

AIR AND NOISE POLLUTION EFFECTS ON AIR QUALITY IN PEACOCK PAINT INDUSTRY, IKOT EKAN, ETINAN, AKWA IBOM STATE, NIGERIA

M. N. CHUKWU*, T. L. AKPAN & C. G. OKOLI

(M. N. C.: Department of Pure and Applied Sciences, National Open University of Nigeria Head Quarters; T. L. A.: Department of Environmental Technology, Federal University of Technology, Owerri; C. G. O.: Department of Environmental Health, National Open University of Nigeria Head Quarters).

*Corresponding author's email: mchukwu@noun.edu.ng

ABSTRACT

Eight sampling locations in the study area were assessed for some air pollutants, level of noise pollution and some meteorological parameters. Portable handheld air monitor was used to measure air pollutants, a sound level meter and anemometer for level of noise and meteorological parameters respectively. Results showed that the highest concentrations of Nitrogen dioxide, Sulphur dioxide, Hydrogen Sulphide and Suspended particulate matter were recorded in indoor II while those for Carbon monoxide and Chloride were recorded in outdoor I. The outdoor locations recorded higher mean noise level and temperature (76.1 dB (A), 30.05°C) than the indoor locations (70.95 dB (A), 27.03°C). On the other hand, the indoor locations recorded higher mean relative humidity (62.8%) than the outdoor locations (48.25%). Significant difference ($P < 0.05$) was observed only in the mean concentration of Chloride in the two environments. The mean concentrations of NO_2 , SO_2 , H_2S , CO and Cl_2 were above the permissible limit of Federal Environmental Protection Agency thus posing environmental risks. Appropriate vehicle emission management should be considered; air and noise pollution control agencies should intervene to reduce the risks associate with these pollutants and improve the air quality of the study area.

Keywords: Pollutants, chloride, concentration, indoor, outdoor, noise pollution.

Introduction

Paint is defined as an opaque coating, generally made with a binder, solvents, additives and pigments which when applied in a liquid form, dries to form a continuous film that protects and improves the appearance of the substrates (Tina Porwal *et al.*, 2015). Paint production includes various processes such as assembling of materials, mixing, dispersing, thinning and adjusting, filling and warehousing. Other related activities include handling of materials, laboratory work and shipping (Tina Porwal *et al.*, 2015).

Air pollution refers the introduction of chemicals, particulate matter or biological materials that cause harms to humans and other living organisms into the atmosphere (Bahatia, 2009). Common air pollutants include Nitrogen oxide (NO), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Hydrogen Sulphide (H_2S), Carbon monoxide (CO), Volatile Organic compounds (VOC), Ammonia (NH_3), Chlorine (Cl_2), Hydrogen Cyanide (HCN), Ozone (O_3), Suspended Particulate Matters (SPM) and Lead (Lutgens & Edward, 2000; Olajire *et*

al., 2011). Air pollutant can be in solid, liquid or gaseous form and also natural or man-made (USEDA, 2006; Narayanan, 2009). The primary source of man-made air pollutants is from exhaust of combustion engines, furnaces of industries, plants and homes (Park, 2005; Komolafe *et al.*, 2014). The quality of air is very essential for sustenance of life (Ojo & Awokola, 2012).

Noise pollution which is also known as environmental noise is the propagation of unwanted sounds into the environment with ranging impacts on the activity of human or animal life. Most of them have adverse effects on such organisms (Anomohanran *et al.*, 2008). Sources of noise include industrial activities, commercial activities, vehicular activities, and human activities (Narendra & Davar, 2004; Li, 2013).

Some researchers had identified automobiles, motorcycles, generator usage and recording houses to be responsible for most of the noise in Nigeria (Onuu, 2002; Anomohanran *et al.*, 2008; Anomohanran & Osemeikhian, 2006). Potential health effects of noise pollution include increased stress levels, sleep disturbance, or hearing damage.

The industrial establishments in Nigeria prefer cheap, inadequate and often ecologically irresponsible methods of industrial waste disposals. It had been reported that about 80% of industries in Nigeria discharge their solid, liquid and gaseous wastes directly into the environment without prior treatment. These wastes are often toxic and hazardous and may likely cause ill health and unexplained deaths (Okopido, 2007). The Peacock Paint Industry in Etinan discharges its wastes into an artificial valley, few meters away from the factory buildings thus contaminating the source of water in the area and constituting health and environmental hazards (Uboh, 2000).

Environmental challenges of the local paint industry are associated with waste water, solid waste, air pollutants and noise pollution. The emphasis of this paper is on air pollutants and noise pollution and their effects on air quality.

Experimental

Study area

The industrialization policy thrust of the late Clement Isong administration in 1999 marked the birth of Peacock Paints industry as a Private Limited Liability Company with the principal objective of producing and marketing paints and allied products. The bedrock of the excellent performance of the company is the highly qualified and dedicated technical and administrative staff that together have raised and sustained the high-quality standard of the company's products. Today Peacock Paint prides itself on an intimidating long range of brands of decorative paints, premium qualities, standard qualities, industrial, protective and marine paints and thinners (Bassey, 2001).

Sampling

Eight sampling locations were randomly selected, four each from the indoor and outdoor environments. These include indoor I (Raw material store), indoor II (Operational room), indoor III (Laboratory), indoor IV (Office), outdoor I (Car park), outdoor II (A Road leading to the industry), outdoor III (Etinan estate) and outdoor IV (Ekomlman junction).

Measurement of air pollutants

Air pollutants such as NO₂, SO₂, H₂S, CO, VOC, NH₃, Cl₂, and HCN were determined using ITX multi-gas monitor. Suspended particulate matter (SPM) was measured using RAM-1200 (Park Davis) over a range of one hour to trap in the suspended particulate matter

and the reading recorded as SPM for the location (Oguntoke *et al.*, 2010). All equipment and meters were properly pre-calibrated before each usage for quality assurance following the manufacturer's guidelines against the National Institute for Standards and Technology (NIST).

Measurement of level of noise pollution

The amount of noise generated from the sampling locations were measured with a 3 MTM 2200 integrating-averaging sound level meter, containing a range of 30 - 140 dB and a weighting method of A, C, Z. stopwatch and a mobile phone. The sources of noise in the factory were identified and the sound level meter was used to measure from the source in decibel, at a height of 1.5m above ground level in free field conditions (Aery, 2010).

Measurement of meteorological parameters

Some meteorological field data such as temperature, relative humidity, wind speed and direction were measured. Temperature was measured using a pen monitor with the average readings over a period of ten to fifteen minutes' record. Relative humidity was measured using a logger fitted with relative humidity probe (Testo, 450) (Hygrometer). The logger measures and stores the values. Wind speed and direction were measured with a Wind vane Model: Deuta, Aremo wind speed indicator and a magnetic compass respectively (Lutgens & Edwards, 2000).

Data analysis

Data collected were analyzed using descriptive statistics; means, standard errors and analyses of variance (ANOVA). Further analysis was carried out using Pearson's Correlation Coefficient at 5% level of significance ($P < 0.05$).

Results and discussion

Air pollutants

Figs. 1a and 1b showed the variations in NO_2 (ppm), SO_2 (ppm) and H_2S (ppm) concentrations at different indoor and outdoor locations in Peacock Paint Industry. The mean indoor NO_2 concentrations ranged from 0.23 ppm at indoor IV (Office) to 0.75 ppm at indoor II (Operational room) (Fig. 1a). In the outdoor locations however, the mean NO_2 concentrations ranged from 0.35 ppm at outdoor III (Etinan estate) to 0.53 ppm at outdoor I (Car park) (Fig. 1b). On the average, the indoor locations recorded higher mean NO_2 concentrations than the outdoor locations (Figs. 1a and 1b). This is in line with the findings of Bahatia (2009) that NO_2 from the indoor environment had values ranging from 0.4ppm – 0.8ppm in the industrial area. The NO_2 concentrations in all the areas were above the permissible limit of 0.04ppm recommended by the FEPA (1991) and pose environmental concern. There were significant differences in the mean indoor NO_2 concentrations while there was no significant difference in the mean outdoor NO_2 concentrations ($P < 0.05$).

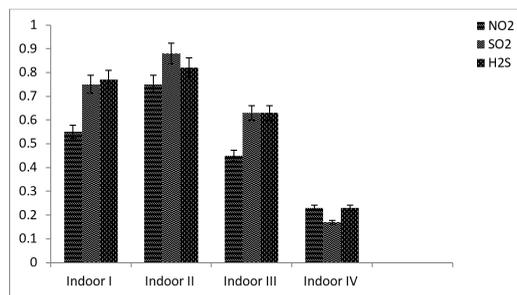


Fig. 1a: Variations in NO_2 (ppm), SO_2 (ppm) and H_2S (ppm) concentrations at different indoor locations in Peacock Paint Industry. Values shown are Mean \pm SE

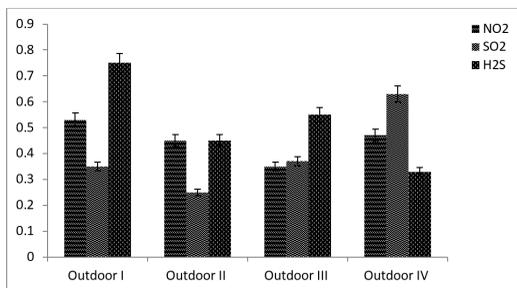


Fig. 1b: Variations in NO₂ (ppm), SO₂ (ppm) and H₂S (ppm) concentrations at different outdoor locations in Peacock Paint Industry. Values shown are Mean \pm SE

The mean indoor SO₂ concentrations ranged from 0.17 ppm at indoor IV (Office) to 0.88 ppm at indoor II (Operational room) (Fig. 1a). In the outdoor locations however, the mean SO₂ concentrations ranged from 0.25 ppm at outdoor II (Road leading to the Industry) to 0.63 ppm at outdoor IV (Ekomlman junction) (Fig. 1b). These values were all above the FEPA (1991) permissible value (0.1ppm) and calls for concern. The indoor locations also recorded higher mean SO₂ concentrations than the outdoor locations (Figs. 1a and 1b). There were significant differences between the mean indoor and outdoor SO₂ concentrations ($P < 0.05$).

The mean indoor H₂S concentrations ranged from 0.23 ppm at indoor IV (Office) to 0.82 ppm at indoor II (Operational room) (Fig. 1a). In the outdoor locations however, the mean H₂S concentrations ranged from 0.33 ppm at outdoor IV (Ekomlman junction) to 0.75 ppm at outdoor I (Car park) (Figs. 1b). The indoor locations also recorded higher mean H₂S concentrations than the outdoor locations (Figs. 1a and 1b). The highest concentration of

all the gases was seen in indoor II (Operational room) and the least in indoor IV (Office). There were significant differences between the mean indoor and outdoor H₂S concentrations ($P < 0.05$).

The mean indoor CO concentrations ranged from 24.3 ppm at indoor IV (Office) to 30.5 ppm at indoor III (Laboratory) (Fig. 2a). In the outdoor locations however, the mean CO concentrations ranged from 26.2 ppm at outdoor IV (Ekomlman junction) to 36.5 ppm at outdoor I (Car park) (Fig. 2b). These values were above the FEPA permissible value (10.00ppm) and calls for concern. On the average, the outdoor locations recorded higher mean CO concentrations than the indoor locations (Figs. 2a and 2b). The highest mean CO concentration at the car park is probably as a result of automobile activities there. This is in line with the findings of Ojo & Awokola (2012) and Akpan *et al.* (2014) that motor vehicles account for approximately 48% CO in urban areas. There was no significant difference between and within the mean indoor and outdoor CO concentrations ($P < 0.05$).

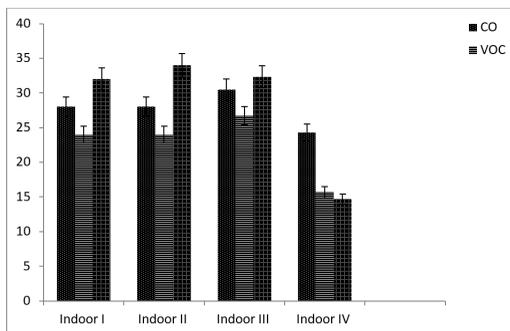


Fig. 2a: Variations in CO (ppm), VOC (ppm) and SPM ($\mu\text{g}/\text{m}^3$) concentrations at different indoor locations in Peacock Paint Industry. Values shown are Mean \pm SE

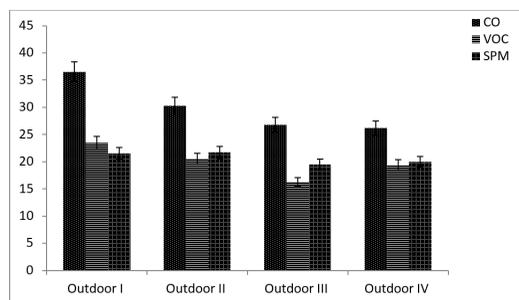


Fig. 2b: Variations in CO (ppm), VOC ($\mu\text{g}/\text{m}^3$) and SPM (ppm) concentrations at different outdoor locations in Peacock Paint Industry. Values shown are Mean \pm SE

The mean indoor VOC concentrations ranged from 15.7 ppm at indoor IV (Office) to 26.7 ppm at indoor III (Laboratory) (Fig. 2a). In the outdoor locations however, the mean VOC concentrations ranged from 16.3 ppm at outdoor III (Etinan estate) to 23.5 ppm at outdoor I (Car park) (Fig. 2b). The indoor locations also recorded higher mean VOC concentrations than the outdoor locations (Figs. 2a and 2b). The highest mean VOC concentration recorded in the Laboratory is probably as a result of industrial activities there. This agrees with the findings of Olajire *et al.* (2011). There was no significant difference between and within the mean indoor and outdoor VOC concentrations ($P < 0.05$).

The mean indoor SPM concentrations ranged from 14.7 ppm at indoor IV (Office) to 34 ppm at indoor II (Operational room) (Fig. 2a). In the outdoor locations however, the mean SPM concentrations ranged from 19.5 ppm at outdoor III (Etinan estate) to 21.5 ppm at outdoor I (Car park) (Fig. 2b). These values

are within the FEPA permissible level of $250\mu\text{g}/\text{m}^3$ daily average of the daily values for one hour. On the average, the indoor locations recorded higher mean SPM values than the outdoor locations probably because of the SW wind that brings rain which could probably wash off the SPM (Figs. 2a and 2b). This is in line with the findings of Ideriah (2008) and Jimoda (2012).

The mean indoor NH_3 concentrations ranged from 2.67 ppm at indoor IV (Office) to 3.0 ppm at indoors I (Raw material store) and III (Laboratory) (Fig. 3a). In the outdoor locations however, the mean NH_3 concentrations ranged from 2.0 ppm at outdoors I (Car park), II (Road leading to the industry) and III (Etinan estate) to 2.67 ppm at outdoor IV (Ekomlman junction) (Fig. 3b). On the average, the indoor locations recorded higher mean NH_3 concentrations than the outdoor locations (Figs. 3a and b). There was no significant difference between and within the mean indoor and outdoor NH_3 concentrations ($P < 0.05$).

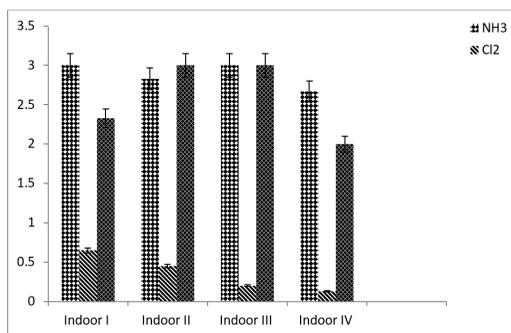


Fig. 3a: Variations in NH_3 (ppm), Cl_2 (ppm) and HCN (ppm) concentrations at different indoor locations in Peacock Paint Industry. Values shown are Mean \pm SE

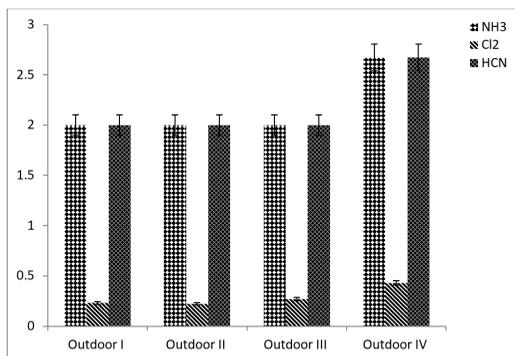


Fig. 3b: Variations in NH₃ (ppm), Cl₂ (ppm) and HCN (ppm) concentrations at different outdoor locations in Peacock Paint Industry. Values shown are Mean \pm SE

The mean indoor Cl₂ concentrations ranged from 0.13 ppm at indoor IV (Office) to 0.65 ppm at indoor I (Raw material store) (Fig. 3a). In the outdoor locations however, the mean Cl₂ concentrations ranged from 0.22 ppm at outdoor II (Road leading to the industry) to 0.43 ppm at outdoor IV (Raw material store) (Figs. 3b). On the average, the indoor locations recorded higher mean Cl₂ concentrations than the outdoor locations (Figs. 3a and 3b). The Cl₂ concentrations in all the areas were above the permissible limit of 0.03ppm recommended by the FEPA (1991) and pose environmental concern. There were significant differences in the mean indoor Cl₂ concentrations while there was no significant difference in the mean outdoor Cl₂ concentrations ($P < 0.05$).

The mean indoor HCN concentrations ranged from 2.0 ppm at indoor IV (Office) to 3.0 ppm at indoors II (Operational room) and III (Laboratories) (Fig. 3a). In the outdoor locations however, the mean HCN concentration was 2.0 ppm at all sampling points except outdoor IV (Ekomlman junction) with mean HCN concentration of 2.67 ppm (Figs. 3b). On the average, the indoor locations recorded higher mean HCN concentrations

than the outdoor locations (Figs. 3a and 3b). There was no significant difference between and within the mean indoor and outdoor HCN concentrations ($P < 0.05$).

Level of noise pollution

The mean indoor level of noise pollution ranged from 54.7 dB (A) at indoor IV (Office) to 80.3 dB (A) at indoor I (Raw material store) (Table 1a). In the outdoor locations however, the mean level of noise pollution ranged from 68.8 dB (A) at outdoors III (Etinan estate) to 88.3 dB (A) at outdoor I (Car park) (Table 1b). On the average, the outdoor locations recorded higher mean level of noise pollution than the indoor locations (Tables 1a and b). These were within the FEPA permissible value of 90 dB (A) for an eight hourly working period and thus acceptable (Tables 1a and b) (FEPA, 1991). There were significant differences in the mean indoor level of noise pollution while there was no significant difference in the mean outdoor level of noise pollution ($P < 0.05$).

Meteorological parameters

The mean indoor temperature values ranged from 26.7°C at indoor II (Operational room) to 27.6°C at indoor IV (Office) (Table 1a). In the outdoor locations however, the mean temperature values ranged from 29.5°C at outdoor I (Car park) to 30.5°C at outdoor IV (Ekomlman junction) (Table 1b). On the average, the outdoor locations recorded higher mean temperature values than the indoor locations (Tables 1a and b). The recorded values were all within the FEPA's permissible value (40°C). There was no significant difference between and within the mean indoor and outdoor mean temperature values ($P < 0.05$).

The mean indoor relative humidity values ranged from 61.5% at indoor IV

(Office) to 63.6% at indoor I (Raw material store) (Table 1a). In the outdoor locations however, the mean relative humidity values ranged from 47.8% at outdoor II (Road leading to the industry) to 48.5% at outdoors I (Car park) and IV (Ekomlman junction) (Table 1b). On the average, the indoor locations recorded higher mean relative humidity values than the outdoor locations (Tables 1a and b). This is probably due to the high moisture of the air indoors where the effect of wind is not felt. There was no significant difference between

the mean indoor and outdoor mean relative humidity values ($P < 0.05$).

In the outdoor locations the mean wind speed ranged from 0.6 ms^{-1} at outdoor I (Car park) to 1.1 ms^{-1} at outdoor II (Road leading to the Industry) and IV (Ekomlman junction) (Table 1b). No wind speed was recorded indoors. This would have contributed to the higher pollutants observed in the indoor locations since the mean wind speed in the outdoors could probably disperse the pollutants faster from the source.

TABLE 1A

Mean level of noise pollution and meteorological parameters for the indoor locations

Sampling Locations	Noise dB(A)	Temperature (°C)	Relative humidity (%)	Wind Direction	Wind Speed (ms^{-1})
Indoor I (Raw material store)	80.3	26.8	63.6	-	-
Indoor II (Operational Room)	80.1	26.7	63.3	-	-
Indoor III (Laboratory)	68.7	27	62.8	-	-
Indoor IV (Office)	54.7	27.6	61.5	-	-

TABLE 1B

Mean level of noise pollution and meteorological parameters for the outdoor locations

Sampling Locations	Noise dB (A)	Temperature (°C)	Relative humidity (%)	Wind Direction	Wind Speed (ms^{-1})
Outdoor I (Car Park)	88.3	29.5	48.5	South-West	0.6
Outdoor II (A Road Leading to the Industry)	76.8	29.9	47.8	South-West	1.1
Outdoor III (Etinan Estate)	68.8	30.3	48.2	South-West	0.8
Outdoor IV (Ekomlman junction)	70.5	30.5	48.5	South-West	0.8
FEPA Standard	90	< 40°C	-	-	-

Correlation between meteorological parameters and air pollutants

Table 2a shows the correlation between the meteorological parameters and air pollutants in the Indoor locations. There were negative correlations between temperature and SO₂ (r = - 0.622), H₂S (r = - 0.148), CO (r = - 0.122), VOC (r = - 0.604), Cl₂ (r = - 0.128), HCN (r = - 0.404) and SPM (r = - 0.202), while temperature showed positive correlations with NO₂ (r = 0.706) and NH₃ (r = 0.550). There were negative correlations between Relative humidity and NO₂ (r = - 0.682) and Cl₂ (r = - 0.428). On the other hand, it showed positive correlations with SO₂ (r = 0.632), H₂S (r = 0.265), CO (r = 0.261), VOC (r = 0.524), NH₃ (r = 0.522), HCN (r = 0.383) and SPM (r = 0.330).

In the outdoor locations, (Table 2b) there were negative correlations between temperature and SO₂ (r = - 0.426), H₂S (r = - 0.182), CO (r = - 0.152), VOC (r = - 0.543), Cl₂ (r = - 0.281), HCN (r = - 0.564) and SPM (r = - 0.207), while temperature showed positive correlations with NO₂ (r = 0.648) and NH₃ (r = 0.460). There were negative correlations between Relative humidity and NO₂ (r = - 0.542) CO (r = - 0.192), and Cl₂ (r = - 0.400). On the other hand, it showed positive correlations with SO₂ (r = 0.650), H₂S (r = 0.332), VOC (r = 0.444), NH₃ (r = 0.568), HCN (r = 0.287) and SPM (r = 0.540). Wind speed showed negative correlations with CO (r = - 0.422), VOC (r = - 0.822), and HCN (r = - 0.686). However, it showed positive correlations with NO₂ (r = 0.520), SO₂ (r = 0.840), H₂S (r = 0.686), NH₃ (r = 0.602), Cl₂ (r = 0.214) and SPM (r = 0.012),

TABLE 2A

Pearson's coefficient correlation values between the meteorological parameters and air pollutants at the indoor locations

Atmospheric Pollutants	Temperature (°C)	Methodological Parameters	
		Relative humidity (%)	Wind Speed (ms ⁻¹)
NO ₂	0.706	- 0.682	-
SO ₂	- 0.622	0.632	-
H ₂ S	- 0.148	0.265	-
CO	- 0.122	0.261	-
VOC	- 0.604	0.524	-
NH ₃	0.550	0.522	-
Cl ₂	- 0.128	- 0.428	-
HCN	- 0.404	0.383	-
SPM	- 0.202	0.330	-

TABLE 2B
Pearson's coefficient correlation values between the meteorological parameters and air pollutants at the outdoor locations

Atmospheric Pollutants	Methodological Parameters		
	Temperature (°C)	Relative humidity (%)	Wind Speed (ms ⁻¹)
NO ₂	0.648	- 0.542	0.520
SO ₂	- 0.426	0.650	0.840
H ₂ S	- 0.182	0.332	0.686
CO	- 0.152	- 0.192	- 0.422
VOC	- 0.543	0.444	- 0.822
NH ₃	0.460	0.568	0.602
Cl ₂	- 0.281	- 0.400	0.214
HCN	- 0.564	0.287	- 0.686
SPM	- 0.207	0.540	0.012

Conclusion and recommendations

This study portrayed the magnitude of indoor and outdoor air and noise pollution in Peacock Paint Industry. Mean concentrations of NO₂, SO₂, CO and Cl₂ at all sampling points were higher than the permissible limit of FEPA. The outdoor locations recorded higher mean noise level and temperature (76.1 dB (A), 30.05°C) than the indoor locations (70.95 dB (A), 27.03°C) while the figindoor locations recorded higher mean relative humidity (62.8%) than the outdoor locations (48.25%). These pose serious environmental and health risks. It is therefore recommended that appropriate vehicle emission management should be considered; air and noise pollution control agencies should intervene to reduce the risks associate with these pollutants and improve the air quality of the study area.

References

- AERY, N. C. (2010) *Annals of environmental analysis*. Taylor and Francis, New York. 413 pp.
- AKPAN, V. (2002) Glossary of Paint Ingredients and painting terms: Courtesy of Paint Quality Institute 1, 16 - 17.
- AKPAN, P. E. USIP, E. E. & JEREMIA U. O. (2014) Impact on Traffics Volumes on Air Quality in Uyo urbam, Akwa Ibom State, Nigeria. *Journal of Environment and Earth Sciences* **21**, 189 - 200.
- ANOMOHANRAN, O., IWEGBUE, C. M. A., OGHENERHOR, O. & EGBAL, J. C. (2008) Investigation of Environmental Noise Pollution level in Abiraka in Delta State, Nigeria. *Trends in Applied Sciences Research* **3** (4), 292 - 297.
- ANOMOHANRAN, O. & OSEMEIKHIAN, J. E. A. (2006) Day and Night Noise Pollution Study in some major towns in Delta State, Nigeria. *Ghana Journal of Science* **46**, 47 - 54.
- BAHATIA, S. C. (2009) *Environmental Pollution and Control in Chemical Process Industries*. Khanna Publishers, 163 pp.
- BASSEY, E. (2001) Peacock Paint Pride Creativity Extravaganza at Easter Programme/Souvenir Award Ceremony, pp 4 - 5.
- FEDERAL ENVIRONMENTAL PROTECTION AGENCY (1991) National Interim Guidelines and Standards for Industrial Effluents, Gaseous Emissions and Hazardous Waste Management. Environmental Pollution Control Handbook FEPA Lagos, pp 62 - 67.

- IDERIAH, T. J. K., BRAIDE, S. A., FAKARURHOB, G. & ORUAMBO, I. (2008) Determination of suspended particulate matter in South-Eastern Nigeria. *Ghana Journal of Science* **41**, 23 - 27.
- JIMODA, L. A. (2012) Effect of Particulate Matter on Human Health, the Ecosystem, Climate and Materials: A Review. *Facta University Series. Orking and Living Environmental Protection* **9** (1), 27 - 44.
- KOMOLAFE, A. A., ADEBGOYEGA, S. A., ANIFOOSE, A. Y. B., AKINLUYI, F. O. & AWONIRAN, D. R. (2014) Air Pollution and Climate Change in Lagos, Nigeria: Need for Proactive Approaches to Risk Management and Adaptation. *American Journal of Environmental Sciences* **10** (4), 412 - 423.
- LI, M. F. (2013) Air Pollution: A case of suspended Air particulate matter at Amanperdana, Klang, Selangor, Malasia. *Greener Journal of Science, Engineering and Technology Research* **3** (6), 186 - 194.
- LUTGENS, F. K. & EDWARDS, J. T. (2000) *The Atmosphere: An Introduction to Meteorology*. 8th ed. Prentice Hall, New Jersey. 512 pp.
- NARAYANAN, P. (2009) *Environmental pollution, principle, analysis and control*. CBS Publishers, New Delhi. 671 pp.
- NARENDRA, S. & DAVAR, S. C. (2004) Noise Pollution-Sources, Effect and Control. *Journal of Human Ecology* **16**, 181 - 187.
- OGUNTOKE, O., OPEOLU, B. O. & BABATUNDE, M. (2010) Indoor Air Pollution and Health Risks among Rural Dwellers in Odeda area, South West, Nigeria. *Ethiopian Journal of Environmental Studies and Management* **3** (2), 39 - 46.
- OJO, O. O. S. & AWOKOLA, O. S. (2012) Investigation of Air Pollution from Automobiles at Intersections on Some Selected Major Roads at Ogbomoso south West Nigeria. *IOSR Journal of Mechanical and Civil Engineering* **1** (4), 31- 3.
- OKOPIDO, I. T. (2007) Environmental Pollution and Emerging Health Hazard. The Nigerian Scenario - *The Nigerian Journal of General Practice* **7** (1), 15-16
- OLAJIRE, A. A., AZEEZ, L. & OLUYEMI, A. E. (2011) Exposure to hazardous air pollutants along Oba Akran Road, Lagos - Nigeria. *Chemosphere* **84**, 1044 - 1051.
- ONU, M. U., MENKITI, A. I. & ESSIEN, J. O. (2002) Spectral Analysis of Industrial noise in Calabar, Nigeria. *Global Journal of Pure and Applied Sciences* **2** (2), 1 - 9.
- PARK, K. (2005) *Preventive and Social Medicine* (18th ed). Jabalpur, India: M/S Banarsidas Bhanot Publishers.
- TINA PORWAL, M. L. B. (2015) Girls P.G. College & Indore, (M.P.). Paint Pollution harmful effects on Environment. *International Journal of Research - Granthaalayah* **3** (9), 1 - 4.
- UBOH, F. E. (2000) *Occupational Health and Safety Design: Biochemical Environmental and Occupational Toxicology*, University Press, Calabar, 1st Ed. 16 - 25.

Received 26 Jun 20; revised 17 Jan 22.