Journal of Multidisciplinary Engineering Science and Technology (JMEST)
ISSN: 3159-0040
Vol. 3 Issue 2, February - 2016

Study of Noise Levels in Small Businesses In Petroleum Training Institute Effurun Delta State, Nigeria

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Abstract*— In developing countries, steady electrical energy supply continues to delude the citizenry, the most widely used alternative to that electrical energy from national grid are portable generators. The benefits of using these portable generators are accompanied by release of toxic gases and loud steady unpleasant sound called noise. The small businesses in Petroleum Training Institute are; computer typesetting for students' projects, photocopying, binding of students final projects, internet cafes and stationary stores. For these businesses to function effectively, they must have uninterrupted power supply. The aim of this research was to determine the noise exposure levels and its implication to the health of about 79 workers in the environment. A sound level meter Model Extech 4077336 Type 2, IEC 651, Accuracy: ± 1.5 dB was used in the measurement of sound at different sites (Sites A, B, C, D and E), three times a day (morning 7 am – 8 am, afternoon 12 – 1 pm, evenings 5 – 6 pm). The noise level measured indicated relatively lower values in the morning ranging from 55.78 dBA in Site E to 66.10 dBA in Site C; these could be as a result of low activities in some shops and late arrival of some shop owners. The highest noise level was measured in the afternoon at Site A (87.78 dBA), while the lowest afternoon noise level was recorded at Site C (81.88 dBA). The highest noise level measured in the evening was recorded at Site E (83.26 dBA), while the lowest was at Site C (80.94 dBA). The highest percentage dose of 42.52% was recorded at Site E, whereas the lowest dose was 23.10% at Site C. The respective doses were used in getting the corresponding values of TWA_8 ranging from 79.30 dBA to 83.80 dBA. The workers and owners of the shops are exposed to average dose of 35.84% equivalent of 82.38 dBA for 9 hours every day Monday to Friday. The noise exposure values of the entire study area revealed an average of 82.34 dBA which exceeded the lower exposure action value in the Republic of Ireland (80 dBA). The noise level exposures as a result of using portable electricity generators by about 54 shops owners concurrently were high, health issues as hearing impairment may be possible. A detailed risk assessment must be completed for the entire Business environment. The immediate connection of the Business shops to the Institute's mains power supply is highly recommended.

Keywords—Noise, Nigeria, Portable Generators

I. INTRODUCTION

In developing countries, steady electrical energy supply continues to delude the citizenry, the most widely used alternative to that electrical energy from national grid are portable generators. The generators have different power output ratings depending on the intended load and affordability. Consequently, small business holders have to resort to those generators in order to break even in their respective businesses. The benefits of using these portable generators are accompanied by release of toxic gases and loud steady unpleasant sound called noise.

The small businesses in Petroleum Training Institute are; computer typesetting for students' projects, photocopying, binding of students final projects, internet cafes and stationary stores. For these businesses to function effectively, they must have uninterrupted power supply. Noise is a prominent feature of the environment including noise from transport, industry and neighbors. An important part of noise assessment is the actual measurement of the noise levels [1].

Noise from the environment, occupational or residential setting is recognized as a stressor agent with sufficient evidence for impacts on hearing impairment, hypertension and ischemic heart disease, annoyance, sleep disturbance, decreased school performance cardiovascular effects and sleep disturbance. For other effects such as changes in the

immune system and birth defects, the evidence is limited. Besides hearing problems, the non-auditory health impacts of noise exposure, including annoyance, sleep disturbance, heart disease and cognitive impairment, are all causing increasing concern. Cardiovascular disease, which includes high blood pressure, heart disease and stroke, has been clearly linked with long-term exposure to environmental noise [2]. When individuals are exposed to intense noise levels some or all of the hair cells in the organ of corti may be damaged temporarily or permanently. Exposure to excessive noise for a short period of time may produce a loss of heavy sensitivity. Temporary damage means that our hearing threshold level has shifted temporarily due to the noise exposure [3]. High noise exposure during critical periods in gestation is a potential stressor that may result in increased risk of implantation failure, dysregulation of placentation or decrease of uterine blood flow [4]. So long as noise is recognized as a hazard, initiatives are required to increase use of effective preventative measures [5]. [6] investigated occupational noise in a textile plants in northern India, in which the study demonstrated the presence of gross occupational noise exposure in both the plants and he believes that occupation noise exposure and the related effects in India is a widespread problem. Noise at levels that do not damage hearing can have other adverse health effects. This can arise when noise chronically interferes with concentration and communication. Persistent noise stress can increase the risk of fatigue and cardiovascular disorders including high blood pressure and heart disease. Although safe levels to guard against these effects have not yet been fully determined, as a guide, the risk of adverse health effects can be minimized by keeping noise levels below: 50 dB(A) where work is being carried out that requires high concentration or effortless conversation. And 70 dB (A) where more routine work is being carried out that requires speed or attentiveness or where it is important to carry on conversations. These levels include the noise from other work being carried out within the workplace. To work safely, workers must be able to hear warning signals above any other noise (ambient noise) at the workplace [7]. Due the fact that the small business environment of Petroleum Training Institute was not connected to the Institute's mains as at the time of conducting this research, all the shops used portable generators as the only source of electricity supply. There were total of 54 shops and 79 workers as at the time of this research, hence one can imagine the amount of noise generated if only about 50% of the shops will concurrently run on generators for hours in order to deliver jobs that may be given to them by students at the peak of rush hour (graduation). The workers or owners of these businesses are subjected to noise being generated by those generating sets running concurrently for several hours daily.

The aim of this research was to determine the noise exposure levels and its implication to the health of about 79 workers in the environment.

II. THEORY

The TWA shows a worker's daily exposure to occupational noise (normalized to an 8 hour day), taking into account the average levels of noise and the time spent in each area. This is the parameter that is used by the OSHA Regulations.

The representative personal noise dose exposure (%) was calculated for each site (location of measurements) using the noise dose equation;

$$Noise\ Dose\ D(\%) = \left(\frac{C_1}{T_1} + \frac{C_2}{T_2} + \cdots \ldots + \frac{C_n}{T_n}\right) - - - (Equation - 1A)$$

For n = 1, the Equation 1A becomes;

$$Noise\ Dose\ D(\%) = 100\frac{C}{T} - - - (Equation - 1B)$$

Where C the total length of the work-day in hours (8 h), T is the reference duration corresponding to the measured A-weighted sound level, L (dBA). T could

be read off a standard table or calculated using the formula [8].

The moment D (%) is calculated the TWA_8 can be calculated;

$$TWA = 16.61Log_{10}\left(\frac{D}{100}\right) + 90 - - - -(Equation - 2)$$

Where,

TWA_8 is the 8hour Time Weighted Average Sound Level D is the Dose % as calculated above (or measured with a dosimeter) and Log10 is the Logarithm to base 10. TWA_8 can simply be looked up in table 3.

III. Materials and Methodology

A sound level meter Model Extech 4077336 Type 2, IEC 651, Accuracy: ± 1.5 dB was used in the measurement of sound at different sites around the shops with functional generators. The sound level meter was calibrated before taking the measurement as stated in the user manual. The meter was adjusted to A-weighting so as to determine the noise level.

The noise measurements were taken in five different sites in the business environment labeled (Sites A, B, C, D and E), three times a day (morning 7 am – 8 am, afternoon 12 – 1 pm, evenings 5 – 6 pm). The measurements were obtained at interval of one minute at distances of about 2 m and 4 m from the noise sources (portable power generating sets) for the period of 30 days in order to estimate the noise dose each worker was exposed to. The distances chosen were as a result of considering the position of a typical worker distance of about 2 m to 4 m from the sources (generating sets). The working hours of each worker ranges from 9 to about 11 hours daily depending on the frequency of jobs received.

IV. Results and Discussion

The measured noise levels at five different Sites within the business environment are presented in table 1 below. The corresponding dose was calculated using (equation 1B) and the values for the dose were used to look up the equivalent Time-weighted Average in the TABLE III.

The noise level measured indicated relatively lower values in the morning ranging from 55.78 dBA in Site E to 66.10 dBA in Site C; these could be as a result of low activities in some shops and late arrival of some shop owners. Fewer generators were on as at that time. The highest noise level was measured in the afternoon at Site A (87.78 dBA), while the lowest afternoon noise level was recorded at Site C (81.88 dBA). The highest noise level measured in the evening was recorded at Site E (83.26 dBA), while the lowest was at Site C (80.94 dBA). The dose was computed for the three sessions (Morning, Afternoon and Evening) averaged over 9 hours working duration using equation 1A. The highest percentage dose of 42.52% was recorded at Site E, whereas the lowest dose was 23.10% at Site C.

TABLE I. : Noise Levels measured (Averaged over 30 Days), calculated daily dose and Equivalent TWA_8

SITES	Morning (dBA)	Afternoon (dBA)	Evening (dBA)	Dose (%)	TWA_8 (dBA)	Daily Duration (hours)
A	56.24	85.67	82.80	35.80	82.52	9
B	56.15	87.61	81.54	40.65	83.50	9
C	68.10	81.88	80.94	23.10	79.30	9
D	56.32	87.43	82.25	37.14	82.80	9
E	55.87	87.78	83.26	42.52	83.80	9

TABLEII: SUMMARY OF THE RANGES OF NOISE LEVELS MEASURED (AVERAGED OVER 30 DAYS), AND EQUIVALENT TWA_8 FOR THE ENTIRE STUDY AREA

Morning (dBA)	Afternoon (dBA)	Evening (dBA)	Dose (%)	TWA_8 (dBA)
56.24 - 68.10	81.88 - 87.78	80.94 - 83.26	23.10 - 42.52	79.30 - 83.80

TABLE III: DOSE TO EQUIVALENT TWA_8 FOR GIVEN DOSE

Dose	TWA_8
10	<=70
20	78.4
30	81.3
40	83.4
50	85.0
60	86.3
70	87.4
80	88.4
90	89.2
100	90.0
110	90.7
120	91.3
130	91.9
140	92.4
150	92.9
160	93.4
170	93.8
180	94.2
190	94.6
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2
320	98.4
330	98.6
340	98.8

Dose	TWA_8
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8
520	101.9
530	102.0
540	102.2
550	102.3
560	102.4
570	102.6
580	102.7
590	102.8
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8

Dose	TWA_8
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
1000	106.6

Source: Table HT- 2 [9]

TABLE IV: IRELAND'S NOISE EXPOSURE VALUES (BASED ON AN 8HR WORKING DAY) (WWW.SMESAFETY.IE)

	Exposure values (dBA)	Action Required
Lower exposure action value	80	If this level of exposure is reached or exceeded, a detailed noise risk assessment must be completed
Upper exposure action value	85	If this level is exceeded organization and or technical measures must be put in place
Exposure limit value	87	This noise level must not be exceeded. Immediate action must be taken to reduce noise levels

Source: [10]

TABLE V: NOISE LEVEL GUIDELINES [11]

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime 07:00 – 22:00	Nighttime 22:00 – 07:00
Residential, industrial, educational[55]	55	45
Industrial, commercial	70	70

The respective Doses were used to look up the corresponding values of TWA_8 (table 3) ranging from 79.30 dBA to 83.80 dBA (it can also be calculated using equation 2). The workers and owners of shops in this small business environment are exposed to average dose of 35.84% equivalent of 82.38 dBA for 9 hours every day Monday to Friday, 45 hours for five days, 270 hours for 30 days during peak period of commercial activities towards the last quarter of every year.

The noise exposure levels of the entire study area as summarized in table 2, revealed an average of 82.34 dBA and when compared with the values in table 4 it exceeded the lower exposure action value in the Republic of Ireland (80 dBA), hence, a detailed risk assessment must be completed for the entire Business environment. Guideline values for community noise in specific environments for Industrial, commercial shopping and traffic areas, indoors and outdoors may result in critical health effect (Hearing impairment) for an exposure of 70dBA and 24hour time duration [12]. Comparing this exposure levels to the ones obtained in this study, it can be deduced that hearing impairment is possible as a result of 82.34 dBA exposure for 45 hours per week at 35.84% dose. The general guidelines for noise level according to [12], noise impact should not exceed the levels presented in table 5 or result in a maximum increase in background levels of 3 dB at the nearest receptor location offsite. The results obtained in this research were compared with these guidelines, it could be deduced that all the noise levels of TWA_8 (TABLE II) are higher than the IFC –EHS guidelines (TABLE V) for industrial and commercial environments. At this point the option of relocating and shielding the Noise source are recommended as control measures.

V. CONCLUSION

The noise level exposures as a result of using portable electricity generators by about 54 shops owners concurrently were high considering the distance from the source each worker stands or sits and work for about 9 hours a day, 5 days in a week, health issues as hearing impairment may be possible.

The noise exposure levels of the entire study area revealed average of 82.34 dBA, which exceeded the lower exposure action value in the Republic of Ireland (80 dBA), hence, a detailed risk assessment must be completed for the entire Business environment. Guideline values for community noise in specific environments for Industrial, commercial shopping and traffic areas, indoors and outdoors which may result in critical health effect (Hearing impairment) for an exposure of 70 dBA and 24 hour time duration (WHO, 1999). It also exceeded the general guidelines for noise level according to International Finance Corporation – World Bank Group, (2007). One central location at a particular distance away from the shops for all the generators, shielding them and using earmuffs could serve as control measures.

The immediate connection of the Business shops to the Institute's mains power supply is highly recommended.

ACKNOWLEDGMENT

Appreciations to Miss Ekanem Promise for her contributions during the data collection.

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