The International Journal Of Engineering And Science (IJES)
|| Volume || 3 || Issue || 3 || Pages || 45-50 || 2014 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

Analysis Of Industrial Noise In A Manufacturing Company

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----------ABSTRACT----------
Noise pollution has always been a prevalent case in industrial environment, yet there has never been a cohesive assertion on the actual effect of these noise exposures on factory workers. Many occupational studies have allied exposure to noise in working environment to a number of physiological and psychological responses like secretion of adrenaline and cortisol needed to adjust the body function. This research looks at noise pollution in sawmills as well as the significant changes as a result of the noise pollution.Sound level meter was used to determine the ambient noise levels in the sawmills. These measured noise levels were used to calculate workers exposure dosage. The results of the study established that noise pollution was prevalent in these sawmills, and has a significant effect on the blood pressure. However, these effects depends on some other uncaptured factors since individual noise appraisal and societal appreciation of the activities generating the noise have also a notable effect on whether the effect would be tending towards a decreae or increase. In conclusion, the noise exposure dosage of these factory workers exceeds the permissible exposure limit as prescribed by the occupational safety and health administration. In addition, prolonged exposure to high (fluctuating) noise levels may be a possible influence on the blood pressure changes.

KEY WORD: *noise pollution; permissible exposure limit; blood pressure.*

Date of Submission: 01 April 2014 Date of Acceptance: 15 March 2014

I. INTRODUCTION

The increase in population in Nigeria has necessitated the growth of industries to meet with the ever demand of the growing population. These technological progresses are aimed to gain velocity in production and decrease the physical work burden of men but now have some negative effects by increasing health problems while at the same time increasing production rate. However, with increased mechanisation there is an increase in environmental pollution like noise which is detrimental to the health of the operators which services are paid for by their employer. Exposures to noise levels found in sawmills are likely to be the most intense and sustained of any experienced in daily living. In the sawmill industry people are generally subjected to noise of a varying nature. High noise levels, particularly those of short duration such as impulse or impact noise, are present in many Sawmill workshops and are capable of causing damage to health. Though noise pollution is a slow and subtle killer, yet very little efforts have been made to ameliorate the same. It is, along with other types of pollution has become a hazard to quality of life. Passchier-Vermeer (2000) reported noise exposue as a constituents of a health risk, by stating a sufficient scientific evidence that noise exposure can induce hearing impairement, hypertension, and ischemic heart disease, annoyance, sleep disturbance, and decrease school performance. But with a limited evidence on other effects such as changes in the immune system and birth defects. Noise is an unwanted sound; its intensity ('loudness') is measured in decibels (dB). The decibel scale is logarithmic, so a three decibel increase in the sound level represents a doubling of the noise intensity.

Types of Noise

Steady Noise: It is a noise with negligibly small fluctuations of sound pressure level within the period of observation.

Non-steady noise: is when sound pressure levels shift significantly during the period of observation. This type of noise can be divided into intermittent noise and fluctuating noise.

Fluctuating noise: is a noise for which the level changes continuously and to a great extent during the period of observation.

Intermittent noise: is noise for which the level drops to the level of the background noise several times during the period of observation.

Tonal Noise: may be either continuous or fluctuating and is characterized by one or two single frequencies. This type of noise is much more annoying.

Impulsive noise: consists of one or more bursts of sound energy, each of duration less than one second.

Effects of Noise

According to Passchier-Vermeer 2000 traffic noise, industrial noise, in addition to neighbour noise also affects environmental quality. Increasingly, people are exposed to noise during recreational activities such as pop concerts, motor races, and arcade activities; often these types of exposures are undergone consciously or at least taken for granted (Passchier-Vermeer 2000). Upham et al (2003) purported noise as a major cause to people feeling stressed and angry which may interfere with conversations and leisure activities in the home, disrupt activities requiring concentration, and discourage people from using outdoor spaces.

Other effects that make noise to be viewed as annoying are:

Occurrence of exposure – noise may be more annoying if it occurs often, even if each noise event is quieter.
Fear of accidents- concerns about air crashes may increase some people's sensitivity to aircraft noise.
Fear of the future- especially about future growth in air travel and potential increases in frequency of flights.
Lack of control – inability to alter or escape from the noise source may make it more annoying.

Noise effects on human health

Bronzaft (1996) suggested noise pollution as one of the major environmental problems, just like air and water pollution. In one of his subsequent articles Bronzaft (2002) titled "quieter school: an enriched learning environment", highlighted noise as not only being hazardous to our children's mental abilities but to their overall well-being. In effect, more people are complaining about the noise from traffic, automobiles, overhead airplanes and helicopters, leaf blowers, pneumatic drills, neighbors who play their televisions and stereo

1. Hearing impacts

Ringing or buzzing noises in head or ears
Temporary hearing loss
Permanent hearing loss
Difficulty of communicating with others

2. Physical impacts

Increase in heart rate and blood pressure
Headaches
Tiredness
Dulling of the senses
Digestion problems by reducing gastric activities

3. Psychological impacts

Loss of concentration
Increase in stress level
Irritability or "edginess"
Sleep disturbances

4. Work impacts

Distraction from task resulting in more errors
Decrease in work efficiency and productivity
Increased employee absenteeism

Psychological health effects

A number of temporary physiological changes occur in human body as a direct result of noise exposure. There is a rise in intra-cranial pressure, an increase in heart rate and an increase in sweating (Park and park 1993). Potential psychological effects associated with noise include interference with speech communication, sleep disturbance, learning effects, and work performance effects (Camp and McKnee, 2001)).

Noise induced hearing loss

It is generally accepted that the link between occupational noise and hearing loss is biological (i.e. there is a clear mechanistic pathway between the physical properties of noise and damage to hearing system).

There are two types of noise-induced hearing loss:

(I).Temporary hearing loss
(ii).Permanent hearing loss

Methodology

Study Group

A good number of sawmill workers aged between 20 - 70years who had spent a minimum of one (1) year in the industry and whose activities are within 10-12 metres away from the noise source(s) were selected as eligible study group after taking exclusion tests. A structured health and lifestyle questionnaire was used to elicit information from the workers. The information elicited from the questionnaire was used for the basis of selection of the eventual subjects. The subjects selected for control group were six volunteer students (male), aged 25-32 years and were exposed to high (fluctuating) noise level, and later exposed to experimental conditions, without production of noise. Procedure was explained to them and consent was taken. Some of the exclusion criteria Includes:

(a) History of high blood pressure.
(b) Smoking.
(c) Evidence of respiratory tract infection including common cold.

The rationale for the long exclusion criteria was to minimize the influence of the many confounding factors in the development of high blood pressure.

Study Area

This sawmill is located in Portharcourt, Rivers State, Nigeria and harbor a number of sawing workshops under a scanty wooden erected building that has strategically positioned wooden pillar support. This sawmill has a large number of workshops demarcated from each other by a wooden partition, with a poor facility layout. Surrounding these sawmill workshops are wood market shops and residential building. Logs of wood and sawed woods were parked in front of the workshops.

The following noisy equipments were identified during the noise measurement:

- Power generating sets: these power generating sets were on a concrete basement with bolts and nuts.
- Wood plaining, molding and sawing machines: These are heavy machines and were supported on a concrete basement with bolts and nuts.
- Circular sawing machines: some of the circular sawing machines are smaller in size, just like about 2m by 2m mainly for cutting planks into shapes and sizes, sawing and de-barking of logs; some of these machines are moveable with the aid of tyre wheels. All the machines are locally fabricated with different sizes of carbide teeth saw; some of these machines are powered by electricity while some are powered by the diesel power sets.
- Sharpening machines: used for sharpening saw blades and tool bits.
- Socket machines
- Band Saw machine: used for sawing and slicing woods in plain sheets.

Calculated permissible exposure limit (PEL), action limit (AL) time, and threshold limit values (TLVs) for a range of sound levels.

Table 1.

Noise level (dBA)	OSHA PEL (h)+	OSHA AL (h)+
87	32.00	16.00
88	10.50	5.25
89	9.20	4.60
90	8.00	4.00
91	7.00	3.50
92	6.10	3.05
93	5.30	2.65
94	4.50	2.25
95	4.00	2.00
96	3.50	1.75
97	3.00	1.50
98	2.60	1.30

Sample Size Selection
Choosing an appropriate sample size is crucial to having a study that will provide statistically significant results. Research needs to be cost effective, so it is best to use as small a sample as possible to reduce time and cost. However, using too small a sample will not attest statistical credibility. An appropriate sample size estimate was used by the researcher in this study. The following steps was taken in determining the appropriate sample size:

Step 1:
Determining the confidence interval- the confidence interval is how closely the results of the study need to mirror real life.

Step 2:
Decide what confidence level is needed (Z-Score) : A Z-score is the number of standard deviations away from the average the range includes. According to F.A.Oyawale 1999, the confidence coefficient equal to 0.95 would imply that $\alpha = .05$ and $Z_{.025} = 1.96$. for example a confidence level of 95 percent contains 3.92 standard deviations, 1.96 0n each side so 1.96 is the Z-score.

Step 3:

Predicting the proportion the study will generate.: since we do not know P, the researcher used a conservative estimate which of .5. this means that if we expect a significant effect on the group blood pressure of 50 percent of the unknown population (likewise expecting non-signicant effect on the blood pressure of 50 percent of the unknown population), we then have to use 50 percent for the proportion.

Description of Noise Sources and Surroundings
The sawmill where the noise measurements were taken are situated inside a wood market, and harbor a number of sawing workshops under a scanty wooden erected buildings that has a strategically positioned wooden pillar support. These workshops were demarcated from each other by wooden partitions, and the workshops were positioned opposite one another housing a number of noisy equipments that are poorly placed closed to each other. The workshops were surrounded by heavy logs of wood, haulage trucks and are situated few meters away from traffic roads and residential buildings.

Sound Level Meter Calibration
The accuracy of measurements taken with a sound level meter depends on the calibration accuracy. In other to obtain accurate readings, the height above mean sea level of the site locations was known, together with the calibration chart that came with the equipment manual so to adhere to allowable error limits of the equipment calibration.

Conclusions:
How noise affects people depends on a complex mix of factors like: the nature of the noise, including its volume, tone and predictability and also on the individual appreciation of the activities generating the noise.
Inferences drawn from the study has shown that:

1. Sawmill workers spend a minimum of eight hours a day in this noisy environment.
2. Noise levels measured in these sawmills exceed the permissible exposure limit.
3. The noisy equipments are poorly placed within sawmills facility.
4. The sawmill workers do not use ear protector gadget.
5. Workers raise's their voice very often when the machines are working in other to communicate with each other

Recommendations

In quite a few assessments, it has been established that productivity and efficiency can be affected by high noise level and fewer mistakes are made when noise levels are reduced, although this is by no means always the case. In sawmill environments; the prime cause of objections due to noise is always related to excessive sound levels within the industrial premises. A systematic approach should be used to tackle the problem of excessive noise levels in sawmills. In controlling the noise problems in the sawmill, note should be made of the three distinguished noise control techniques:

- Engineering controls
- Administrative controls
- Personal protective control.

These noise control techniques can be applied at any point along the sound transmission chain by considering the sound transfer chain systems which are classified into:

1. Source.
2. Transmission path.
3. Receiver.

One of the cardinal directives in planning for noise control in sawmills is to reduce the noise at its source. The source of any sound excitation will normally be identified as the point of origin of the noise which is believed to be objectionable. The problems of noise in sawmill environment usually concern a few people who are normally located within a short distance of the noise generating process. For these personnel a limited choice of procedures is available which would provide an improved acoustic environment. In minimizing noise at source in sawmills an appropriate engineering control techniques should be applied such as:

- Maintain and lubricate machines and equipment to eliminate rattles and squeaks.
- Replace loose and worn parts of machines.
- Acquire equipment with low noise levels; obtain noise data about machines and processes from their vendors.
- Mount vibrating machines on firm, solid foundations. Foundation bolts must be kept tight.
- Conduct regular maintenance, including water lubrication of machines and cutting blades, and resin build-up removal.
- Adjust circular saw parameters (e.g. bite depth, blade angle, blade speed) in relation to the timber being cut and the machinery used.
- Consider use of low noise saw blades, e.g. frame saws.

In addition to engineering control technique, an appropriate administrative control should also be administered wherever noise levels exceed the permissible exposure limit. The workers may be isolated from high noise level fields for periods longer than is advisable by US federal regulations, by rotating workers to maintain noise exposure dosage in an acceptable range and re-organizing work schedules to run within shifts. Feasibly, only engineering and administrative solution can well be implemented in sawmill environment. Personal protective equipment is a noise control technique at the receiver, this approach is only applied when all other remedies are insufficient to reduce the noise exposure to within the permissible exposure limit, Personal protective equipments include ear muffs, ear-canal caps and ear plugs are the most common but less dependable methods of noise reduction. The key problems with the use of personal protective equipments are:

- Workers may not use it because they would feel uncomfortable working with it.
- Difficulty in communicating during work.

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Fig 1.0 ***Industrial Machines that generates Noise in a Sawmill Factory***

Fig 2.0 ***Factory Machines with high Noise Level***