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Original Research Article

Assessment of Air Pollutants from Generator Fumes in Ebonyi State University Business Centers

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ABSTRACT

The level of gaseous pollutants CO, NO_2, NH_3, and H_2S at four strategic places CAS campus (site A), PRESCO campus (site B), ISHIEKE campus (site C), and PERMSITE campus (site D) in Ebonyi State University, Abakaliki business centers were determined using a hand-held Portable gas monitor (gas man model CO1925 6H, NO_2 19835H, NH_3 19736H, and H_2S1975 2H) for a period of two seasons (dry and rainy season). The ascending order of magnitude of the concentration of the gaseous pollutants in the dry season was $NH_3 < NO_2 < CO$. The same trend was also recorded in the rainy season while H_2S was not detected in both seasons. The range of NH_3, NO_2, and CO in the dry season was 0.24±0.00 site B to 0.53±0.05 site D, 0.38±0.08 site B to 0.82±0.25 site D, and 0.98±0.28 site C to 1.52±0.51 site D respectively. The result of NH_3 obtained during the rainy season ranged from 0.12±0.10 site B to 0.64±0.24 site C while the range of NO_2 and CO were 0.43±0.21 site B to 0.70±0.25 site A, 0.89±0.36 site C to 1.03±0.56 site D respectively. CO recorded the highest concentration in all the sites studied followed by NO_2 while NH3 had the least concentration. In this study, all the results obtained were not above World Health Organization (W.H.O) standard (NO_2=20.1 ppm, NH_3=67 ppm, CO = 2.68 ppm, and H_2S = 0.03 ppm). Therefore, the air quality of these campuses' business centers is conducive for now.

Keywords: Fumes, contaminant, exhaust, gas

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INTRODUCTION

Fresh air is taken to be an essential necessity of life. However, air pollutants are still a large threat to fitness globally [1]. The major products of the complete combustion of petroleum-based fuels in generators and other internal combustion engines are carbon dioxide, water, and nitrogen from air comprising the highest percentage [2]. A very small part of the nitrogen is converted to nitrogen oxides and some nitrated hydrocarbons. Carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NOx), particulate matter, and Polycyclic Aromatic Hydrocarbons (PAHs) are the major culprit for carcinogenicity in humans when inhaled [3]. CO, SO_2, and H2S are the major generator exhaust emissions and they are harmful to humans as stipulated by the Centers for Disease Control and Prevention [4]. Some excess oxygen may be emitted which is dependent on the operating conditions of the generator's engine [2]. According to World Health Organization (W.H.O) assessment, the effects of air pollutants in 2016 place greater than 2 million untimely deaths every year on the city outdoors and indoor air pollutants. More than half of these problems came from the populations of growing countries [5]. Presently in Nigeria, portable generators are commonly used in business centers, shops, and homes to supply electricity which is very much detrimental to human health. Electricity generator emission is dangerous to human health because of its chemical constituents which have been reported to be toxic and carcinogenic on inhalation [6]. Death through electricity generator exhaust and other related pollutants from the environment has become daily news in Nigeria. Notwithstanding, the generator has its own advantage, but most Nigerians aren't aware of the destructive impact of emissions from generator usage on their health. The operation or running of generators requires the use of fossil fuels such as diesel and petrol [1]. The burning of hydrocarbon fossil fuel results in the emission of different fractions of noxious Particulate matter into the environment. As a result, the air we breathe is infected with those air pollutants which might be dangerous to human health [7].The problem of generator emissions in cities has been expressed because of the recognition of the numerous adverse effects of these particulate emissions on man and the environment. The generators emit hydrocarbons, carbon monoxide, nitrogen dioxide, lead, and particulate matter, and in strong sunlight, some of those hydrocarbons and oxides of nitrogen can be transformed into "photochemical pollutants" of oxidizing nature [1]. Ebonyi state having cut out from Abia and Enugu has been slow in development not until recently where there is rapid

development owing to the proactive government on board. The state is also witnessing a direct proportional growth in the demand and purchase of generators which in turn transcends to increased emissions in the study areas [8]. Ebonyi State is a major player in farming it has serious power supply challenges, as almost all companies, homes, businesses, farms, schools, hospitals, etc., have resulted in generating electric power by themselves. At least, one generator set is located at a residential, official, industrial, or agricultural, unit as the case may be [2] An instance is the smallest and most inexpensive generator popularly called "I better pass my neighbor".Most likely, exposure to those generator emissions may have caused the growth in cancer-associated cases, breathing ailment conditions, etc.; most of which are common to smokers. These are now being observed in non-smoking residences. Also, most of these generators are over-aged and poorly maintained and subsequently may generate more particulate emissions [9].

MATERIALS AND METHODS

STUDY AREA

The Four 4 campuses of Ebonyi State University (EBSU) that were chosen for this study as sample sites were within the Abakaliki metropolis. The sites include CAS Campus (SITE A), PRESCO CAMPUS (SITE B), Ishieke Campus (SITE C), and PERM SITE (SITE D) all within the Abakaliki metropolis. The four sample sites were within an average distance of 5 - 10 kilometers from one another. These sites are characterized as student population-dense areas.

Table 1. Sample Location and Identification

S/N	Location of sample	Sample identification
1	CAS Campus	Site A
2	Presco Campus	Site B
3	Ishieke Campus	Site C
4	Permsite	Site D

MATERIALS

The sampling materials/equipment used during the study includes portable hand-held gas monitor Gas man model CO 1925 6H, Gas man model NO_2 19835H, Gas man model NH_3

19736H, Gas man model H_2S1975 2H, Hand glove, and Nose mask. The gaseous pollutants monitored were carbon monoxide (CO), nitrogen dioxide (NO_2), ammonia (NH_3), and hydrogen sulfide (H_2S).

METHODS

Portable handheld gas monitors (Gas man model (CO 1925 6H, NO_2 19835H, NH_3 19736H, and H_2S 1975 2H) with detection limits of atom set at 3 ppm. The atmospheric conditions of these gases were monitored. The four monitors were hung on a wooden platform raised to the height of 1m above the ground level. A distance of 50m away from the point at which the monitors were hung was moved and allowed the machine to trap the surrounding atmospheric gases (CO, NO_2, NH_3, and H_2S). The monitors were well calibrated on each occasion of use due to regular weather variations. The monitor was switched from testing to gas after it beeped 3 to 4 times. The green light emitting diode (LED) and the sounder operated once every three seconds. The flashing of red (LED) during testing is an indication that the gas concentration has passed the alarm range. Hourly timing was done with the aid of a stopwatch and all readings were carefully taken when the monitors stabilizes.

RESULTS AND DISCUSSION

The results of the air pollutants obtained from the four campuses, CAS, Presco, Ishieke, and the Permanent site of Ebonyi State University, Abakaliki which were represented by site A (CAS), site B (Presco), site C (Ishieke), and site D (Permanent site) respectively were depicted in tables 2 and 3. The analysis was conducted between December to February 2022 which represents the dry season and the results obtained in these three months were used to calculate the mean and standard deviations and hence, the dry season results. The same way was used to conduct the rainy season which started in May and ended by July 2022. From the results obtained in both seasons, CO concentrations were said to be higher in both seasons compared to other gaseous pollutants obtained. CO ranged from 0.89±0.36 ppm site C to 1.03±0.56 ppm site D in the rainy season while its range in the dry season was 0.98±0.28 ppm site C to 1.52±0.51 ppm site D. The ascending order of magnitude of the concentration of the gaseous pollutants in the dry season was $NH_3 < NO_2 < CO$. The same trend was also recorded in the rainy season while H_2S was not

detected in both seasons. The concentrations of pollutants in the dry season were seen to be higher than the concentrations in the rainy season. This could be a result of the higher dispersal of gaseous pollutants during the dry seasons by wind than in the rainy season. According to Bhatia, [10] pollutant dispersal is always higher during the dry season than during the rainy season. The concentrations of the pollutants were compared with the permissible limit recommended by W.H.O. but were all below the acceptable limit and hence, do not pose serious environmental concerns.

Table 2. Result of the dry season sampling data (ppm)

S/N	Location	NH_3	NO_2	CO	H_2S
1	SITE A	0.38±0.02	0.62±0.12	1.24±0.42	ND
2	SITE B	0.24±0.00	0.38±0.08	1.08±0.40	ND
3	SITE C	0.45±0.01	0.53±0.10	0.98±0.28	ND
4	SITE D	0.53±0.05	0.82±0.25	1.52±0.51	ND
5	WHO	67 ppm	20.1 ppm	2.68 ppm	0.03 ppm

KEY: ND = Not Detected

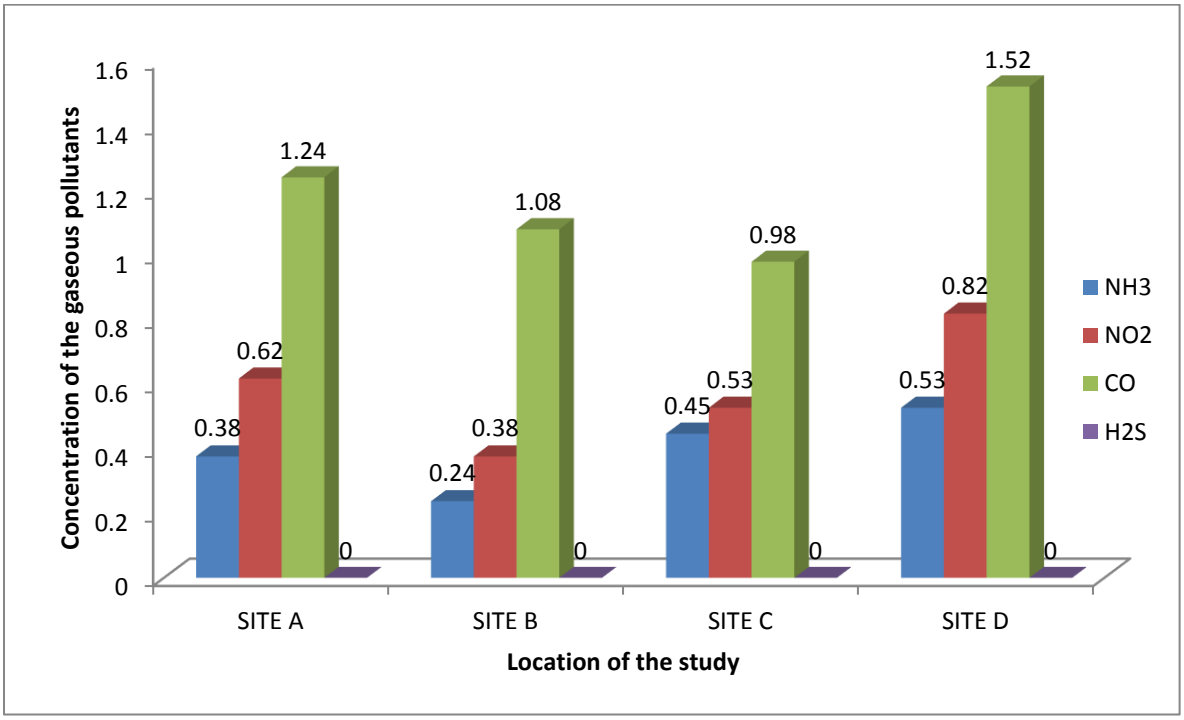

Figure 1. Shows the chart of the result obtain in dry season

Table 2 and Figure 1 above show the results of the gaseous pollutants obtained in the study. The range of the concentrations of the pollutants was NH_3 0.24±0.00 site B to 0.53±0.05 site D, NO_2 0.38±0.08 site B to 0.82±0.25 site D, CO 0.98±0.28 site C to 1.52±0.51 site D. Site D had the highest concentration of pollutants compared to other sites study while site B had the lowest concentration except in Site C were the concentration of CO were recorded lowest. This increase in the concentrations of the pollutants in site D could be attributed to the number of people using generators to carry out their business activities within the campus premises.

Table 3. Result of the rainy season sampling data (ppm)

S/N	Location	NH_3	NO_2	CO	H_2S
1	SITE A	0.4±0.11	0.70±0.25	0.99±0.52	ND
2	SITE B	0.12±0.10	0.43±0.21	0.97±0.48	ND
3	SITE C	0.64±0.24	0.47±0.15	0.89±0.36	ND
4	SITE D	0.38±0.17	0.56±0.22	1.03±0.56	ND
5	WHO	67 ppm	20.1 ppm	2.68 ppm	0.03 ppm

KEY: ND = Not Detected

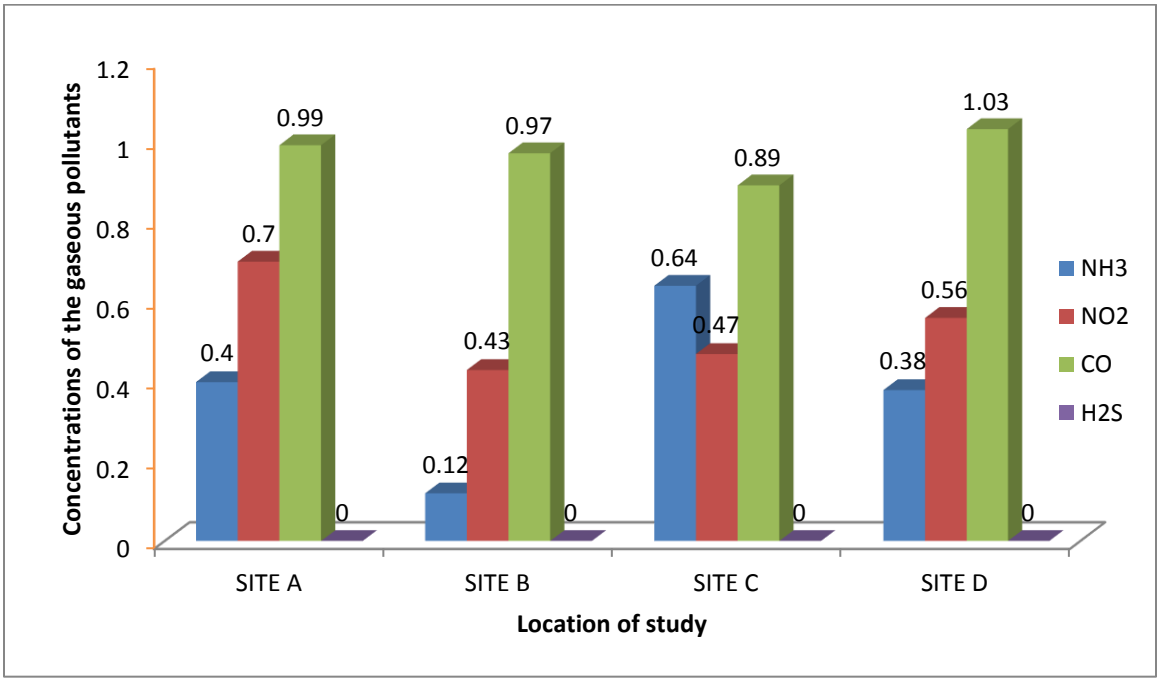

Figure 2. Shows the chart of the result obtain in rainy season

Table 3 and Figure 2 show the results of the gaseous pollutants NH_3, NO_2, CO, and H_2S obtained in different campuses of Ebonyi State University, Abakaliki business centers. The result of NH_3 obtained ranged from 0.12±0.10 site B to 0.64±0.24 site C while the range of NO_2 and CO were

0.43±0.21 site B to 0.70±0.25 site A, 0.89±0.36 site C to 1.03±0.56 site D respectively. CO recorded the highest concentration in all the sites studied followed by NO_2 while NH_3 had the least concentration. CO is obtained via water gas and producer gas. Producer gas is obtained as a result of the combustion of carbon at high temperatures while water gas is generated as a result of the endothermic reaction of steam and carbon. Another way CO can be obtained is by direct oxidation of carbon in a minimum supply of oxygen.

$$2C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)}$$

NO_2 can be obtained via oxidation of nitrous oxide by oxygen and as well in the laboratory.

$$2NO_{(g)} + O_{(g)} \rightarrow 2NO_{2(g)}$$

Industrially it can be produced vai two step procedure. Dehydration of nitric acid to generate dinitrogen petaoxide and the undergoes thermal decomposition to obtain NO_2.

$$2HNO_{3(aq)} \rightarrow N_2O_{5(g)} + H_2O_{(l)}$$

$$2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$$

NO_2 is very significant for the formation of acid rain, causes body disorientation, visual disturbance, dizziness etc [11, 12].

NH_3 is found majorly in agricultural waste. It is a building block of pharmaceutical synthesis. It is nutritional to terrestrial organisms and as well serves as a precursor to foodstuffs and fertilizer. In the atmosphere, it reacts with the oxide of nitrogen and sulfur to form secondary particulate [13]. Exhaust fume has been also reported to have a detrimental effect on the fetus of a pregnant woman [14].

CONCLUSION

The study revealed that the four campuses were contaminated with NO_2, CO, and NH_3 but not above W.H.O standard limit. Therefore, the air qualities of these campuses are conducive for now. This is owing to the fact that there is no dense population within the campuses. However, there was a negligible record for H_2S.

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