Assessment of Automobile Induced Pollution in an Urban Area (A Case Study of Owerri City South-east, Nigeria)

S.I. Okonkwo[1], V. O. Ezigbo[2] and K.O. Okpala[3]

Abstract— Studies on the effect of automobile emission in an urban area (Owerri City South East Nigeria) was carried out for a period of one month. Locations noted for heavy traffic congestion in the city were chosen for the study and concentration measure for Carbon monoxide (CO), Nitrogen dioxide (NO2), Sulphur dioxide (SO2), Hydrogen sulphide (H2S), Hydrocarbon (HC) and Total Suspended Particles (TSP) were carried out in the morning (7.00-800am) and evenings (5-7pm), peak periods of traffic congestion using standard gas monitors. The temperature at the time of measurement was noted and velocity to assess its effect on the dispersion rate. The following values were obtained 37.042 ppm, 0.127ppm, 0.113ppm, 0.067ppm 0.021ppm and 0.013mglm3 respectively. When compared with the World Organization standards, it was found out that the area is polluted with CO, NO2, SO2, and H2S

Keywords — Air Pollution, Automobile Emissions, Urban Pollution, Total Suspended Particles, Hydrocarbons, Hydrogen sulphide, carbon monoxide

1 INTRODUCTION

Owerri is the capital of Imo State in the South East of Nigeria, and has an estimated population of about 4.5million people[1]. It occupies an area of 5,289.48 sq km. It lies in the tropical rain forest of the Guinea-Congolean region and has two distinctive seasons (dry and wet)

A preliminary survey of the area indicates that there is always heavy traffic congestion in morning and evening hours. The air around its immediate environment, of each of the area is heavy polluted with smoke and soot. Owerri City is a fast growing city in terms of human population and industrialization. Thus vehicular emissions are expected to contribute significantly to air pollution. The effects of these vehicular emissions have become a major concern for the residents of Owerri city. Unfortunately, the environmental, socio-economic and health hazards these automobile emissions poses have not been addressed by neither Non-Governmental Organization (NGOs) nor Federal Government regulating agencies. The authorities appear to be more interested in revenue derived from commercial activities in the city. Studies carried out on air showed that an average human being required about12kg of air each day [2].

A small concentration of pollutants present in the air becomes harmful to human health. This shows that air free from solid, liquid or gaseous pollutants is essential for human health and survival. It was in view of the potential effects of the various activities of the automobile emission to air pollution especially in urban areas that this study was carried out, with the aim of establishing the pollutant levels of the air and its compliance with set standards. Air quality parameter were thus measured daily for one month (between 19-09-2005 to 18-11-2005) per week for 4 week period.

In recent years there has been considerable research on the vehicular emission and fumes [3]. There is a common occurrence of carbon monoxide research (CO) in urban cities [2]. Depletion of ozone layer is largely due to pollution from industries as the use of automobile [4]. Research conducted by [5] show that Nitrogen oxides and sulphur oxide are linked with immune system impairment, aggravation of asthma and chronic respiratory diseases, reduced lung function and cardiovascular disease. Particulates have been implicated in the development of lung cancer and higher rates of mortality [5]. Volatile organic matter can react with sunlight to form ozone which exacerbates asthma and has other adverse respiratory effects [6]. Modelling framework has also been used to produce the future emission levels in Europe [7].

Environmental investigation has also been conducted on the detection of excess ammonia emission from in-use vehicle [7]. Another survey was conducted in Nigeria on the effects of vehicle emission on human health [8].

2 MATERIALS AND METHODS

Materials

The sample areas selected were Assumpta-Okigwe Road by Orlu (warehouse), Ama-J.K, Okigwepark, Government house, Assumpta Round about, Wetheral by MCC, Douglas Road by Mbaise and New Market. The instruments used were TIF 8800 combustible gas detector, model G 225, Monoxorll gas detector, model 8004, minimax, XT and Global position system.

Method

Air quality parameter were measured daily for one month

(between 19-09-2005 to 18-11-2005) per week for 4 week period. Three days in a week were taken; Monday, Wednesday and Friday. The levels of HC, SO_2 NO_2, H_2S, and CO were monitored at defined sample position of the selected areas in the city. The ambient temperatures around the location were measured. The gas detection device was pointed to the atmosphere with the sensor portion upwards. The knob was clicked simultaneously to the sampling point and the reading was taken. This was done for seven different locations in Owerri Municipal. Average was taken and compared with the local stability data to assess all pollution level. The same procedure was adopted for particulate (TSP) detection device.

3 RESULTS

The results of the assessment of the pollution level in Owerri city are shown below:

1ST week measurement in month of September, 2005

DAYS/DATES	UNITS	MAJOR POLLUTANTS	ASSUMPTA OKIGWE ROAD BY ORLU ROAD (WAREHOUSE)		AMA – JK		OKIGWE PARK		GOVERNMENT HOUSE		ASSUMPTA OKIGWE ROAD		WETHERAL ROAD BY MCC		DOUGLAS BY MBAISE ROAD	
Peaks			M	E	M	E	M	E	M	E	M	E	M	E	M	E
Monday [illegible]	PPM	CO	44	42	30	24	31	22	40	32	32	28	18	36	20	40
	PPM	NO_2	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.2	0.0	0.1	0.0	0.0
	PPM	SO_2	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0
	PPM	H_2S	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1
	PPM	HC	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
	Mg/M^3	TSP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Wednesday [illegible]	PPM	CO	19	25	16	18	14	26	39	47	15	15	30	38	32	38
	PPM	NO_2	0.1	0.2	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.1
	PPM	SO_2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
	PPM	H_2S	0.1	0.0	0.2	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
	PPM	HC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	Mg/M^3	TSP	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
FRIDAY [illegible]	PPM	CO	21	21	22	28	42	30	21	38	26	42	17	17	20	19
	PPM	NO_2	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.2
	PPM	SO_2	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.2
	PPM	H_2S	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.1
	PPM	HC	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	Mg/M^3	TSP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

Table 1: 1ST week measurement in month of September, 2005

2nd week measurement in month of September, 2005

DAYS/DATES	UNITS	MAJOR POLLUTANT	ASSUMPTA OKIGWE ROAD BY ORLU ROAD (WAREHOUSE)		AMA – JK		OKIGWE PARK		GOVERNMENT HOUSE		ASSUMPTA OKIGWE ROAD		WETHERAL ROAD BY MCC		DOUGLAS BY MBAISE ROAD	
Peaks			M	E	M	E	M	E	M	E	M	E	M	E	M	E
Monday 24/09/05	PPM	CO	17	19	28	33	18	28	44	31	32	16	31	28	30	28
	PPM	NO_2	0.0	0.2	0.2	0.1	0.0	0.1	0.0	0.2	0.1	0.1	0.1	0.2	0.1	0.1
	PPM	SO_2	0.1	0.1	0.1	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2
	PPM	H_2S	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.1
	PPM	HC	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
	Mg/M^3	TSP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WEDNESDAY 26/09/05	PPM	CO	38	32	20	29	33	22	37	32	5	19	32	30	28	20
	PPM	NO_2	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.0	0.0
	PPM	SO_2	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.2	0.0	0.1	0.0	0.0
	PPM	H_2S	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1
	PPM	HC	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Mg/M^3	TSP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
FRIDAY 28/09/05	PPM	CO	23	25	44	40	18	20	40	44	34	37	28	30	29	32
	PPM	NO_2	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
	PPM	SO_2	0.1	0.1	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.0	0.1	0.1	0.2
	PPM	H_2S	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.2	0.2
	PPM	HC	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1
	Mg/M^3	TSP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2

Table 2: 2nd week measurement in month of September, 2005

3rd Week Measurement in month of October, 2005

DAYS/DATES	UNITS	MAJOR POLLUTANTS	ASSUMPTA OKIGWE ROAD BY ORLU ROAD (WAREHOUSE)		AMA – JK		OKIGWE PARK		GOVERNMENT HOUSE		ASSUMPTA OKIGWE ROAD		WETHERAL ROAD BY MCC		DOUGLAS BY MBAISE ROAD	
Peaks			M	E	M	E	M	E	M	E	M	E	M	E	M	E
Monday 01/10/05	PPM	CO	20	21	25	28	32	33	30	30	20	27	26	24	22	28
	PPM	NO_2	0.0	0.1	0.1	0.1	0.2	0.2	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
	PPM	SO_2	0.1	0.2	0.1	0.2	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2
	PPM	H_2S	0.1	0.1	0.0	0.0	0.0	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2
	PPM	HC	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Mg/M^3	TSP	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Wednesday 3/10/05	PPM	CO	20	21	33	38	30	35	30	25	18	17	28	34	26	28
	PPM	NO_2	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.0
	PPM	SO_2	0.2	0.0	0.2	0.2	0.0	0.1	0.2	0.2	0.0	0.1	0.0	0.1	0.1	0.1
	PPM	H_2S	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.2	0.1	0.1	0.0	0.1	0.0
	PPM	HC	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	Mg/M^3	TSP	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
FRIDAY 5/10/05	PPM	CO	22	25	27	30	30	26	42	44	20	22	23	25	25	29
	PPM	NO_2	0.1	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2
	PPM	SO_2	0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1
	PPM	H_2S	0.0	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.1	0.1	0.1	0.2	0.0	0.2
	PPM	HC	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
	Mg/M^3	TSP	0.0	0.0	0.1	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1

Table 3: 3rd week measurement in month of October, 2005

4th Week Measurement in month of October, 2005

DAYS/DATES	UNITS	MAJOR POLLUTANTS	ASSUMPTA OKIGWE ROAD BY ORLU ROAD (WAREHOUSE)		AMA – JK		OKIGWE PARK		GOVERNMENT HOUSE		ASSUMPTA OKIGWE ROAD		WETHERAL ROAD BY MCC		DOUGLAS BY MBAISE ROAD	
Peaks			M	E	M	E	M	E	M	E	M	E	M	E	M	E
Monday 01/10/05	PPM	CO	20	20	29	30	18	30	44	35	28	30	18	30	28	30
	PPM	NO_2	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.1
	PPM	SO_2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2
	PPM	H_2S	0.1	0.0	0.0	0.1	0.2	0.0	0.1	0.1	0.0	0.1	0.2	0.0	0.0	0.1
	PPM	HC	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	Mg/M^3	TSP	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Wednesday 3/10/05	PPM	CO	35	32	20	29	33	29	33	35	20	20	30	32	22	28
	PPM	NO_2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
	PPM	SO_2	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.2	0.1	0.1	0.1	0.1
	PPM	H_2S	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1
	PPM	HC	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mg/M^3	TSP	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2
FRIDAY 5/10/05	PPM	CO	23	25	34	30	44	40	40	44	34	37	28	30	29	32
	PPM	NO_2	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.2
	PPM	SO_2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.0	0.2	0.0	0.1	0.2	0.2
	PPM	H_2S	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.2	0.1	0.1
	PPM	HC	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
	Mg/M^3	TSP	0.0	0.0	0.1	0.0	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1

Table 4: 4th week measurement in month of October, 2005

4 DISCUSSIONS

Carbon monoxide is a pollutant derived from incomplete combustion of hydrocarbon in automobile engines and many industrial processes. The average monthly concentration was 36.89 ppm obtained by taking the mean of the weekly reading. It was discovered that it is above the standard concentration which is 9ppm. The average monthly concentration of Nitrogen oxide (NO_2) is 0.110ppm. This is obtained by taking the mean of the weekly reading. When compared with the set standard concentration of 0.05ppm, it was discovered to be above the permissible limit. Sulphur dioxide (SO_2) has an average monthly reading of 0.113ppm which is above the standard concentration of 0.030ppm while Hydrogen sulphide derived from paper processing, pulp industries and sulphur-containing substance has the average monthly reading of 0.067 ppm against the set standard concentration of 0.020 ppm.
The concentration of both hydrocarbons and Total Suspended Particulate were below the standard concentration. This is due to the fact that Owerri is not an oil producing town hence the low concentration of hydrocarbons. Also, the Total Suspended Particulate was below the set standard because the city is not industrialised. Moreover, there was no harmattan at the time the measurement was carried out.

5 CONCLUSION

From the result obtained, Owerri Municipal is found to be polluted. This is due to the presence of pollutants such as Nitrogen dioxide, Sulphur dioxide, Carbon monoxide and Hydrogen sulphide in high concentration which exceeded the permissible limit set for each pollutant. Proper urban planning measures are needed to ameliorate the effect of these emissions. Such measures include emission absorption and reduction.

6 RECOMMENDATION

Since the most significant of these gases from the results is Carbon monoxide, Carbon sinks can be created by planting trees in Owerri city. Also, Diesel Exhaust Programme, good policies against environmental pollution and insisting on clean news cars will go a long way in mitigating the high level of air pollutants in Owerri as a result of automobile emissions.

REFERENCES

[1] National Bureau of Statistics of Nigeria May, 2007, "2006 Population Census Retrieved in 27 July, 2010.
[2] P. Arcado, Environmental Engineering. A design Approach Asoke Publishers pp 467 – 508.
[3] P. Narayamam, Environmental Pollution Principles and Analysis Control 2007, CBS Published PP 71 – 100.
[4] M. Erica, Vehicular Emission and Health Impact (200). http://ezinearticles.com
[5] D. Schwela, O. Air pollution and Health in urban area. Review on environments Health 2002 <http://en.wikipedia.org.
[6] World Health Oragnization (WHO). Air quality guidelines for Europe. Who regional office for Europe, Copenhagen 2005.
[7] J. Agunwaba, Waste Engineering and Management 2001, immaculate publication. Pp 382 – 399.
[8] N. Ndoke Contributions of Vehicular Traffic to carbon dioxide emission in Kaduna and Abuja, Northern Nigeria 2005. HUISSN 1418 7108: HEJ manuscript No. Enn – 060531 – B. http/ezinearticles.com

AUTHOR'S PROFILE

1. ***S. I Okonwo*** *is a Professor of Chemistry in the Department of Pure and Industrial Chemistry, Chukwuemeka Odumegwu Ojukwu Univeristy, Uli, Anambra State, Nigeria. Email: si.okonkwo@coou.edu.ng or sylocs70@yahoo.com*
2. ***V. O Ezigbo (Ph.D.)*** *is Senior Lecturer in the Department of Pure and Industrial Chemistry, Chukwuemeka Odumegwu Ojukwu Univeristy, Uli, Anambra State, Nigeria. Email: veroigbo@yahoo.com*
3. ***K.O. Okpala*** *is a Professor of Chemical Engineering in the Department of Chemical Engineering, Federal University of Technology Owerri, Imo State, Nigeria.*