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Identification of major noise donors, a sure way to abating noise

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Abstract

A Study was conducted to ascertain the specific noise emitted by presumed noisy environments. This was achieved by direct measurement of the noise with the use of an integrated sound level meter in which a built-in frequency filter or weighting network is incorporated. Ten (10) environments were selected in Ilorin and Akure towns in Nigeria, in which sixty (60) readings were taken at intervals of 30 seconds for 30minutes separately at each location. This amounted to an overall reading of six hundred (600) readings. The results show that the Lawn Mower emits noise with the highest Equivalent sound level, L_{Aeq} of (98.55dB (A)) followed by the Food Milling Machine (93.80dB (A)). The lowest L_{Aeq} value of (61.76dB (A)) obtained in the study was arrived at with the measurements taken while standing 20 meteres away from a generating set. These values are extremely outside those recommended for community noise by the WHO. Signal analysis obtained with the measurements indicates the complex and non-periodic signal of noise. Identifying this fact therefore, calls for direct efforts at abating noise emitted by these known donors of noise. This effort will ensure that better equipment are designed to free the environment from the influx of noise, which has been identified as major source of environmental pollution. This will enhance the creation of clean products and ultimately a clean technology.

Key words: Noise, Noise donors, Equivalent sound level, integrated sound level meter, signal analysis, weighting network

1. Introduction

The word noise is derived from the Latin term nausea. It has been defined as unwanted sound [Hasall et al., 1979; Jaiswal, 2003; Omubo-Pepple, et al., 2010]; an undesirable by-product of society's normal day-to-day activities. In physical terms, Hasall et al., defined sound as the "Mechanical vibration of gaseous, liquid or solid elastic medium through which energy is transferred away from the source by progressive sound waves". He added that, "whenever an object moves or vibrates, a small proportion of the energy involved is lost to the surrounding medium as sound" (Hasall and Zaveri, 1979).

Noise could also be defined as an available acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person. (Saadu, 1987).

Noise is defined as unwanted sound (Laurent et al, 1977; Enger, et al, 2002). Sound, which pleases the listeners, is music and that which causes pain and annoyance is noise. At times, what is music for some can be noise for others [Parivesh, 1996].

A decibel (dB) is the standard for the measurement of noise. The zero on a decibel scale is at the threshold of hearing, the lowest sound pressure that can be heard. 20 db is whisper, 40 db the noise in a quiet office. 60 db is normal conversation, 80 db is the level at which sound becomes physically painful. "Decibel scales are logarithmic, rather than linear". Therefore, an increase in loudness from 40dB to 80dB is a ten-thousandth percent rise in the loudness of the noise (Enger, et al, 2002).

According to Encyclopedia Britannica; **an acoustic noise is defined as any undesired sound.** In chambers 21st Century Dictionary the definition of noise has undergone a change. Noise pollution stands carved out as phrase separately from noise. The two are defined as follows: **Noise**- a sound; a harsh disagreeable sound, or such sound; a din. **Noise Pollution**- This is an excessive or annoying degree of

noise in a particular area, eg from traffic or aero plane engines.

Noise can be described as sound without agreeable musical quality or as an unwanted or undesired sound. Thus, noise can be taken as a group of loud, non-harmonious sounds or vibrations that are unpleasant and irritating to ear. [Jaiswal, 2003] The audiologist says noise is a meaningless sound; the communicator says it is any barrier to effective communication Dunmoye, (2011).

In the sciences, especially in physics and telecommunication noise is fluctuations in, and the addition of external factors to the stream of target information (signals) being received at a detector.

Noise can be created deliberately for some communication effects e.g. jamming of a radio or TV signal. However, it is still regarded as an undesired interference with intended operations. Natural and deliberate noise sources can provide both or either of random interference or patterned interference.

Environmental noise is a worldwide problem. However, the way the problem is handled differs immensely from country to country and is very much dependent on culture, economy and politics. It is saddening that the problem persists even in areas where extensive resources are being used for regulating, assessing, and damping noise sources, and or for creation of noise barriers.

Noise has been identified as a pollutant. Section 2(a) of the Environment (Protection) Act, 1986 of India; states that: **air pollution** means any solid, liquid or gaseous substance including noise present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.

Pollution is a word derived from the verb pollute. Section 2 (c) of the Act defines **environmental pollution** to mean the presence in the environment of any environmental pollutant. Section 2 (b) defines **environmental pollutant** to mean any solid, liquid or gaseous substance present in such concentration as may be ,or tends to be injurious to environment. Section 2 (a) of the Air (Prevention and Control of Pollution) Act, 1981 includes noise in the definition of 'air pollutant'.

Studies have shown that noise has a significant impact on the quality of life, and in that sense, it is a health problem in accordance with the World Health Organization (WHO) definition of health which includes total physical and mental well-being, as well as the absence of disease. A 1971 WHO working group stated, that: "Noise must be recognized as a major threat to human well-being," (Ali andTamura, 2003).

The U.S. Department of Housing and Urban Development (HUD) (Oyedepo and Saadu, 2011)
recommends the following noise levels for residential areas, measured outdoors:

LAeq ≤ 49 dBA
—clearly acceptable
49 < LAeq ≤ 62 dBA (or LDN≤65 dBA)
—normally acceptable
62 < LAeq ≤ 76 dBA (or 65 < LDN≤ 75 dBA) —normally unacceptable
LAeq > 76 dBA (or 75 dBA< LDN)
—clearly unacceptable

Researchers throughout the world have been conducting investigations with a view to tackling the problem of noise pollution in cities. (Oyedepo, et al 2008; Morillas et al., 2005; Zannin et al., 2002) It is no news again that noise causes a great deal of discomfort in lives of people. This has long been established (Ozer, et al, 2009; Marius et al., 2005).

Physical, physiological, psychological and effects on work performance are the four categories of health effects on human. As in all form of pollution, the degree of the effects of noise pollution depends on the dose in terms of the amount and duration of exposure (Yilmaz, et al., 2005).

Instances such as hearing defects (physical effects); irregularity of heart rhythms, increased blood pressure and ulcers (physiological effects), insomnia and going to sleep late, disorders, irritability and stress (psychological effects); and lastly misunderstanding of instructions and reduction of productivity (effects on work performance) are observed in human. (Evans and Hygge, 2000; Passchier-Vermeer and Passchier, 2000;). Nigerian researchers are not taking the back seat in the

quest to curb noise pollution problems. In 1998 Saadu, et al carried out a study on "Road Traffic Noise Survey and Analysis of some Major Urban Centres in Nigeria". Anomohanran,et al (2008), Omubo-Pepple, et al (2010), Oyedepo and Saadu, (2008); Saadu, (1987); Saadu et al, (1998) and many more have also worked on different cities in Nigeria; such as Ilorin, Kwara State, Abraka Delta State, Port Harcourt, Rivers State etc. These studies have generally revealed that generators, loudspeakers, food milling machines, Worship centres actually dole out the highest level of the community noise.

The outpouring of noise into the Nigerian Cities calls for lots of research to evaluate the effects of the public noise on residents. This will help to checkmate the current and imminent adverse effects resulting from the noise. It has been observed from the studies that, many families in the Nigeria have generators which give uncontrolled noise to the neighbourhood. The effects of noise from such if not identified and checked, may lead to a chronic situation which may be difficult to subdue.

This study is therefore, carried out to measure and ascertains the actual values of noise emitted by these sources. In addition, since what is music for some can be noise for others; it is necessary to make an objective measurement of the noise produced by the sources so that the noise level can be compared adequately with the world standard, which is not subjective and not subjected to human limitations.

Environmental noise is the one resulting from neighborhood activities. It is different from industrial noise, which results from industrial, production activities. However, in many Nigerian cities, there seems to be no discernable difference between the two, because the few industries in the towns are embedded in the residential areas and residential houses have smuggled themselves into the designated industrial areas (Abolarin, 2012).

1.1 Sources of Noise Pollution:-

Noise pollution like other pollutants is also a by-product of industrialization, urbanization and modern civilization. Most leading noise sources will fall into the following categories: roads traffic, aircraft, railroads, construction, industry, noise in buildings, and consumer products

1.2 Road Traffic Noise:

In many cities in the world, the leading source of noise is the traffic noise (Yilmaz and Ozer, 2005). These are emitted by the motors and exhaust system of automobiles, smaller trucks, buses, and motorcycles. Panadya, (2003) cited in social surveys that: this type of noise is the major source of nuisance and annoyance.

1.3 Aircraft Noise: -

According to Omubo-Pepple et al., (2010), rail and aircraft noise are acoustically characterized by high noise levels of relative short duration. Increasing noise of airport and motorway traffic in the city centres have become a part of modern life (Passchier-Vermeer, 1996). Now-a-days, the problem of low flying military aircraft has added a new dimension to community annoyance. The only succour to these is the submission of Omubo-Pepple et al, which identified noise pollution of aircraft as of short duration. It has to be noted also that airport in many cities in Nigeria is far from the city centre; therefore the dose per person living in the city is negligible. However, noise is a problem for residents of villages near the airport (Yilmaz and Ozer, 2005)

1.4 Noise from railroads: -

The noise from locomotive engines, horns and whistles, and switching and shunting operation in rail yards can impact neighboring communities and railroad workers. For example, rail car retarders can produce a high frequency, high level screech that can reach peak levels of 120 dB at a distance of 100 feet (30.48m), which translates to levels as high as 138, or 140 dB at the railroad worker's ear. As cited for Erzurum city in Turkey, noise from the railway is especially dominant in the area near the railway, where noise level was over 90 dB (A) (Yilmaz and Ozer, 2005).

1.5 Construction Noise: -

The noise from the construction of highways, city streets and buildings is a major contributor to the urban scene. However, use of manpower rather than mechanical power means that the noise of construction is less of a problem. Construction noise sources include pneumatic hammers, air compressors, bulldozers, loaders,

dump trucks (and their back-up signals), Quarries, mining explosives and pavement breakers.

1.6 Noise in Industry: -

Although industrial noise is one of the less prevalent community noise problems, neighbours of noisy manufacturing plants can be disturbed by sources such as fans, motors, and compressors mounted on the outside of buildings Interior noise can also be transmitted to the community through open windows and doors, and even through building walls.

1.7 Noise in building: -

Apartment dwellers are often annoyed by noise in their homes, especially when the building is not well designed and constructed. In this case, internal building noise from plumbing, boilers, generators, air conditioners, and fans, can be audible and annoying. Improperly insulated walls and ceilings can reveal the sound of-amplified music, voices, footfalls and noisy activities from neighboring units. External noise from emergency vehicles, traffic, refuse collection, and other city noises can be a problem for urban residents, especially when windows are open or insufficiently glazed.

1.8 Noise from Consumer products: -

Certain household equipment, such as vacuum cleaners and some kitchen appliances have been and continue to be noisemakers, although their contribution to the daily noise dose is usually not very large.

A consumer product, which may eventually break the long apathy of the public to noise pollution, is the headphones, which are also called headsets. It is highly probable to see someone with a headset wire drooping down from his or her ear in nearly all environment one finds him or herself. It is often discovered that the person is hearing a sound with heavy percussion turned to maximum volume. Many a times the individual is unconscious of the events around him. (Adeniji, 2011)

Earphones are placed in the outer part of the ear normally in circumstances where solitude is required by an individual to either prevent interference by other sounds or prevent him from disturbing others. However, they cannot be said to have the capacity to entirely muffle external sounds, as a result, the user increases the volume thereby raising the risk of hearing loss. Headphones are often connected to devices such as cell phones, computers and radio sets as well as media players. A recent survey by Australia's National Acoustic Laboratories revealed that about 25 percent of people addicted to portable music players experienced daily noise level capable of causing hearing damage.

1.9 Loudspeaker: -

The indiscriminate use of loudspeakers in the urban centres calls for caution. This is because the noise emitted by these electronic devices are usually of high intensity which could seriously and adversely impact on the health of the hearers. Citing (Oyedepo and Saadu, 2008, Abolarin, 2012), the use of loudspeaker is common at transporters' loading points, where they are used to call prospective passengers. Survey also revealed that marketers of some household products such as local/traditional herbs use public address system (PAS) as mode of advertising their market not minding the loudness of the speaker. "In fact the louder it is the happier they are".

Churches, Mosques and prayer grounds are increasingly noisy in Nigeria with public address systems. In a survey conducted in Port Harcourt, (Omubo-Pepple et al, 2010) it was discovered that the use of loudspeaker which may be comfortably merged with religious activities ranked second to the use of generator as source of noise.

1.10 Electric Power Generating Sets: -

This is a major producer of community noise in our nation. At market places, neighbourhoods, etc dwellers are often annoyed by noise created by the next neighbour. Even at social gatherings and official events, the use of these appliances as stand-by source of power infuriates participants. It is amazing that this major source of noise in Nigeria is never mentioned in many literatures from Asian and European countries. In a study conducted by Omubo-Pepple et al, in 2010; sources of noise were verified from residents of Port Harcourt in Rivers State Nigeria. Eighty Five percent of respondents agreed that generator supplies the highest noise to the environment.

This survey has clearly shown that noise from generators affects residents of urban cities in Nigeria more than any other form of noise. This finding also corroborates the view of Anomohanran et al, 2008; in the investigation of environmental noise pollution level of Abraka, Delta State Nigeria. The researchers observed that noise level in the town was non-conducive at night owing to the use of power generating set.

1.11 Internal Combustion Engines (ICE)

A group of noise generator that is appropriate under this heading is comprised of domestic food milling machines, chainsaw and the lawn mower. This group is powered by diesel or gasoline powered internal combustion engines (ICE) which at times generate more noise than the common generating set. In fact, the effect of these other engines could be more hazardous because the users are very close to the source, while the generating set is commonly placed some metres away from users.

2.0 Materials and methods

The study focuses on the results obtained from outdoor and indoor sound level measurements carried out between August 2011 and May 2012 at 10 different locations in Ilorin, Kwara State and Akure, Ondo State of Nigeria. Table 1 shows the Selected Noise Sources for the measurements while Table 2 shows the raw data obtained.

2.1 Procedure for Noise Measurement

The digital noise level metre was used to measure noise level emitted by the selected noise producers. The noise level meter is an integrated A-weighted measuring instrument with internationally standardized networks. It is a lightweight hand-held instrument, the type ANSI S1.4; pointed to the direction of the major source of noise in each location and being very sensitive equipment it gave the accurate readings, which were recorded from the meter screen (liquid crystal display, LCD in 4-digit and 0.1dB resolution). It has an accuracy of $\pm$ 2.0dB (under reference conditions). The noise level was recorded at a regular interval of thirty (30) seconds for a period of thirty (30) minutes; with a total of sixty (60) readings at each location.

2.2 The Digital Sound Level Meter:

The noise level metre has a dynamic characteristics setting facility that allows measurement for slow/fast responses and maximum hold. It belongs to the very large group of sound level metres meeting the *Precision* requirements of IEC 651. It is supplied with $1/2$ inch electric condenser microphone and $1/3$ -octave filter for which a windshield could be used. This gives the metre a display dynamism enabling it to measure very large measuring range and especially for a widely fluctuating noise. The digital display eliminates the uncertainties of visual averaging and provides a repeatable value when measuring fluctuating noise levels. It displays with 0.1dB steps on a 4-digit LCD.

Proper care was taken against reflected sound waves from the operators' body when using the sound level meter. This was achieved by ensuring that the microphone is adequately pointed away from the user.

Table 2 shows the data obtained from the readings including the Equivalent sound level, L_{Aeq} The maximum and minimum values. Where L_{Aeq} is the A-weighted equivalent noise pressure level which is the A-weighted energy mean of the noise level averaged over the measurement period as defined by Hassall, et al1979.

The 10 randomly selected points were picked as measurement points with reference to the following guides.

Table 1: Selected Noise Sources

Location	Noise Sources	Location
1.	Generator	0 metre
2.		6 metres
3.		20 metres
4.	Mower	0 metre
5.	Food Milling	0 metre
6.		2 metres
7.	Ramadan Lecture	
8.	Crusade Ground	
9.	Celebrating Indoor	
10	Student Union Building	

Table 2: Raw data obtained from 10 selected locations

GENERATOR			MOWER	FOOD MILLING		WORSHIP			
0m	6m	20m	0m	0m	2m	CRUSADE	RMDN LECT	CELEBRATING	SUB
92.2	70	60	100	94.8	77.9	78.8	59.9	80.3	62
91.9	71.3	67	96	94.6	87.7	68.7	60.5	80.1	72
92	70.6	61.5	95	94.7	78	81	60.4	65.5	69.9
91.9	70.6	59.7	97	94.9	78.2	72.3	85.2	70.8	67
92.2	70.9	60.2	102	94.1	78.3	82.6	87	84.4	69.6
91.8	70.8	60.4	99	94.5	78.8	92.2	61.4	78.6	75.3
92	71.1	61.4	90	95	78.4	88.4	60	82.1	62.1
93.3	71	60	99.8	95.2	78.5	91.5	59.3	70	73.2
92.3	70.2	59.3	98.3	95.3	78.9	95.4	59.9	86.6	65.6
92.6	71.3	59.9	99.1	94.4	79	63.9	61.1	89	68
92.2	71.6	61.1	103.2	94.1	77.9	73.7	60	79.1	63
92	71.1	60	97	94	78.1	75.4	57.9	84.5	76.6
92.2	70.1	57.9	100	95.6	78.5	82.1	51.7	84	70.5
91.7	71	60.5	96.7	96.2	78.6	85.6	48.9	82.2	77.5
92	70.8	59	98.1	96.3	78.7	83	59.9	83.2	69.8
92.5	70.6	62.3	99.2	96.2	79	77.3	59	81	71.8
91.8	73	65	97	96	79.2	70.7	60.5	61	62
92.1	75	51.7	100.2	96.4	79.1	62	59	62.3	59
92.3	75.7	64.8	103	98.5	79.3	84.4	62.3	69.7	61.5
91.8	74.4	59.9	99.1	99.2	79.3	75.6	65	61.3	66.7
91.7	75.3	59	98.8	99	79	71.4	51.7	70.7	60.4
91.9	75.2	62.1	95.5	100.8	79.2	85.8	64.8	61.4	73
93.1	74.9	60.2	99	100.9	79.1	83.5	50.6	63	68.5
93.2	76	59.6	97.7	100.3	78.1	79.3	59	73.9	72.1
92.5	75.1	63	97.1	100.5	78.2	86.6	62.1	78.9	69.9

GENERATOR			MOWER	FOOD MILLING		WORSHIP			
0m	6m	20m	0m	0m	2m	CRUSADE	RMDN LECT	CELEBRATING	SUB
93	74.7	62.5	97.9	101	78.3	74.6	60.2	71.1	60.8
93.3	75.9	59.6	100.3	97	78	82.1	59.6	70.2	61
92.9	74.4	73.2	98	96	78.8	80	63	78.2	59.7
93	74.8	67	110	82	78.4	81.2	62.5	79	81.9
93.1	75.1	59.4	99.4	85.3	79.5	78.8	59.6	66.6	61.6
93.6	76	60.4	99.7	84.4	90.2	78.2	73.2	77	58.4
93.9	75.9	58.7	96.1	84.3	79.1	73.8	67	67.5	60.5
92.6	76.3	62.1	97.8	86.2	78.6	66.4	59.4	79.9	61.4
92.7	74.2	78.8	90.9	84.9	78.8	84.9	60.4	85.9	62.4
93.9	74.7	74.9	96.6	90	78.9	66.1	98.6	74.4	65.1
91	75.1	60	99.7	99.4	78.6	69.7	62.1	78.8	71
93	75.2	61.1	98.1	99.7	78.7	84.3	78.8	64	57
92.9	76.1	66.9	95.3	96.1	78.1	83	74.9	72.2	62
92.8	75.8	59.6	104.6	97.8	78.4	77.2	60	81	76.3
93.1	74.7	60.3	101.8	90.9	78	92.9	61.1	66.8	59
94	75.2	61.2	95.9	96.6	78.3	95.7	66.9	80.2	60.2
93	74.8	60	100.5	99.7	89.7	83.6	59.6	80.8	63.9
92.9	75.4	60.7	98.8	98.1	87.8	96	60.3	73	66.6
92.6	76.5	59.6	99.9	86.3	87.9	95.9	61.2	79.5	65.8
93.1	74.1	60.2	92.6	86.6	87.6	88	60	81.1	68.5
93.4	74.2	59.7	94	86.2	87.2	78.2	60.7	77.7	75.5
94.3	75	63.7	98.6	86	89.4	77.7	59.6	85.9	66.5
92.7	74.3	61.5	97.9	87.1	89.1	92.5	60.2	79.4	60.5
92.3	73.8	71	96.5	86.1	89.6	94	59.7	72.2	88.1
92.8	77.3	59.4	106.6	87.3	89.9	76.8	63.7	76.1	70.9
92.9	75.9	66	101.1	87.5	89.8	75.9	61.5	80.3	70.5
92.7	77.2	59.7	95	98.8	89.1	85.6	71	79.6	75
93	77.8	61	98.1	99	77.9	80.1	59.4	86	76.3
93.3	74.3	61.1	97	90	79.2	79.9	66	81.9	74.4
92.8	75.5	60.1	99.1	99.8	78.6	88.4	59.7	82.2	60.1
92.6	76.8	60.4	98	98.3	78.7	80.1	61	81.7	61.8
93.1	74.8	59.8	95.6	99.1	78.1	79.6	61.1	80	60.9
92.9	75	60	97.3	89.7	78.6	91.4	60.1	70.3	60.2
93.3	74.9	59.7	97.1	89.1	78.4	79.8	60.4	78.8	65.7
93	75	60.6	109.1	90.2	78.8	79	59.8	80	88
Av92.68	74.07	61.76	98.55	93.80	80.82	81.04	62.66	76.38	67.41
Mx94.30	77.80	78.80	110.00	101.00	90.20	96.00	98.60	89.00	88.10
Mn 91.00	70.00	51.70	90.00	82.00	77.90	62.00	48.90	61.00	57.00

3. Results and discussion

Table 2 shows that the maximum and the minimum noise level recorded are 110.00dB (A) and 48.90dB (A) respectively. The highest was recorded while standing by a lawn mower and the lower from a worship centre. The result of this study shows that the equivalent noise levels (L_{Aeq}) of the ten locations surveyed are not within acceptable standard. 50% falls in the normally unacceptable range and the other 50% are in the clearly unacceptable range.

The World Health Organization (WHO) recommends a noise level limit of about 55dB (A) as a general health goal for outdoor noise in residential areas, (Oyedepo et al, 2008 & 2011). This is usually considered as a comfortable environment with little or no annoyance so that no negative physical and mental influence will be caused to essential activities such as working leisure and sleeping (Dai et al, 2005; Dhananjay & Prashant, 2005). It is observed that the values recorded in this study are generally of high noise level higher than the recommended values by the WHO.

3.1 Signal Analysis: Figure 1 shows the typical noise graph with the noise level plotted against the frequency of measurement. The figure is a true reflection of the non-sinusoidal nature of noise waves, which is a subset of sound. This also shows the accuracy of the data in its own right. This graph was plotted with the Microsoft Excel software. The root and the peak of the wave is 62(dB) and 96(dB)A respectively.

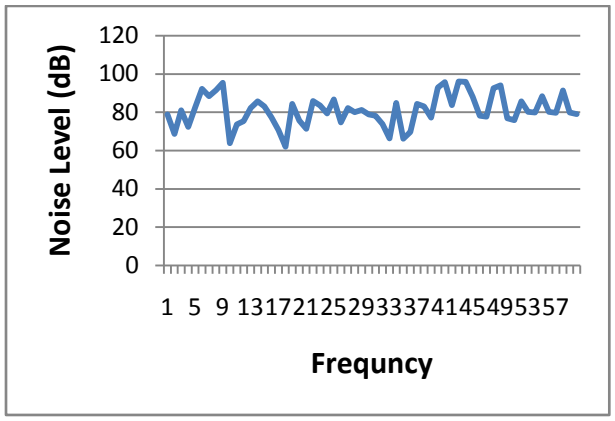

Fig 1: Typical Noise Graph (Measurement at a crusade ground)

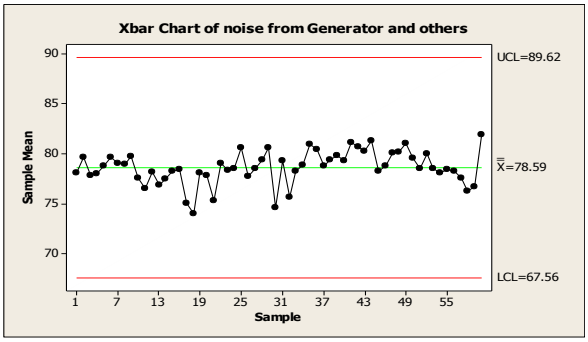

Figure 2: Control Charts for Variables (Noise sources)

The analysis of the data by the Control Chart figure 2, obtained through the SPSS software revealed that the noise emitted by the different sources have a generally high noise level. These noise level from the isolated sources is so high and therefore should be treated as occupational noise which requires greater attention. This actually corroborates the unacceptability of the equivalent noise levels.

4.0 Conclusion

This study has clearly shown the various sources of noise and has been able to establish that some sources pose more threat to citizenry than others do. It is therefore imperative for engineers and the public to work towards abating noise from internal combustion engines (ICE) as there is no visible end to their use in Nigeria with unreliable state of the national power supply. Efforts should also be geared towards utilizing other noiseless sources of power such as solar. Working in this direction will enhance the design of clean products thereby and ultimately a clean technology for a clean environment.

References

Abolarin, T. S. (2012): Monitoring of Noise Pollution in Ilorin Metropolis, Proceedings of the 1st Joint National Conference, Kwara State Polytechnic Ilorin, Nigeria. Vol.1, 2012 pp 124-132.

Adeniji, Gbenga, (2011): 'Feature: Headphones can cause hearing loss, columnist in the Punch Newspaper, 01/09/11

Ali, S. A., Tamura, A (2003): Road traffic noise levels, restrictions and annoyance in greater Cario, Egypt. Appl. Acoustics. 64(8): 815-823.

Anomohanran, O., Iwegbue, C. M. A., Oghenerhoro, O., and Egbai, J. C. (2008): 'Investigation of Environmental Noise Pollution Level of Abraka in Delta State Nigeria, Trends in Applied Sciences Research 3(4), 292-297.

Dai .L, Cao.J, Fan.L and Mobed .N, (2005) "Traffic Noise Evaluation and Analysis in Residential Areas of Regina", *J. of Environmental Informatics* 5(1), 17–25.

Dhananjay, K. P. and Prashant, B. N (2007) "Assessment and ANN Modeling of Noise Levels at Major Road Intersections in an Indian Intermediate City", *J. of Research in Science, Computing, and Engineering* 4(3), 39–49.

Dunmoye, S (2011): Department of Oto-Rhino-Laryngology, University of Ilorin Teaching Hospital (UITH), Ilorin, Nigeria. Oral Communication

Evans, G. W. and Hygge, S. (2000): Noise and performance in children and adults. In D. Prasher (Ed.), Handbook of noise and health

Hassall, J. R. & Zaveri K. (1979): Acoustic Noise Measurements, Bruel & Kjaer Publications, N/Erum, Denmark.

Jaiswal, P.S. and Nistha Jaiswal (2003): Environmental Law, Second Ed., p.327.

Laurent, H. H. Rinehart, I and Winston, R.(1977): Environmental Pollution 2nd Ed. Iowa State University, Library of Congress Cataloguing Publication Data. pp.147-160

Marius A, Tijunelis, M. D., Fitzsullivan, B. A., Sean, O. & Henderson, M.D.(2005): Noise in the ED. Am. J. Emerg. Med. 23(3): 332-335.

Morillas, B. J. M., Escobar GV, Vaquero JM, Sierra MJA, Gómez VR (2005): Measurement of Noise Pollution in Badajoz City, Spain. Acta Acustica United with Acustica; 91(4): 797-809.

Omubo-Pepple, V. B., Briggs-Kamara, M. A. and Tamunobereton-ari, I. (2010): 'Noise Pollution in Port Harcourt Metropolis: Sources, Effects and Control, the Pacific Journal of Science and Technology, Vol. 11, No. 2, pp. 592-600.

Oyedepo, O S., & Saadu, A. A. (2008): Changing Noise Climate of Ilorin Metropolis. Environmental Engineering Science, 25(6), 797-808.

Oyedepo, O S., & Saadu, A. A. (2011): Noise Map: Tool For Abating Noise Pollution in Urban Areas, Proceedings of the National Engineering Conference of the Nigerian Society of Engineers.

Ozer, S., Yilmaz, H., Yesil, M. and Yesil, P. (2009): 'Evaluation of noise pollution caused by vehicles in the city of Tokat, Turkey', Scientific Research and Essay, Vol. 4, No. 11, pp. 1205-1212.

Panadya, G. H.: (2003): 'Assessment of traffic noise and its impact on the community, International Journal of Environmental Studies 60(6), 595–602.

Parivesh (1996): News-Letter: Central Pollution Control Board, New-Delhi, India.

Passchier-Vermeer W, Passchier WF (2000): Noise exposure and public health. Environ.Health Perspect. Suppl. 108 (1): 123-131.

Saadu, A.A. (1987): Community and Occupational Noise Survey and Analyses of some selected Nigerian Cities and Industries. Ph.D Thesis, University of Benin, Benin-City, Nigeria.

Yilmaz, H. and Ozer, S. (2005): 'Evaluation and Analysis of Environmental Noise Pollution in the City of Erzurum, Turkey', Int. J. Environment and Pollution, Vol. 23, No. 4, pp. 438-448

Zannin, P. H. T., Calixto, A., Diniz, F. and Ferreira, J.A. (2002): 'A Survey of Urban Noise Annoyance in a Large Brazilian City: The Importance of Subjective Analysis in Conjunction with an Objective Analysis', Environmental Impact Assessment Review 22.