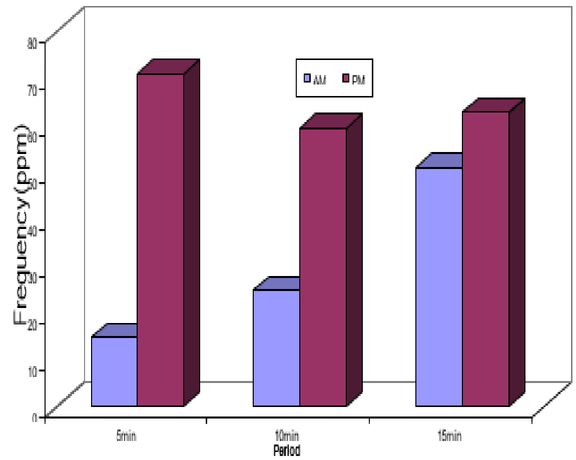

Fig. 4. Variation of CO

The concentration of SO_2 in Egbeda varied between 0.2 and 0.3 ppm, with the highest value recorded during the am peak, 5-minute average concentration of SO_2 is still lower than the maximum value stipulated by FEPA (Fig. 5 and Table 1).

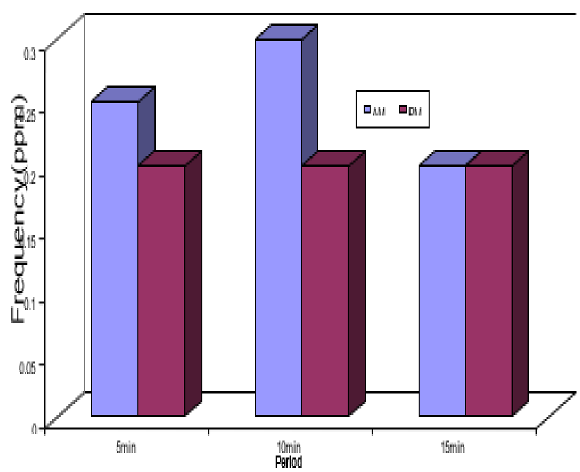

Fig. 5. Variation of SO_2

The average concentration of NO_2 in Egbeda at every 5 minutes varied between 0.35ppm and 0.4ppm, with both values recorded during the PM peak and no value recorded during the am peak (Fig. 6 and Table 1).

Table 1. Pollution gas measures at Iyana Ipaja, Egbeda and Ikotun (parts per million-ppm)

	Location	Iyana Ipaja		Egbeda		Ikotun	
Gases	Period	Data	Average	Data	Average	Data	Average
CO	AM 5mins	5,8	6.5	5,8,13,20,28	14.8	6,9,7,13,16,18,21,22	14
	AM 10mins	12,13	12.5	13,23,25,30,33	24.8	24,26,25,28,35,30,40,41	31.1
	AM 15mins	14,21	17.5	63,45,58,43,45	50.8	43,44,46,50,45,49,53,56	48.3
	PM 5mins	4,7,8,5,11,12,9,13	8.6	18,35,40,100,105,103,95	70.9	25,13,6,4,10,18,21,22,2,4	12.5
	PM 10mins	17,14,16,18,21,25,30	20.1	99,88,80,10,55,45,38	59.3	25,41,51,50,56,47,63,69,84	54
	PM 15mins	32,33,38,43,61,80,66	50.4	28,8,5,65,100,118,11,5	42.5	88,78,131,137,101,104,102,110,111	106.9
SO_2	AM 5mins	0	0	0.3,0.2	0.25	0.3,0.2	0.25
	AM 10mins	0	0	0.2,0.4	0.3	0.3,0.4	0.35
	AM 15mins	0	0	0.2,0.2	0.2	0.3,0.2	0.25
	PM 5mins	0.4,0.4	0.4	0.2,0.2	0.2	0.2,0.3,0.3	0.27
	PM 10mins	0.3,0.3	0.3	0.2,0.2	0.2	0.4,0.5,0.4	0.43
	PM 15mins	0.3,0.3	0.3	0.2,0.2	0.2	0.4,0.2,0.2	0.27
NO_2	AM 5mins	0	0	0	0	0.4,0.4	0.4
	AM 10mins	0	0	0	0	0.4,0.4	0.4
	AM 15mins	0	0	0	0	0.4,0.4	0.4
	PM 5mins	0.4,0.4	0.4	0.3,0.4	0.35	0.4,0.4	0.4
	PM 10mins	0.4,0.4	0.4	0.4,0.5	0.45	0.4,0.5	0.45
	PM 15mins	0.4,0.4	0.4	0.3,0.4	0.35	0.2,0.1	0.15

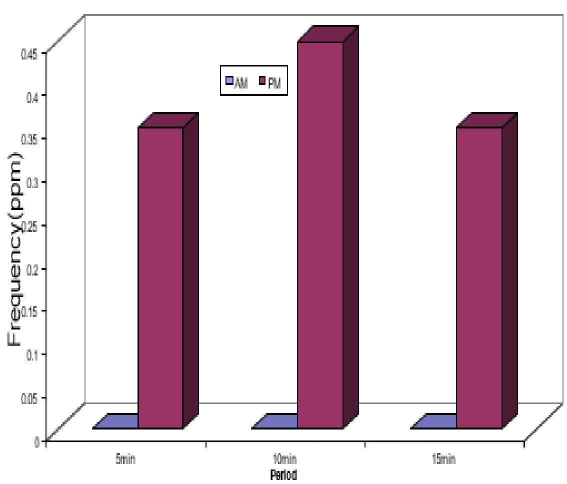

Fig. 6. Variation of NO_2

Fig. 7 shows that the concentration of CO varied between 14 and 105.77 ppm. The concentrations of CO detected at Ikotun exceeded the maximum hourly concentration of 10ppm.most of the time every 5 minutes (Table 1). Figure 8 shows that the concentration of NO_2 varied between 0.15ppm and 0.45ppm. The concentration of NO_2 at Ikotun is lower than the maximum safe limit of 0.06 ppm. The concentration of NO_2 could be attributed to low speed and traffic congestion at Ikotun (Table 1). Figure 9 shows that the concentration of SO_2 varied between 0.25ppm to 0.43ppm, with the highest value recorded during the PM peak (Table 1).

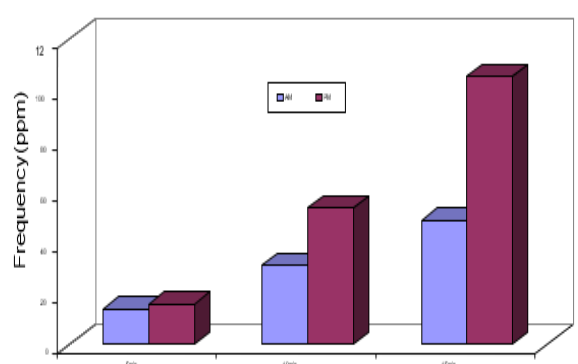

Fig. 7. Concentration of CO

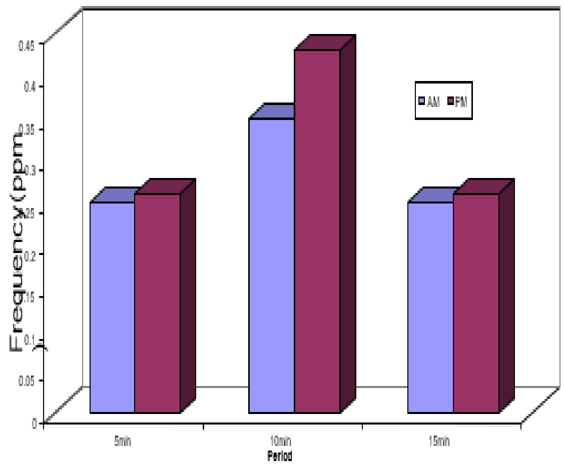

Fig. 8. Concentration of SO_2

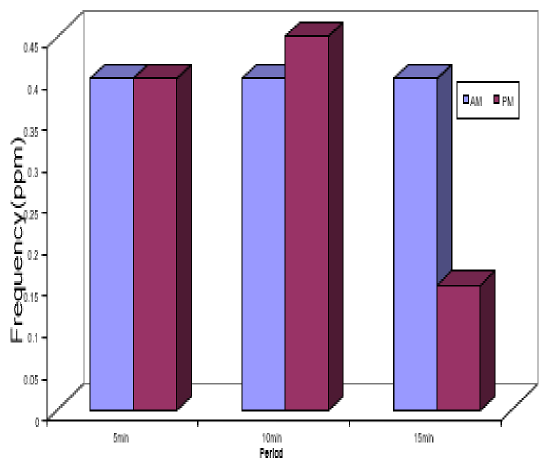

Fig. 9. Concentration of NO_2

Table 2 shows the static emission level in the three locations of Iyana Ipaja, Egbeda and Ikotun. This table has deflated the measurement of the concentration of CO, SO_2 and NO_2 to parts per million per minute since the raw data obtained from field observation is divided by the period under observation. From Table 2, the CO concentration in all the locations is observed. The highest parts per million per minute is identified as the most critical site in terms of the adverse presence of CO in the location. From all the values indicated in Table 2, the highest is 14.18 parts per million per minute, suggesting that Egbeda is the most adversely affected by CO concentration in all three locations. In terms of SO_2, the highest value obtained is 0.08 parts per million per minute, which suggests that Iyana Ipaja is the most critically affected by the concentration of SO_2. Finally, the highest concentration per minute of NO_2 is a tie between Iyana Ipaja and Ikotun with a value of 0.08 parts per million per minute.

Table 2. Static emission level (SEL_{CO}, SEL_{SO2} or SEL_{NO2}) in 3 locations

Gases	Period	Emission level/ minute		
		Iyana Ipaja	Egbeda	Ikotun
	AM 5mins	1.30	2.96	2.80
CO	AM 10mins	1.25	2.48	3.11
	AM 15mins	1.17	3.39	3.23
	PM 5mins	1.36	14.18	3.18
	PM10mins	1.76	5.92	5.40
	PM 15mins	2.94	4.18	7.05
	AM 5mins	-	0.05	0.05
SO_2	AM 10mins	-	0.03	0.04
	AM 15mins	-	0.01	0.02
	PM 5mins	0.08	0.04	0.05
	PM10mins	0.03	0.02	0.04
	PM 15mins	0.02	0.01	0.02

Gases	Period	Emission level/ minute		
		Iyana Ipaja	Egbeda	Ikotun
NO_2	AM 5mins	-	0.01	-
	AM 10mins	-	-	0.08
	AM 15mins	-	-	0.04
	PM 5mins	0.08	0.07	0.03
	PM10mins	0.04	0.05	0.05
	PM 15mins	0.03	0.02	0.01

Table 3 reflects the dynamic emission level (DEL_{CO}, DEL_{SO2} or DEL_{NO2}) in each of the three locations. In the computation of DEL, a base location is chosen, which is a reference location with which the concentration of other locations is compared. From this work, Iyana Ipaja is chosen arbitrarily as the base location. However, the decision taken based on the values obtained using different base locations for analysis would be the same. The values obtained maybe 1, equal to or less than 1. When compared with itself, the values of 1 are obtained for all the comparisons under Iyana Ijapa. Concerning the concentration of CO, the highest value under the dynamic emission level is 10.43 parts per million per minute, which falls at the Egbeda location. For SO_2 concentration, the highest value is 1.43 parts per million per minute, which falls under Ikotun. For the NO_2 concentration, there is a tie between Egbeda and Ikotun with a value of 1.13 parts per million per minute.

Table 3. Dynamic emission levels in 3 locations (DEL_{CO}, DEL_{SO2} or DEL_{NO2}) (base location is Iyana Ipaja)

Gases	Period	Emission level/ minute		
		Iyana Ipaja	Egbeda	Ikotun
CO	AM 5mins	1.00	2.28	2.15
	AM 10mins	1.00	1.98	2.49
	AM 15mins	1.00	2.90	2.77
	PM 5mins	1.00	10.43	2.34
	PM10mins	1.00	3.36	3.07
	PM 15mins	1.00	1.42	2.40
SO_2	AM 5mins	-	-	-
	AM 10mins	-	-	-
	AM 15mins	-	-	-
	PM 5mins	1.00	0.50	0.68
	PM10mins	1.00	0.67	1.43
	PM 15mins	1.00	0.67	0.90
NO_2	AM 5mins	-	-	-
	AM 10mins	-	-	-
	AM 15mins	-	-	-
	PM 5mins	1.00	0.88	1.00
	PM10mins	1.00	1.13	1.13
	PM 15mins	1.00	0.88	0.38

Simulation experiments were carried out using Monte Carlo sampling to test the relationship between pairs of data. In the scientific literature, Monte Carlo sampling has been used to increase the size of the experimental sample and permit statistical testing. Recall that these locations were sampled: Iyana Ipaja, Egbeda and Ikotun. In each of these locations, observations made were on the concentration of CO, SO_2, and NO_2 for each of 5mins, 10mins and 15mins in the AM and PM periods. These comparisons were made for pairs of locations:

{Iyana Ipaja and Egbeda}, {Iyana Ipaja and Ikotun}, {Egbeda and Ikotun}

For Monte Carlo sampling, additional information relating to the range of values selected is as follows:

Iyana Ipaja: CO for AM 5mins, Range: 5ppm - 8ppm
CO for AM 10mins, Range: 12ppm - 13ppm
CO for AM 15mins, Range: 14ppm - 21ppm
CO for PM 5mins, Range: 4ppm - 13ppm
CO for PM 10mins, Range: 14ppm - 30ppm
CO for PM 15mins, Range: 32ppm - 80ppm

Egbeda: CO for AM 5mins, Range: 5ppm - 28ppm
CO for AM 10mins, Range: 13ppm - 33ppm
CO for AM 15mins, Range: 43ppm - 63ppm
CO for PM 5mins, Range: 18ppm - 103ppm
CO for PM 10mins, Range: 10ppm - 99ppm
CO for PM 15mins, Range: 5ppm - 118ppm

Ikotun: CO for AM 5mins, Range: 6ppm - 22ppm
CO for AM 10mins, Range: 24ppm - 41ppm
CO for AM 15mins, Range: 43ppm - 56ppm
CO for PM 5mins, Range: 2ppm - 25ppm
CO for PM 10mins, Range: 25ppm - 84ppm
CO for PM 15mins, Range: 78ppm - 137ppm

Iyana Ipaja: SO_2 for AM 5mins, Range is 0ppm
SO_2 for AM 10mins, Range is 0ppm
SO_2 for AM 15mins, Range is 0ppm
SO_2 for PM 5mins, Range is 0ppm
SO_2 for PM 10mins, Range is 0ppm
SO_2 for PM 15mins, Range is 0ppm

Egbeda: SO_2 for AM 5mins, Range: 0.2ppm - 0.3ppm
SO_2 for AM 10mins, Range: 0.2ppm - 0.4ppm
SO_2 for AM 15mins, Range is 0ppm
SO_2 for PM 5mins, Range is 0ppm
SO_2 for PM 10mins, Range is 0ppm
SO_2 for PM 15mins, Range is 0ppm

Ikotun: SO_2 for AM 5mins, Range: 0.2pm - 0.3ppm
SO_2 for AM 10mins, Range: 0.3ppm - 0.4ppm
SO_2 for AM 15mins, Range: 0.2ppm - 0.3ppm
SO_2 for PM 5mins, Range: 0.2ppm - 0.3ppm
SO_2 for PM 10mins, Range: 0.4ppm - 0.5ppm
SO_2 for PM 15mins, Range: 0.2ppm - 0.4ppm

Iyana Ipaja: NO_2 for AM 5mins, Range is 0ppm
NO_2 for AM 10mins, Range is 0ppm
NO_2 for AM 15mins, Range is 0ppm
NO_2 for PM 5mins, Range is 0ppm
NO_2 for PM 10mins, Range is 0ppm
NO_2 for PM 15mins, Range is 0ppm

Egbeda: NO_2 for AM 5mins, Range is 0ppm
NO_2 for AM 10mins, Range is 0ppm
NO_2 for AM 15mins, Range is 0ppm
NO_2 for PM 5mins, Range: 0.3ppm - 0.4ppm
NO_2 for PM 10mins, Range: 0.4ppm - 0.5ppm
NO_2 for PM 15mins, Range: 0.3ppm - 0.4ppm

Ikotun: NO_2 for AM 5mins, Range is 0ppm
NO_2 for AM 10mins, Range is 0ppm
NO_2 for AM 15mins, Range is 0ppm
NO_2 for PM 5mins, Range is 0ppm
NO_2 for PM 10mins, Range: 0.4ppm - 0.5ppm
NO_2 for PM 15mins, Range: 0.1ppm - 0.2ppm

The results are shown in Tables 4 to 12. Also, the summarized result of the t-test carried out is in Table 13.

Table 4. Monte Carlo sampling data for a concentration of CO at Iyana Ipaja

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	8	13	15	13	16	54
2	7	12	19	11	14	43
3	5	13	17	12	18	66
4	7	12	18	13	21	41
5	8	13	16	13	25	53
6	5	13	18	7	30	65
7	6	12	14	8	20	63
8	5	13	19	11	19	35
9	6	12	19	13	29	34
10	7	13	16	13	28	56
11	8	12	14	11	27	48
12	6	13	17	8	21	32
13	8	13	17	11	19	51
14	9	12	18	5	16	50
15	7	13	19	4	14	54
16	5	13	20	9	23	37
17	5	12	20	9	28	49
18	6	13	21	5	27	61
19	7	13	21	6	16	47
20	5	12	15	10	20	33

Table 5. Monte Carlo sampling data for a concentration of SO_2 at Iyana Ipaja

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	0	0	0	0.4	0.3	0.3
2	0	0	0	0.4	0.3	0.3
3	0	0	0	0.4	0.3	0.3
4	0	0	0	0.4	0.3	0.3
5	0	0	0	0.4	0.3	0.3
6	0	0	0	0.4	0.3	0.3
7	0	0	0	0.4	0.3	0.3
8	0	0	0	0.4	0.3	0.3
9	0	0	0	0.4	0.3	0.3
10	0	0	0	0.4	0.3	0.3
11	0	0	0	0.4	0.3	0.3
12	0	0	0	0.4	0.3	0.3
13	0	0	0	0.4	0.3	0.3
14	0	0	0	0.4	0.3	0.3
15	0	0	0	0.4	0.3	0.3
16	0	0	0	0.4	0.3	0.3
17	0	0	0	0.4	0.3	0.3
18	0	0	0	0.4	0.3	0.3
19	0	0	0	0.4	0.3	0.3
20	0	0	0	0.4	0.3	0.3

Table 6. Monte Carlo sampling data for a concentration of NO_2 concentrations at Iyana Ipaja

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	0	0	0	0.4	0.4	0.4
2	0	0	0	0.4	0.4	0.4
3	0	0	0	0.4	0.4	0.4
4	0	0	0	0.4	0.4	0.4
5	0	0	0	0.4	0.4	0.4
6	0	0	0	0.4	0.4	0.4
7	0	0	0	0.4	0.4	0.4
8	0	0	0	0.4	0.4	0.4
9	0	0	0	0.4	0.4	0.4
10	0	0	0	0.4	0.4	0.4
11	0	0	0	0.4	0.4	0.4
12	0	0	0	0.4	0.4	0.4
13	0	0	0	0.4	0.4	0.4
14	0	0	0	0.4	0.4	0.4
15	0	0	0	0.4	0.4	0.4
16	0	0	0	0.4	0.4	0.4
17	0	0	0	0.4	0.4	0.4
18	0	0	0	0.4	0.4	0.4
19	0	0	0	0.4	0.4	0.4
20	0	0	0	0.4	0.4	0.4

Table 7. Monte Carlo sampling data for a concentration of CO at Egbeda

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	10	32	53	67	93	82
2	9	19	51	79	52	36
3	21	31	54	91	38	33
4	11	31	46	91	52	59
5	7	29	45	56	39	71
6	28	24	43	48	51	47
7	12	13	49	89	63	35
8	13	23	61	94	75	114
9	25	32	56	51	49	36
10	23	21	48	37	96	68
11	13	16	59	60	98	76
12	5	14	54	35	88	87
13	17	33	41	47	73	92
14	16	15	53	59	85	89
15	8	27	51	71	53	73
16	15	13	52	83	97	77
17	27	28	45	76	72	65
18	11	19	43	57	91	90
19	14	31	53	68	95	41
20	9	29	53	81	56	67

Table 8. Monte Carlo sampling data for a concentration of SO_2 at Egbeda

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	0.2	0.3	0.2	0.2	0.2	0.2
2	0.2	0.2	0.2	0.2	0.2	0.2
3	0.3	0.4	0.2	0.2	0.2	0.2
4	0.2	0.2	0.2	0.2	0.2	0.2
5	0.2	0.4	0.2	0.2	0.2	0.2
6	0.3	0.3	0.2	0.2	0.2	0.2
7	0.3	0.2	0.2	0.2	0.2	0.2
8	0.2	0.3	0.2	0.2	0.2	0.2
9	0.2	0.3	0.2	0.2	0.2	0.2
10	0.2	0.4	0.2	0.2	0.2	0.2
11	0.2	0.2	0.2	0.2	0.2	0.2
12	0.3	0.3	0.2	0.2	0.2	0.2
13	0.2	0.4	0.2	0.2	0.2	0.2
14	0.3	0.4	0.2	0.2	0.2	0.2
15	0.3	0.3	0.2	0.2	0.2	0.2
16	0.3	0.2	0.2	0.2	0.2	0.2
17	0.3	0.4	0.2	0.2	0.2	0.2
18	0.2	0.3	0.2	0.2	0.2	0.2
19	0.3	0.3	0.2	0.2	0.2	0.2
20	0.2	0.3	0.2	0.2	0.2	0.2

Table 9. Monte Carlo sampling data for a concentration of NO_2 concentrations at Egbeda

Problem	AM 5mins	AM 10mns	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	0	0	0	0.3	0.4	0.4
2	0	0	0	0.3	0.5	0.3
3	0	0	0	0.4	0.5	0.4
4	0	0	0	0.4	0.4	0.3
5	0	0	0	0.3	0.5	0.3
6	0	0	0	0.4	0.4	0.4
7	0	0	0	0.4	0.4	0.3
8	0	0	0	0.3	0.5	0.4
9	0	0	0	0.4	0.4	0.3
10	0	0	0	0.3	0.5	0.4
11	0	0	0	0.3	0.5	0.4
12	0	0	0	0.4	0.4	0.3
13	0	0	0	0.4	0.4	0.3
14	0	0	0	0.3	0.4	0.4

Problem	AM 5mins	AM 10mns	AM 15mins	PM 5mins	PM 10mins	PM 15mins
15	0	0	0	0.4	0.5	0.3
16	0	0	0	0.3	0.5	0.3
17	0	0	0	0.4	0.4	0.4
18	0	0	0	0.3	0.5	0.4
19	0	0	0	0.4	0.4	0.3
20	0	0	0	0.4	0.4	0.3

Table 10. Monte Carlo sampling data for a concentration of CO at Ikotun

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	12	41	45	6	83	91
2	21	34	55	8	34	93
3	19	39	49	7	53	97
4	8	31	47	8	72	99
5	11	41	53	12	31	87
6	13	29	41	13	56	81
7	11	28	48	15	54	95
8	14	36	51	14	48	83
9	12	33	51	16	29	94
10	15	37	54	11	41	84
11	13	25	56	8	53	91
12	16	27	43	16	32	134
13	8	32	55	21	65	89
14	7	33	53	23	51	91
15	6	35	48	13	77	79
16	6	23	47	11	51	92
17	17	36	45	24	75	78
18	19	41	48	19	54	97
19	20	24	51	14	87	111
20	11	31	40	15	73	99

Table 11. Monte Carlo sampling data for a concentration of SO_2 at Ikotun

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	0.2	0.4	0.3	0.2	0.4	0.2
2	0.3	0.4	0.2	0.3	0.4	0.2
3	0.3	0.3	0.2	0.3	0.5	0.3
4	0.2	0.3	0.3	0.3	0.4	0.4
5	0.2	0.3	0.3	0.2	0.5	0.3

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
6	0.2	0.4	0.3	0.2	0.4	0.3
7	0.2	0.3	0.2	0.2	0.5	0.2
8	0.3	0.4	0.3	0.3	0.5	0.3
9	0.3	0.4	0.3	0.2	0.4	0.4
10	0.2	0.4	0.2	0.2	0.5	0.2
11	0.3	0.3	0.2	0.3	0.4	0.2
12	0.3	0.4	0.2	0.3	0.4	0.4
13	0.2	0.4	0.3	0.2	0.4	0.3
14	0.3	0.4	0.2	0.2	0.5	0.4
15	0.3	0.3	0.3	0.3	0.5	0.2
16	0.3	0.4	0.2	0.2	0.4	0.4
17	0.2	0.3	0.3	0.2	0.5	0.3
18	0.2	0.3	0.2	0.3	0.4	0.2
19	0.2	0.4	0.2	0.3	0.4	0.3
20	0.2	0.4	0.3	0.2	0.4	0.3

Table 12. Monte Carlo sampling data for a concentration of NO_2 concentrations at Ikotun

Problem	AM 5mins	AM 10mins	AM 15mins	PM 5mins	PM 10mins	PM 15mins
1	0.4	0.4	0.4	0.4	0.4	0.1
2	0.4	0.4	0.4	0.4	0.4	0.1
3	0.4	0.4	0.4	0.4	0.5	0.1
4	0.4	0.4	0.4	0.4	0.5	0.2
5	0.4	0.4	0.4	0.4	0.4	0.1
6	0.4	0.4	0.4	0.4	0.5	0.2
7	0.4	0.4	0.4	0.4	0.5	0.1
8	0.4	0.4	0.4	0.4	0.4	0.2
9	0.4	0.4	0.4	0.4	0.5	0.2
10	0.4	0.4	0.4	0.4	0.4	0.1
11	0.4	0.4	0.4	0.4	0.5	0.1
12	0.4	0.4	0.4	0.4	0.4	0.1
13	0.4	0.4	0.4	0.4	0.5	0.2
14	0.4	0.4	0.4	0.4	0.5	0.2
15	0.4	0.4	0.4	0.4	0.4	0.1
16	0.4	0.4	0.4	0.4	0.4	0.1
17	0.4	0.4	0.4	0.4	0.5	0.2
18	0.4	0.4	0.4	0.4	0.4	0.2
19	0.4	0.4	0.4	0.4	0.4	0.2
20	0.4	0.4	0.4	0.4	0.5	0.1

Table 13. T-test results of pairs of comparisons

S/No.	Locations		Decision
1.	CO Iyana Ipaja (AM 5 mins)	CO Egbeda (AM 5 mins)	not significant
2.	CO Iyana Ipaja (AM 5 mins)	CO Ikotun (AM 5 mins)	not significant
3.	CO Egbeda (AM 5 mins)	CO Ikotun (AM 5 mins)	not significant
4.	CO Iyana Ipaja (AM 10 mins)	CO Egbeda (AM 10 mins)	not significant
5.	CO Iyana Ipaja (AM 10 mins)	CO Ikotun (AM 10 mins)	not significant
6.	CO Egbeda (AM 10 mins)	CO Ikotun (AM 10 mins)	not significant
7.	CO Iyana Ipaja (AM 15 mins)	CO Egbeda (AM 15 mins)	not significant
8.	CO Iyana Ipaja (AM 15 mins)	CO Ikotun (AM 15 mins)	not significant
9.	CO Egbeda (AM 15 mins)	CO Ikotun (AM 15 mins)	not significant
10.	SO_2 Iyana Ipaja (AM 5 mins)	SO_2 Egbeda (AM 5 mins)	-
11.	SO_2 Iyana Ipaja (AM 5 mins)	SO_2 Ikotun (AM 5 mins)	-
12.	SO_2 Egbeda (AM 5 mins)	SO_2 Ikotun (AM 5 mins)	not significant
13.	SO_2 Iyana Ipaja (AM 10 mins)	SO_2 Egbeda (AM 10 mins)	-
14.	SO_2 Iyana Ipaja (AM 10 mins)	SO_2 Ikotun (AM 10 mins)	-
15.	SO_2 Egbeda (AM 10 mins)	SO_2 Ikotun (AM 10 mins)	not significant
16.	SO_2 Iyana Ipaja (AM 15 mins)	SO_2 Egbeda (AM 15 mins)	-
17.	SO_2 Iyana Ipaja (AM 15 mins)	SO_2 Ikotun (AM 15 mins)	-
18.	SO_2 Egbeda (AM 15 mins)	SO_2 Ikotun (AM 15 mins)	not significant
19.	NO_2 Iyana Ipaja (AM 5 mins)	NO_2 Egbeda (AM 5 mins)	-
20.	NO_2 Iyana Ipaja (AM 5 mins)	NO_2 Ikotun (AM 5 mins)	-
21.	NO_2 Egbeda (AM 5 mins)	NO_2 Ikotun (AM 5 mins)	-
22.	NO_2 Iyana Ipaja (AM 10 mins)	NO_2 Egbeda (AM 10 mins)	-
23.	NO_2 Iyana Ipaja (AM 10 mins)	NO_2 Ikotun (AM 10 mins)	-
24.	NO_2 Egbeda (AM 10 mins)	NO_2 Ikotun (AM 10 mins)	-
25.	NO_2 Iyana Ipaja (AM 15 mins)	NO_2 Egbeda (AM 15 mins)	-
26.	NO_2 Iyana Ipaja (AM 15 mins)	NO_2 Ikotun (AM 15 mins)	-
27.	NO_2 Egbeda (AM 15 mins)	NO_2 Ikotun (AM 15 mins)	-
28.	CO Iyana Ipaja (PM 5 mins)	CO Egbeda (PM 5 mins)	not significant
29.	CO Iyana Ipaja (PM 5 mins)	CO Ikotun (PM 5 mins)	not significant
30.	CO Egbeda (PM 5 mins)	CO Ikotun (PM 5 mins)	not significant
31.	CO Iyana Ipaja (PM 10 mins)	CO Egbeda (PM 10 mins)	not significant
32.	CO Iyana Ipaja (PM 10 mins)	CO Ikotun (PM 10 mins)	not significant
33.	CO Egbeda (PM 10 mins)	CO Ikotun (PM 10 mins)	not significant
34.	CO Iyana Ipaja (PM 15 mins)	CO Egbeda (PM 15 mins)	not significant
35.	CO Iyana Ipaja (PM 15 mins)	CO Ikotun (PM 15 mins)	not significant
36.	CO Egbeda (PM 15 mins)	CO Ikotun (PM 15 mins)	not significant
37.	SO_2 Iyana Ipaja (PM 5 mins)	SO_2 Egbeda (PM 5 mins)	not significant

S/No.	Locations		Decision
38.	SO_2 Iyana Ipaja (PM 5 mins)	SO_2 Ikotun (PM 5 mins)	not significant
39.	SO_2 Egbeda (PM 5 mins)	SO_2 Ikotun (PM 5 mins)	not significant
40.	SO_2 Iyana Ipaja (PM 10 mins)	SO_2 Egbeda (PM 10 mins)	not significant
41.	SO_2 Iyana Ipaja (PM 10 mins)	SO_2 Ikotun (PM 10 mins)	not significant
42.	SO_2 Egbeda (PM 10 mins)	SO_2 Ikotun (PM 10 mins)	not significant
43.	SO_2 Iyana Ipaja (PM 15 mins)	SO_2 Egbeda (PM 15 mins)	not significant
44.	SO_2 Iyana Ipaja (PM 15 mins)	SO_2 Ikotun (PM 15 mins)	not significant
45.	SO_2 Egbeda (PM 15 mins)	SO_2 Ikotun (PM 15 mins)	not significant
46.	NO_2 Iyana Ipaja (PM 5 mins)	NO_2 Egbeda (PM 5 mins)	not significant
47.	NO_2 Iyana Ipaja (PM 5 mins)	NO_2 Ikotun (PM 5 mins)	not significant
48.	NO_2 Egbeda (PM 5 mins)	NO_2 Ikotun (PM 5 mins)	not significant
49.	NO_2 Iyana Ipaja (PM 10 mins)	NO_2 Egbeda (PM 10 mins)	not significant
50.	NO_2 Iyana Ipaja (PM 10 mins)	NO_2 Ikotun (PM 10 mins)	not significant
51.	NO_2 Egbeda (PM 10 mins)	NO_2 Ikotun (PM 10 mins)	not significant
52.	NO_2 Iyana Ipaja (PM 15 mins)	NO_2 Egbeda (PM 15 mins)	not significant
53.	NO_2 Iyana Ipaja (PM 15 mins)	NO_2 Ikotun (PM 15 mins)	not significant
54.	NO_2 Egbeda (PM 15 mins)	NO_2 Ikotun (PM 15 mins)	not significant

From the results of the t-test, it was found that out of the fifty-four comparisons between Iyana-Ipaja and Iyana-Ipaja, Iyana-Ipaja and Egbeda, Egbeda and Egbeda using CO and CO, SO_2 and SO_2 and NO_2 and NO_2 in all locations for the periods of 5 minutes, 10 minutes and 15 minutes, fifteen comparisons did not yield results perhaps because of certain paucity of data. However, in all the thirty-nine feasible comparisons, the decision made is non-significance. This is interpreted at $p>0.05$, there is no significant difference between the means of mentioned pairs in each location tested. Besides, in Table 13, several comparisons were made concerning the tests of significance using the student's t-test kit. In all, 30 t-tests were made. It is interesting to note that all 30 combinations yielded results that the differences in the results obtained are not significant. Hence, it can be concluded that the differences between the three locations in the corridor are not significant.

By considering the standard of CO concentration permissible by the US Environmental Protection Agency (EPA), the threshold of 9 ppm should not be exceeded. However, all the values recorded for Iyana Ipaja are below the standard and acceptable. For Egbeda, only one value, 14.18 ppm exceeds the 9ppm standard which represents only 16.67% of the time. But for Ikotun, all the data points are below the standard value and are therefore acceptable. Considering the SO_2, the standard declared by the US EPA is 0.03 ppm. Weighed against the values obtained for Iyana Ipaja, only one case (33.3%) of the total measures exceed the 0.03 ppm threshold. For Egbeda, also 33.3% of all the six instances exceed the threshold of 0.03 ppm. For Ikotun, 66.7% of the instances exceeded the 0.03 threshold. Now, considering No2, the US EPA standard is 53 ppb, which is 0.053 ppm. By considering the Iyana Ipaja location, out of the three datasets provided, 33.3% of the dataset exceeds the standard. For Egbeda, out of the four data points considered, only 25% exceeds the required standard of 0.053 ppm. But for Ikotun, out of the five data points, only 16.67% exceeds the standard. Overall, by considering the CO concentration, locations at Iyana Ipaja and Egbeda perform exceedingly well while only Ikotun performs fairly. Regarding NO2 emissions, all the locations of Iyana Ipaja, Egbeda and Ikotun perform fairly well. However, regarding the SO2 emissions, the performance of the three locations within the corridor is the worst.

Furthermore, to overcome the limitations of previous research, which was always trapped in the shortcoming of the use of only intuition and experience of the decision maker, this research proposes field experimental values on the concentration of pollutants (CO, SO_2 and NO_2) and emission severities as a cornerstone to establishing benchmark data that reduce the generation of pollutants from vehicles and the exposure of inhabitants of the Lagos location to its adverse effects. Once the measured threshold of pollutants is ascertained, the comparison is made with the standard in light of the acceptable thresholds by the government regulatory agencies. To the best of the authors' knowledge, this is the first time an on-site investigation is reported for the territory studies with such a unique feature of monte carlo simulation within the ambit of the transport-stimulated air pollution problem in the Ikotun-Egbeda-Iyana Ipaja corridor of Lagos, Nigeria. Within the vehicle traffic environment, air having elevated concentrations of carbon monoxide starves the environment of amount of oxygen available to commuters, residents and passers-by of the transportation environment. This shortens the available oxygen amount to stimulate the working of critical body organs such as the brain and the heart. When the CO content in the environment is high, confusion, dizziness, unconsciousness or even death may occur. Moreover, sulphur dioxide is associated with serious respiratory problems such as throat, nose and lung irritation and bronchitis. Also coughing, asthma attack, wheezing and phlegm are caused by the inhalation of Sulphur dioxide.

Besides, Sulphur dioxide has an association with cardiovascular disease. However, nitrogen dioxide inhaled in high levels has been associated with chronic lung disease, impairing the smelling sense of individuals for odours. Thus, to assure the CO, SO_2 and NO_2 and their effects are avoided for locations with intense traffic situations in Lagos, field experimental capture of data on these pollutants is deemed necessary. In this study, the TOXIRAE II Toxic gas and Oxygen monitors, which have been known to provide outstanding data quality measurements, exhibit a continuous display of gas concentration during their use. The data was obtained in 3 field surveys at intervals of 30 minutes 15 minutes at the morning (am) peak and the other 15 minutes at the evening peak.
Notice that the CO concentration in the afternoon is much higher than in the morning. This might have happened for different reasons. First, in the morning, the day's business just started and over the hours of the day, more vehicles come on the road. Thus, at the beginning of the day (morning), the available oxygen concentration is preserved and very little CO is released to the atmosphere because of the limited vehicles generating it. However, with increased population and higher volume of traffic, more vehicles consume limited oxygen and release higher levels of CO. Therefore, to combat this, efforts should be intensified on the production of electrical-oriented vehicles as promoted by the Lagos State recently. Secondly, many vehicles are very old in Lagos and the more the number of hours they work on the road, the more CO is released to the environment. But for the difference in hours from the morning to afternoon, CO is hugely generated in the afternoon within the corridor. Furthermore, it is noted that regulations by the government to allow the importation of vehicles with the standard of Euro 6 would help reduce this pollution. At present, many vehicles operating in the corridor are below environment standard Euro 2. The attraction to Euro 6 is that it produces less sulphur and less pollution to the environment.

5. CONCLUSIONS

This study showed that the concentration of CO at Iyana Ipaja, Egbeda and Ikotun during peak traffic exceeded the maximum value of 10ppm stipulated by FEPA. Since CO combines with limited oxygen in the body, exposed individuals (pregnant women and others) may be exhausted and risk sudden death due to reduced oxygen content in the blood circulation system. The concentration of SO_2 at Egbeda and Iyana Ipaja was below the FEPA stipulated value of 0.10 ppm. This suggests low sulphur content in vehicle fuel. The concentration of NO_2 at Iyana Ipaja and Egbeda did not exceed the limit of 0.04-0.06ppm stipulated by FEPA. However, this limit was not exceeded at Ikotun. The measurement of SEL and DEL revealed the severity of the concentration of CO, SO_2 and NO_2 in each of the locations. CO was most severe in terms of its pollution level at Egbeda. The corresponding value of DEL confirms this measurement threshold. For SO_2, the most severe location is Iyana Ipaja while for NO_2, Iyana-Ipaja and Ikotun are the most severe locations.

The Monte Carlo sampling (MCS) technique has been used to simulate experimental data for statistical testing using a t-test. This aided in the determination of the relationship between two pairs of data from different locations. Many of the results indicate statistical significance while a few show a significant relationship between the pair of elements. Studies in Egbeda and Ikotun have shown that there is an increase in traffic volume within the city with a corresponding increase in the concentration of pollutants emitted into the environment. Since the problem of emissions is largely dependent on vehicle characteristics and driving behaviours, policies aimed at reducing overall vehicle use and encouraging good driving behaviour to minimize congestion or pollution would be effective. The pollution problem stems from the rate of traffic generation and improper management of vehicles and roads. The rectification of these inadequacies would provide a solution to the problem of traffic management, which is very common.

In general, it is recommended that government should establish measuring locations where officials will be saddled with the responsibility of obtaining information concerning air quality in the corridor studied. From one of the authors' experiences, it was observed that several years ago, the air quality of an alternative corridor considered was extremely poor. At the same time, the author's personal experience shows that the loss of a baby through the termination of pregnancy and in another case, the death of a woman may be associated with poor air quality. Therefore, air quality measurements as suggested above could have indicated high-risk levels and such occurrence could have been avoided. Therefore, at the corridor studied, measurement results should be made available to residents and hospitals through the media and other sources.

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