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Measurement and Analysis of Peak Noise Levels around Two Selected Generator Houses within Michael Okpara University of Agriculture, Umudike, South East Nigeria

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Abstract

Power supply from Enugu Distribution Company (EEDC) is not steady in Michael Okpara University of Agriculture (and in the nation at large). As such, the institution resorted to alternative means of power supply. Such means is by use of power generating sets. These power generating sets commonly known as 'Generators' generate a lot of noise as they operate. Michael Okpara University of Agriculture is located in Ikwuano local Government area of Abia State. Southeastern Nigeria; between latitude 5°29'N and longitude 7°32'E. In this study, effort was made to measure and analyze the noise output from these generators using a NOISH sound level meter. The instrument was mounted at a height of 1m above the ground in the two locations. The results show that the noise outputs from these generators were quite high and above the recommended levels by WHO.

Keywords: Noise, Pollution, Generator, Power

Introduction

Noise has many definitions depending on where the sound exists and its effect on the recipient. One of the definitions of noise is that, it is a sound that is undesired by the recipient. The Latin word nausea is the root word for noise which means unwanted sound. Consequently, it can be considered as wrong reverberation in wrong situations/positions at wrong moments (Kiely, 1997). Noise is also considered an environmental sterner and according to World health organization (WHO), Noise is the

third most hazardous type of pollution next to air and water pollution (WHO, 2005). Noise is the main source of pollution in urban areas (for which our campuses are part of) and is a part of environmental pollution which interferes with communication and human health (Agarwal and Swami, 2011; Pathak *et al*., 2008; Adekunle *et al*, 2021). People are mainly affected by noise in three major areas: their performance, health and comfort (Miedema and Outshroon, 2001). Hence it becomes imperative to understand the sources and types of noise pollution, monitoring techniques and possible effects on human health.

Noise is an environmental pollutant that is increasing very rapidly as a result of increase in commercial, industrial and social activities (Onuu, 2000). It is referred to as an undesirable sound which results from the activities of man. The study of noise covers all fields of sound production, propagation and reception. Sound pressure level depends on the power output of the noise source and the environment.

The ear has remarkable ability to handle enormous range of sound, however sound becomes a problem when it interferes with our activities such as sleep, work, recreation and reading. The human hearing mechanism responds to changes in sound pressure in a relative rather than absolute manner. This is why a logarithmic scale called the decibel (dB) is used to measure sound pressure level.

The weakest sound that the human ear can detect is referred to as the threshold of hearing and it corresponds to 0dB. On the other hand, the level of sound pressure that will cause pain to the ear is referred to as the threshold of pain and it corresponds to 120 dB. The magnitude of the pressure variations is always directly proportional to loudness of the sound (Mishra *et al*, 2010; Banerjee *et al*., 2008; Tiwari and Kudesia, 2007; Carter, 1996). The threshold of hearing is usually called the reference pressure.

A change of 3 dB in sound level is enough to make such a change noticeable. In the measurement of sound, two weighting network namely the A and C network are employed. However, for environmental purposes, the measurement is made using the A-weighted scale (dBA) because this scale measures sound level in approximately the same way as the human ear.

The determination of noise level in some towns in Delta State, Nigeria shows that most noise pollutions

are caused by lack of public awareness and the ignorance of the people. This is why a lot of people in Nigeria are subjecting themselves to loud amount of noise.

According to Anomohanran *et al* (2008), automobiles, commercial motorcycles, recording houses and the use of electricity generators are factors responsible for most of the noise experienced in Nigeria. In the same light, the study conducted at Agbor, Nigeria shows that noise from most points in the city are caused by big trucks such as lorries and luxurious buses and also by commercial activities (Anomohanran *et al*, 2008). However, Olayinka and Abdullahi (2008) in a study conducted in Ilorin, Nigeria, observed that the population growth of the city which increased over 50% between 1980 and 2006 was partly responsible for the rise in noise pollution. They also asserted that road traffic is the predominant and most generalized noise source in Nigeria.

Sound is a very common phenomenon in human life as it is a means of communication for humans as well as animals. A small sound which is pleasant to the ear is generally referred as music while an irritating sound which generally causes annoyance and soreness is referred to as "noise". In this regard, the study wishes to investigate the measurement and analysis of environmental noise around two selected Generator houses in Michael Okpara University of Agriculture, Umudike.

Materials and methods

The study area is Michael Okpara University of Agriculture, Umudike in the south Eastern region of Nigeria. **Umudike** is a community in Abia State, Nigeria, about 10 kilometers southeast of Umuahia, the state capital. It lies between longitude 7° 32' 33.59" E and latitude 5° 28' 19.79" N.

In carrying out the noise level measurements, two locations were selected, namely: The Administrative Block Power House and COLPAS (College of Physical and Applied Sciences) Power House. The specifications of the generators (according to their manufacturers) in each of the power houses are given in table 1.

Table 1: Generator Specifications and their locations

Location	Manufacturer	Model	Year Manufactured	Rated Voltage	Rated Power (Prime)	Ambient Temperature	Rated Frequency
Admin. Block	**FG Wilson (Eng. LTD)**	**P800 P1**	**2012**	**415V/240V**	**800kVA**	**25^{o}C**	**50Hz**
COLPAS	**FG Wilson (Eng. LTD)**	**P800 P1**	**2006**	**415V/240V**	**800kVA**	**27^{o}C**	**50Hz**

The measurement of the sound level was carried out using a NIOSH sound level application which is a type 1 integrated sound level meter mobile application. This instrument is very suitable for environmental noise survey. The instrument was mounted at a height of 1 m above the ground in the two locations for consistency of measurement with the antenna pointing towards the sound source. The instrument was set at the A-weighting network and the Peak which is the maximum value reached by the sound pressure were measured for the two locations. The measurement was carried out in two hourly intervals for three consecutive days.

The instrument was set at automatic mode to run continuously for two hours. By so doing, the instrument follows all the fluctuations, stores them in its memory and at the end gives the peak value. The measured Peak values (which are the maximum values reached by the sound pressure) for the two locations were recorded. These values were compared with the standard noise quality specifications by the WHO given in table 2.

Table 2: Standard Noise Quality Classifications

	Day time			Night time
Leq (dBA)	Noise Quality Description		Leq (dBA)	Noise Quality Description
0 – 30	Excellent Quality		0 – 30	Excellent Quality
31 – 40	Very good quality		31 – 40	Very good quality
41 – 60	Good quality		41 – 50	Good quality
61 – 75	Satisfactory quality		51 – 65	Satisfactory quality
76 – 90	Unsatisfactory		66 – 75	Unsatisfactory
91 – 110	Hazardous quality		76 – 90	Hazardous quality
>111	Not allowed		> 90	Not allowed

Results

The results of the measurement are presented in tables 3 and 4. From the tables, the peak noise levels, as well as the average peak noise levels were plotted against time as seen in figures 1 to 4. Figure 5 is a Bar Chat comparing the different noise levels over time for Admin. Block power house and COLPAS power house.

Table 3: Peak Noise Level Measurement for Generator in Admin. Block, Mouau

Day 1 Time (Hrs)	Peak Noise Level (dB)	Day 2 Time (Hrs)	Peak Noise Level (dB)	Day 3 Time (Hrs)	Peak Noise Level (dB)	Average Peak Noise Level
0	95.9	0	90.5	0	92.9	93.1
2	95.1	2	98.2	2	93.5	95.6
4	94.5	4	96.5	4	93.2	94.7
6	97.6	6	94.1	6	93.1	94.9

Table 4: Peak Noise Level Measurement for Generator in Colpas, Mouau

Day 1 Time (Hrs)	Peak Noise Level (dB)	Day 2 Time (Hrs)	Peak Noise Level (dB)	Day 3 Time (Hrs)	Peak Noise Level (dB)	Average Peak Noise Level (dB)
0	110.1	0	107.1	0	109.9	109.0
2	111.4	2	110.9	2	108.6	110.3
4	107.2	4	110.2	4	111.5	109.6
6	111.2	6	111.8	6	111.4	111.4

Note that the unit of the noise level is dB (A) but we have used dB for convenience.

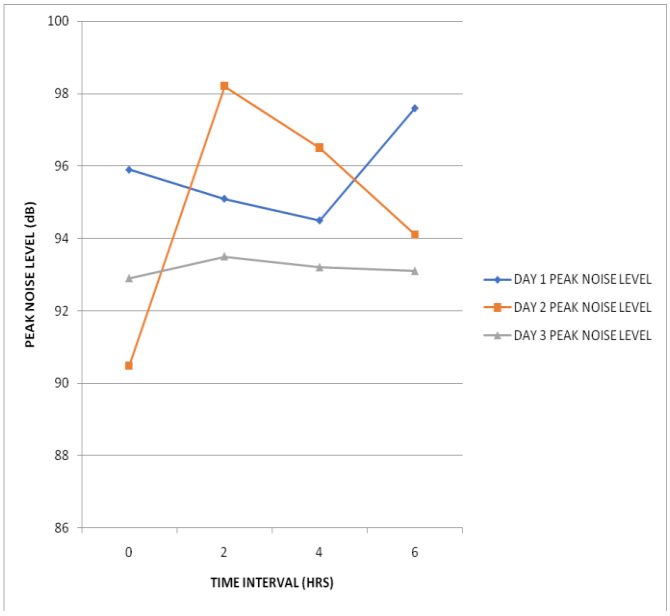

Fig. 1: Plot of peak noise levels against time around Admin. block power house

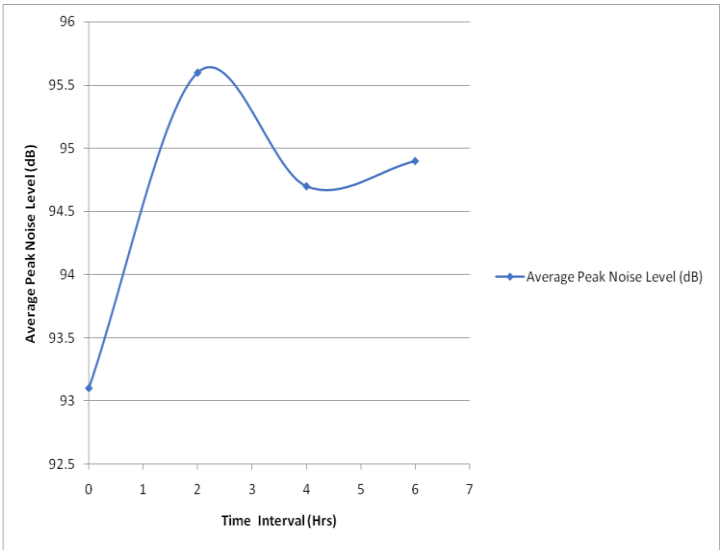

Fig.2: Plot of Average Peak Noise Level against time around Admin. Block power house

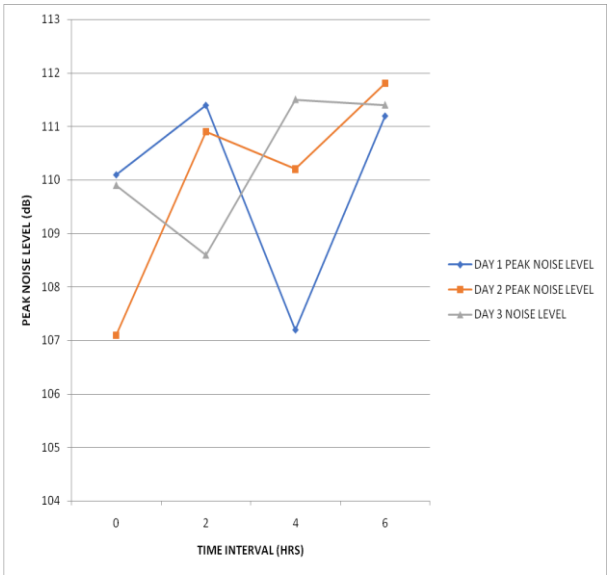

Fig.3: Plot of peak noise levels against time around COLPAS power house

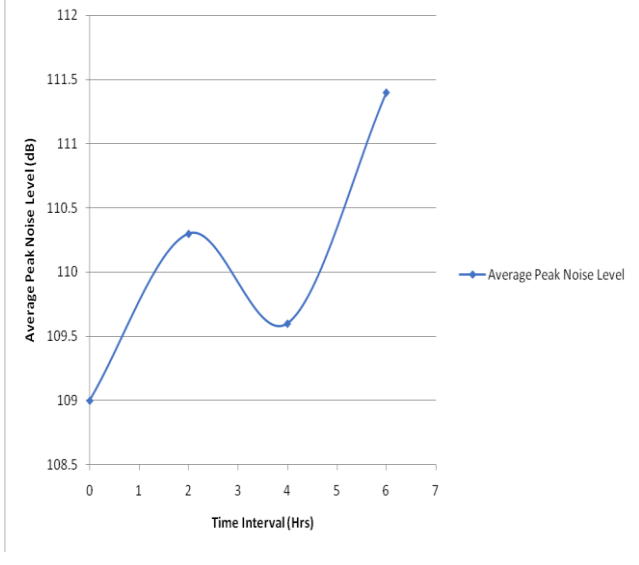

Fig.4: Plot of average peak noise level against time around COLPAS power house

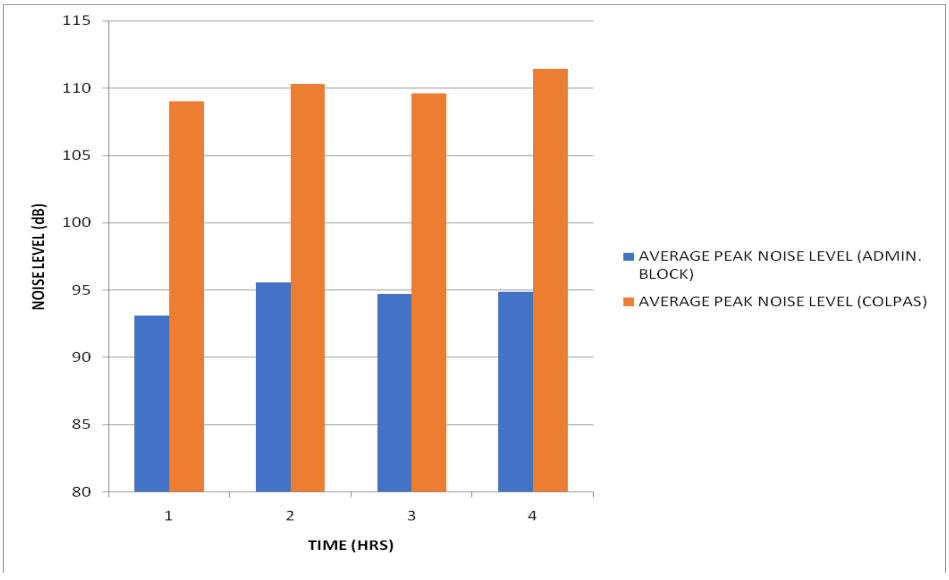

Fig. 5: Bar Chat comparing the different noise levels over time for Admin. block power house and COLPAS power house.

Discussion

Table 3 shows the data collected around the power house in Admin. block for three consecutive days while table 4 shows the data for the second location from day 1 (one) to day 3 (three).

Looking at figure 1, the values of the peak noise levels for the six hours period for each day the measurement was carried out were between 90dB and 100dB all through. Figure 2 shows an increase in the average peak noise level from 93.2dB to 95.7dB in about 2hours and a decrease from 95.7dB to between 94.5 and 95 dB throughout the rest of the time the measurement was carried out. Figure 3 shows peak noise values within 107dB and 112dB while figure 4 (which is the plot of average peak noise level against time around the COLPAS power house) shows an increase from 109dB to 110.3dB and a fall from 110.3dB to 109.7dB around the fourth hour of the measurement period. Afterwards, the average noise level increased to 111.4dB in about the sixth hour of the measurement period.

The bar chart of figure 5 compares the results from the two power houses. It is obvious from the chart that the peak noise levels around the power house in COLPAS were greater than those around the Admin. power house. This could

be due to the age of the generator at the COLPAS power. The generator produces more noise than that in the Admin power house (though they are of the same capacity). Nevertheless the noise levels recorded from both generators exceed the recommended levels by the WHO, which is from 61dB to 75dB. The above range is the satisfactory noise quality range recommended by WHO (WHO, 2005). This invariably means that the Generator operators and those around the generator houses are at risk of noise hazards.

Conclusion

Noise pollution has been recognized as a major treat confronting the world today. The World Health Organization (WHO) reveals that noise is a dangerous agent which affects human health and the environment. The noise levels from the two generator houses studied were quite high, above the WHO recommended standard (though those of COLPAS power house were far greater than those of Admin. block power house). On this note, efforts should be made by Management of the University to protect workers and students from the harmful effects of noise from these power houses. Some of the harmful effects include: distortion in thought processes amongst staff and student, hearing loss, psychological stress and killing of the nerve ending in the inner ear. In order to mitigate against these negative effects, the University management could ensure the provision of noise protectors for the Generator Operators. This they will put in their ears as they carry out their day-to-day activities. The management can also ensure that the generator houses are padded with acoustic shields to minimize the noise output from those generators. The padding of the generator houses with acoustic shield will ensure that the entire noise generated was not transmitted to the surrounding environment.

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