ASSESSMENT OF NOISE EMISSION LEVELS IN A SELECTED WOOD PROCESSING LABORATORY

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ABSTRACT

The study is designed to evaluate the noise levels of locally fabricated wood working machines in the Wood Processing Laboratory of the Department of Agricultural and Environmental Engineering, University of Ibadan, Nigeria. Maximum, minimum and average noise levels at the source were measured and recorded using a noise meter for a period of 10-20 minutes operation of each machine in the laboratory, and at sampled locations around the laboratory at distances of 5 – 30m at 5m interval during critical operating conditions of the machines. The results revealed that average noise levels from planing/thicknessing and grinding machines were above the generally advocated safe limit of 90dB(A). People engaging in different teaching and educational activities in buildings that are more than 10m away from the laboratory were not exposed even during critical operating conditions. It is recommended that noise preventive measures should be implemented in the laboratory before resorting to orientate the workers on the use of protective equipment as this is a precursor to improving quality of life of workers and to ensure environmental sustainability.

Keywords: Machines, Noise Levels, Operation, Wood Processing Laboratory.

INTRODUCTION

Noises are unpleasant and disturbing sounds conveyed to the ear by water or air through repetitive periodic oscillation of vibrating materials (Hayta, 2007). These "unwanted" sounds usually come out as by-products of many industrial processes and operations through the use of specific devices such as industrial machines, pumps, blowers, loudspeakers and generators (Sataloff and Sataloff, 1993). Determination of noise is achieved by measuring the intensity or pressure of sound waves as recorded in human ears in decibel, dB(A). A threshold of hearing of zero dB(A) is the initial (lowest) loudness level that humans can hear, while a 140 dB(A) intensity level, usually termed "pain" threshold is the sound pressure above which human ear cannot bear (Nelson, 1987; CCOHS (2018)). The harmful impacts of noise on human health may be physical or psychological; with the negative effects such as hearing loss, annoyance, deterioration of sleep quality, and stress-related various heart diseases (Anonymous, 1997; Morrell *et al.*, 1997). The effects of different noise levels on human health are given in Table 1.

Hasan (2012) reported that although individuals may experience noisy environments at different periods of life, industrial workers and those in the surrounding areas of various industrial institutions are the social group most affected by exposure to noise due to high intensity of sound created by machinery and equipment during usage.

In wood processing industries, noise exposure has been shown to be a well-known threat to human health, with related studies revealing that at least 50% of individual employees were exposed to a noise level greater than the universally allowable sound intensity limit of 85/90 dB(A) for an 8-hour time-weighted average period of exposure (Ntalos & Papadopoulos, 2005). High noise exposure levels beyond this decibel value, the period of exposure notwithstanding, will not only hinders effective communications between the workers during wood working operations, but also has a cumulative damaging effect on the hearing capacity of the employees, which may eventually lead to a temporary or permanent deafness of the workers.

Table 1: effects of different noise levels on human health

Noise Interval (dB(A))	Negative Effects on Humans
0-35	Harmless noise
36-65	Disturbing noise disrupting sleep and resting
66-85	Disturbing noise causing mental and hearing disorder
86-115	Noise causing mental, physical and psychosomatic disorders
116-130	Dangerous noise causing deafness and similar disorders
131-150	Hazardous noise requiring protection apparatus

Source: Polat and Kirikkaya, 2004.

In a study of nine small and medium scale wood industries in Valencia, Spain, by Garcia *et al.* (1997), it was gathered that one in five wood and furniture workers suffered "advanced acoustic trauma" hearing loss defect due to exposure to high noise level. The authors however reported also that the presence of huge quantities of raw materials and manufactured wood products produced an unintentional and significant sound absorption effect by reducing the reverberation time from about 2.3 seconds to 0.9 seconds decay time. However, most woodworking machinery creates high noise levels requiring that employers not only provide both preventive and protective control measures for their employee so as to lessen the harmful effects of these high sound intensity levels, but also establish and maintain effective hearing conservation programmes that will educate and orientate the employees on the need to frequently adhere strictly to rules and regulations of the wood processing industries in order to curtail all hearing-related problems (Hagan *et al.,* 2015; Anonymous, 2004).

Based on these findings, it is therefore essential that frequent measurements of noise levels in and around wood workshops should be carried out in order to evaluate its effects on workers on periodic basis. Thus, this study is aimed at evaluating and assessing the noise emission levels generated during operations of machinery in the Wood Processing Laboratory of the Department of Agricultural and Environmental Engineering, Faculty of Technology, University of Ibadan. Therefore significant health benefits can be achieved by integrating interventions that reduce noise pollution which is consistent with national sustainable goals.

Limitation of the study

The work is limited to the assessment of noise in a wood processing laboratory, particularly from locally fabricated wood working machines. The work included the measurements of noise levels at varying distances from the machines. Noises causes and mitigating factors were also considered.

MATERIALS AND METHOD

The study was conducted in the Wood Processing Laboratory of Agricultural and Environmental Engineering Department, University of Ibadan (Plate 1 & 2). The laboratory houses seven (7) locally fabricated machines: grinding machine, cross-cut machine, drilling machine, tenoning machine, bed sander, table circular saw, and planing/thicknessing machine used for primary and secondary wood conversions. It is surrounded by administrative buildings, classrooms, stores and implement sheds as shown in Figure 1. The study conducted involved monitoring the work environment to assess and characterise the extent of noise hazards using area sampling method.

Plate 1: the wood processing laboratory

Plate 2: the interior of the laboratory

An auto range sound level meter of high accuracy (Extech Instrument, RS232 Interface 407768; R.146041, made in Taiwan) was used to measure the noise level. The noise meter was placed on a stand at an angle of 45^0 and was programmed to measure noise at maximum and minimum levels for a 10-munite period of machine operation. In order to prevent sound reverberation, the meter was positioned 1.5m above the ground and away from the walls; and 1m away from the person taking measurement.

Measurement of noise levels were taken at the source during operation and at ten (10) different locations in each of the buildings, classrooms, stores and sheds (Figure 3) around the laboratory when each machine was solely and separately switched on and operated. Noise levels at distances of 1, 5, 10, 15, 20, 25 and 30 metres were also measured and recorded when some two or three machines were operated together to estimate the highest average values at critical conditions. The results were then analyzed descriptively and comparatively.

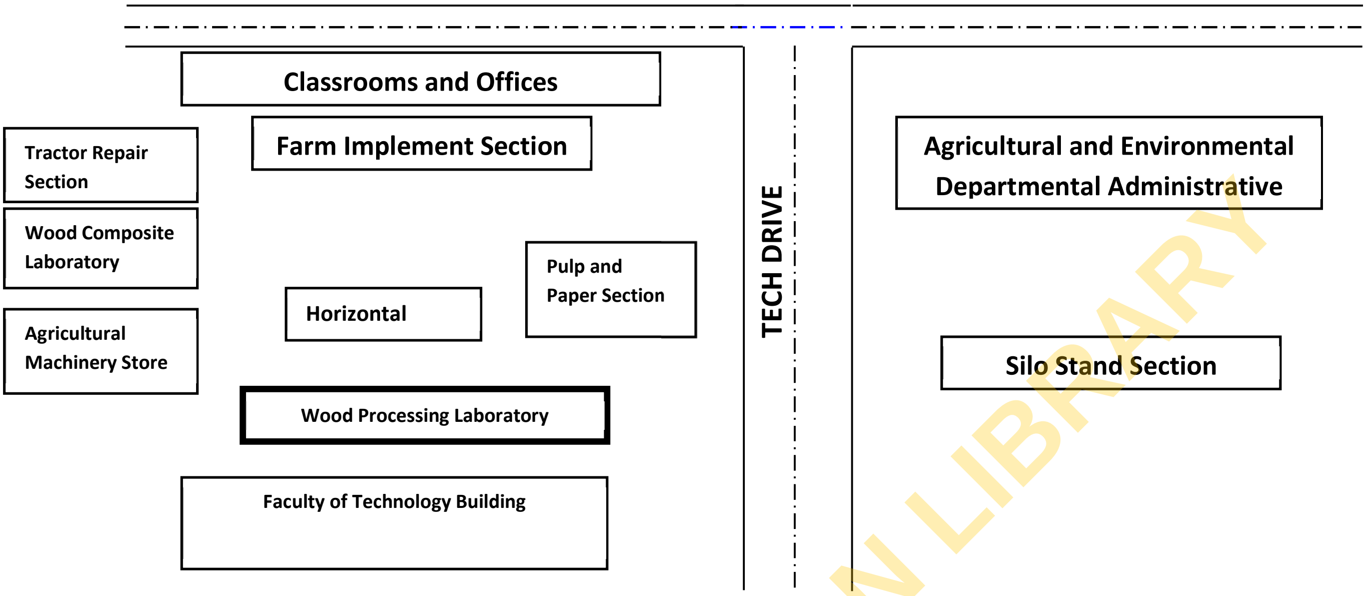

Figure 1: layout of each structure relative to the wood processing laboratory.

RESULTS AND DISCUSSION

Results of noise measurement of each wood-working machine during operations, and in relation to the distance from the laboratory as measured from locations generated using area sampling technique are shown in Tables 2 and 3.

Table 2: Sound Levels of Each Machine at the Source during Operation

Machine	Sound level (dB(A)) Minimum	Maximum	Average
Grinding	91.80	99.00	95.40 (4.78)*
Cross-cut	74.40	93.30	83.85 (13.05)
Drilling	61.90	76.70	69.30 (10.47)
Tenoning	78.80	91.55	85.18 (7.49)
Bed sander	75.30	83.40	79.35 (5.97)
Table Circular saw	104.30	118.70	111.50 (12.52)
Planing/thicknessing	125.40	133.60	129.50 (10.84)

**standard deviation in parentheses*

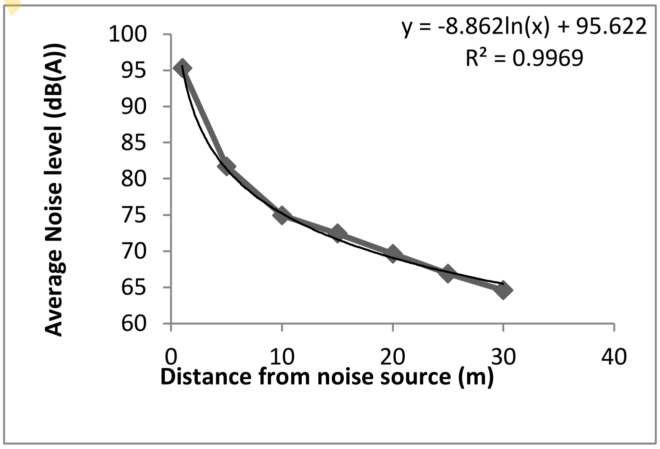

Figure 1. Noise equivalent level in relation with distance from noise source

From Table 1, it can be observed that the high frequency noise of 129.5dB (A) and 115.50dB (A) were recorded for planing/thicknessing and table circular saw machines respectively. These values fall within the limits related by Polat and Kirikkaya (2004) as being enough to cause negative effects of mental and hearing disorder. Several regulatory agencies advocate a time-weighted average (TWA) sound level of 85 dB(A) to 90 dB(A) as a noise exposure limit for 8-hour work day (CCOHS, April 2018), implying that workers in the Wood Processing Laboratory are particularly exposed to negative effects of noise when operating grinding machine, table-circular saw and planing/thicknessing machines. This may be because these machines were fabricated locally with crude technology available in the developing country. However, when two or three machines were working together, the increase in noise barely agreed with the principle of noise level addition (Table 3). When all machines worked together the sound level averaged 98.74(1.71)dB(A) which exceeded statutory levels. The case was an experimental scenario, which was never the reality, as not all the machines will be operated simultaneously at any given time.

As shown in Table 3, the sound level reduces as the distance increases away from the laboratory with only people that are less than 10 meters away from the laboratory likely to be negatively affected during critical operation hours. Thus, it is expected that workers in the processing laboratory protect themselves from excessive sound energy especially during wood processing operations of planing, thicknessing, cross-cutting and grinding. Simple preventive control measures such as properly positioned barriers, machinery isolation, double-wall enclosures, acoustically treated in-feed and out-feed tunnels, employee rotation, and machine enclosures have been recognized and efficiently employed in abating high sound intensity from the source (General EHS Guidelines, April 2007). These control measures should be able to reduce the amount of sound energy released by the noise source and divert the flow of sound energy away from the receiver. As a last resort, workers in the laboratory should wear personal protective equipment (PPE) such as earflaps and earplugs to prevent them from direct impact of sound energy during operations.

However, the exposure period of people around the laboratory is low since they are not stationed permanently around the laboratory for an 8-hour period, and the machines are not operated for such long duration hours simultaneously together. In addition, people inside the classrooms and administrative buildings are particularly shielded from high noise levels by barriers such as the walls, roofs and windows of the structural buildings in which they are housed, thereby not affecting teaching and educational activities.

CONCLUSION AND RECOMMENDATIONS

Noise levels in the Wood Processing Laboratory are lower than 90dB generally recommended as safe limit, except during the operation of planing/thicknessing and grinding machines. At critical operating conditions, the noise exposure to people working in buildings around the laboratory is within safe limit when the building is 10m away, with walls, roofs and windows providing barriers against sound penetration into the building. Thus, the noise from the laboratory does not negatively affect the teaching and educational activities going on in classrooms and administrative buildings in the study area. It is recommended that minimization of noise levels through the use of protective equipment should not be adopted as the first option as it represents the least desirable method of reducing noise exposure, but should rather be employed as the last line of defence, when all other preventive and control measures of elimination and isolation have been considered and implemented. Also, a comprehensive hearing conservation programmes should be organized on regular basis to educate and orientate the workers on the need to frequently adhere strictly to rules and regulations of the wood processing laboratory in order to curtail all hearing-related problems.

CONTRIBUTIONS TO KNOWLEDGE

1. The need for noise containment in wood working industries, the importance of Personal protective equipment and the need to regulate workers exposure time to the noisy environment were established
2. Noise levels in the wood workshop were determined and control measures were recommended
3. The need to minimise the impact of noise level on human health, to ensure peaceful and healthy lives and promote well – being of the workers was ascertained

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