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Assessment of Occupants' Satisfaction with Noise in Kilang Kelapa Sawit Bukit Pasir Sdn. Bhd.

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Abstract

This study is a study related to the noise received by workers at three specific places around Kilang Kelapa Sawit Bukit Pasir Sdn Bhd. This noise is often a major problem for the entire manufacturing industry. This was because many use tools and machines that have a level of noise that disturbs the hearing of workers who are around the area. As such, the Department of Occupational Safety and Health (DOSH) has set limits on the daily exposure period and related acts so that this issue does not have a larger and lasting impact on workers as long as they work in the factory. The researcher has set two objectives that need to be achieved at the end of this study, one of which is to identify the level of noise exposure that workers receive and to measure the noise level experienced by workers. Therefore, the researcher has set 3 methodologies that will be carried out to ensure that the method used can achieve the objective that has been set. To identify the noise around the studied area, the researcher has used a checklist where the researcher makes observations based on the questions in the checklist. This checklist was obtained from the Industry Code of Practice (ICOP) for Management of Occupational Noise Exposure and Hearing Conservation 2019 as well as a questionnaire that have been distributed to 10 employees. In the use of equipment to detect noise, researchers have used dosimeters and personal monitoring methods to identify the level of exposure of each worker to noise. The data obtained from the study that has been carried out is the condition of workers in the factory before conducting personal monitoring. At the end of this study, the researcher has given appropriate recommendations for improvement of each department or area according to the results obtained.

1. Introduction

Noise is a significant environmental pollution problem that can negatively impact building occupants, causing discomfort and disturbing physical and mental growth [2,3]. It can be caused by loud machines, environmental noise, or occupational noise, such as welding workers or airport workers. Excessive noise can cause emotional changes, irritability, depression, and hearing impairment. To address these issues, a study focusing on noise in the factory environment will be conducted, including a noise level test for workers, distribution of

questionnaires, and statistical analysis of data. This study will provide a comprehensive understanding of noise levels in the factory environment and their impact on Kilang Kelapa Sawit Bukit Pasir Sdn Bhd.

Excessive noise pollution, particularly in factories, negatively impacts employee performance and emotional and physical health. The Occupational Health and Safety Act 1994 mandates employers to provide Personal Protective Equipment (PPE) or specific Personal Hearing Protection (PHP) to employees to prevent injury or bodily harm [1]. This is in line with the Department of Occupational Safety and Health (DOSH), which emphasizes the importance of providing PHP or PPE to employees in high-hazard areas to prevent accidents [1]. Addressing excessive noise pollution in this factory is crucial for a safe working environment for workers.

Noise pollution, a significant concern in Malaysia, can negatively impact the acoustic comfort of building occupants. DOSH reported that in 2021, occupational noise-related hearing disorders had the highest number of reported cases with 3648 cases out of 5289 cases [4]. This equates to 68.97% of the total number of cases reported by workers facing occupational noise-related hearing disorders [4].

The manufacturing sector recorded the highest number of cases from January to April 2023 with Selangor recording the highest number of cases at 566 cases and the lowest was in Perlis with only 3 cases [4].

Noise exposure is a common occupational hazard in the palm oil industry, especially in the milling process where loud machinery and equipment are used. Prolonged exposure to high noise levels can cause adverse effects on the health and well-being of the workers [3]. However, there is some lack of research on the occupant's satisfaction with the noise environment in the palm oil mills, and how it affects their performance and motivation. Therefore, this study aims to assess the occupant's satisfaction with noise exposure in Kilang Kelapa Sawit Bukit Pasir Sdn Bhd, a palm oil mill located in Johor, Malaysia. The study will also identify the sources and levels of noise in the mill and the noise control measures implemented by the management. The expected outcome of this study is to provide recommendations for improving the noise environment and the occupants' satisfaction in the palm oil mill. The objectives of this study are to identify the level of noise exposure that workers receive and to measure the noise level experienced by workers.

2. Literature Review

The Regulations Occupational Safety and Health (Noise Exposure) 2019 was reenacted under the Occupational Safety and Health Act 1994 (OSHA 2019) on 1 June 2019, to protect workers in the industrial sector from noise hazards and hearing loss risks [1,2]. This change aligns with the Department of Occupational Safety and Health's vision of ensuring a safe workplace environment [1]. The regulations cover various noise levels, daily exposure periods, and equipment requirements [2]. Employers must be aware of these regulations to reduce the risks to themselves and their employees. Occupational noise-related hearing disorders are a significant health issue, with 21.9% of workers in Malaysia reporting hearing problems [4]. There are two types of hearing loss caused by occupational noise: acoustic injury and obstructive hearing loss [5]. Acoustic injury occurs when the ear organ is damaged by exposure to extreme noise, while obstructive hearing loss is difficult to cure due to damage to the nerve and cochlear organs [7].

Excessive noise exposure can lead to permanent hearing loss, as per the U.S. Department of Labour [8]. Employers must identify potential sources of excessive noise by conducting tests. Excessive noise can be defined as daily exposure above 82 dB(A), daily self-noise dose exceeding 50%, maximum sound pressure level exceeding 115 dB(A), or peak sound pressure level of 140 dB(C) [2,3]. The ICOP 2019 provides a checklist for employers to assess employees' work areas. DOSH emphasises that noise exposure has a set period and requires complete preparations, such as wearing Personal Protective Equipment (PPE), to avoid occupational disease [2,3].

3. Methodology

The data collection process for this study involves observing and measuring noise levels using a Sound Level Meter (SLM) and dosimeter. The International Electrotechnical Commission (IEC) Standards ensure compliance with noise measurement equipment [9]. DOSH Malaysia uses a noise dosimeter to determine individual noise tolerance. The compliance of noise measurement equipment must be verified by an accredited laboratory or manufacturer at intervals not exceeding 12 months [2]. Data collection was conducted at predetermined points following the factory's existing plan using the SLM and the person who would conduct personal monitoring would be chosen by the researcher. The Similar Exposure Group (SEG) would be determined in the early stage which was on the first day of collecting data [2]. The checklist for identifying excessive noise and the questionnaire form were used to gather data regarding ongoing projects and procedures resulting in excessive noise. The researcher would observe to determine the necessary actions to control noise, either through administrative or engineering control.

This study would implement a personal monitoring method for Noise Risk Assessment to identify the level of noise that has been exposed to the workers. SEG is defined to reduce variability in data collection. Two people from each area with a job position as supervisor or operator would conduct a personal monitoring assessment.

Data analysis was conducted to extract actionable information and make accurate decisions. The data collected would be used to determine preventive measures, such as administrative and engineering control. Engineering control measures include absorption materials, insulation, dampers, silencers, and vibration insulation, while administrative control involves rearranging workers' schedules to limit exposure. The data would be presented in tables, descriptions, diagrams, graphs, and charts to simplify understanding. The data would be presented in Microsoft Excel, Noise Tools Apps, and SPSS to achieve the study's objectives. There are 2 equation that has been use for calculation for this study which is equation (1) and equation (2).

$$L_{EX,8h}, dB(A) = L_{eqTe} + 10\ log\left(\frac{T_e}{T_0}\right) \quad (1)$$

$$Dose, \% = 100 \times \frac{T_e}{8} \times 10^{\frac{L_{eq}-85}{10}} \quad (2)$$

4. Results and Discussion

The data analysis that was carried out and acquired from the study that was carried out over the previous 19, 21, and 23 October 2023 will be thoroughly explained by the researcher. Over the three days that the data gathering process took place, observation and data collection tasks were completed. The observation would noted in the checklist, and a subset of the workers has been chosen to respond to the researcher's prepared questionnaire. The researcher acquired the questions from ICOP 2019 for mutual reference, as there are standard questions that must be known before beginning the data-gathering process. To ensure that the data collected is correct and useful, this procedure must be adhered to. Additionally, four topics will be covered in this chapter, covering the measurement data that has been collected and the application of the checklist and audiometric testing questions. The conclusions and results of the collected research will also be supplied at the end of this chapter.

4.1 Indication Plan

Based on Fig. 1, the researcher has labeled each area that would used as an SEG for this study. In each area that has been labeled, the researcher has also listed the source of noise that needs to be identified before doing personal monitoring in Table 1. The noise level value is also stated in the table to make it easier for the researcher to identify the source of excessive noise. The researcher did not conduct personal monitoring in all areas around the factory but only focused on three areas, which are the Sterilizer Station on 19 October 2023, the Boiler Plant on 21 October 2023, and the Kernel Plant on 23 October 2023.

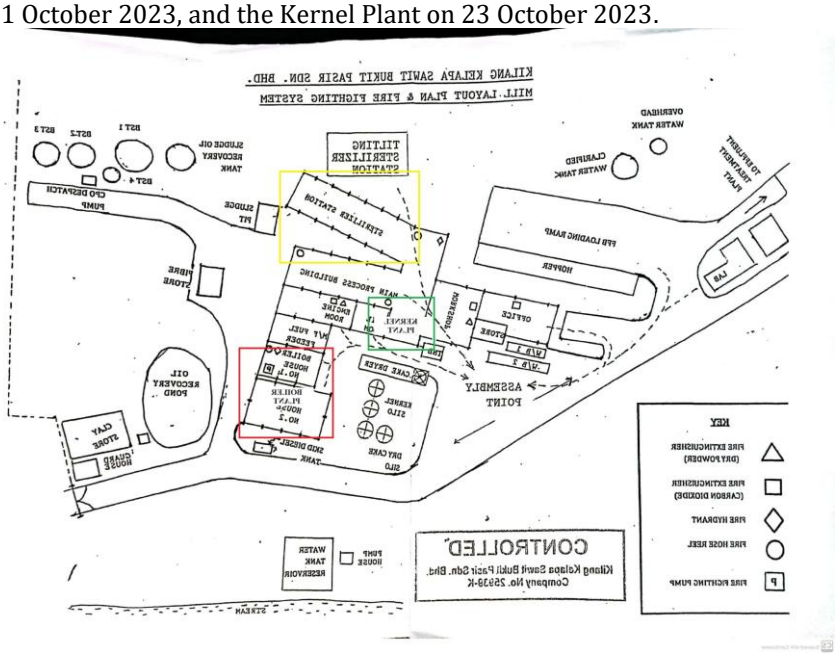


Fig. 1 *Mill layout plan*

Progress in Engineering Application and Technology Vol. 5 No. 1 (2024) p. 624-634

Table 1 *List of sources of noise for each working area*

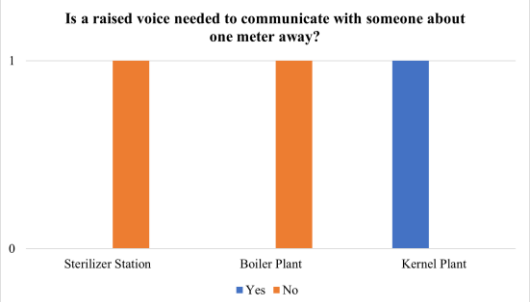
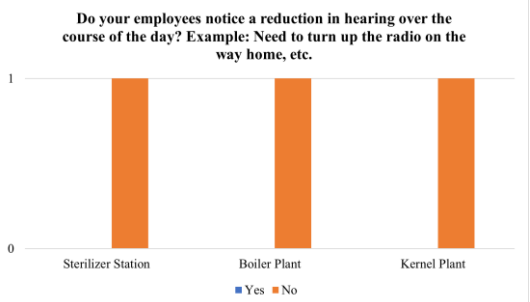
Working Area	Source of Noise	Type of Noise	Noise Level dB (A)
Sterilizer Station	Steam release	Fluctuate	92-98.4
	Tilting sterilizer station	Continuous	88-89.7
Boiler Plant	Turbine	Continuous	106-108.2
	FD Fan Boiler	Continuous	107.1-108.2
	ID fan	Continuous	94.9-95
	Secondary fan	Continuous	93-93.1
	Fuel feeder pump	Continuous	91-91.1
	Water feed pump	Continuous	96-97.1
	Compressor	Continuous	92-92.1
	Deaerator pump	Continuous	97-97.1
	Salt mixer	Continuous	92.5-94
	Water recycles tanker pump	Continuous	92-92.4
	Cake dryer	Continuous	90-90.1
Kernel Plant	Polishing drum nut kernel	Continuous	95-95.9
	Kernel dryer fan	Continuous	96-96.7
	Ripple mill	Continuous	99-100.1
	Kernel transfer pump	Continuous	101.7-104.5
	Nut silo	Continuous	93-94

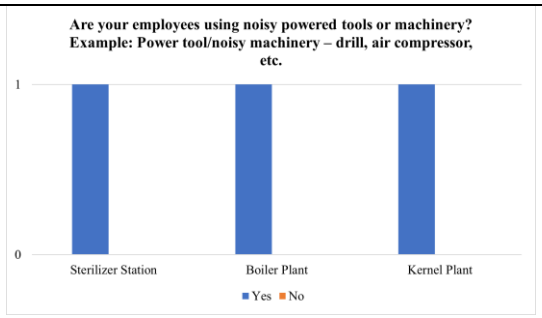
4.2 Checklist and Questionnaire

The checklist for identification of excessive noise is a research tool that helps identify potential hazards in the site for workers. It consists of 10 questions designed to detect potential hazards, with a "Yes" response indicating excessive noise in the vicinity. The checklist covers all activities or procedures related to the job area and requires on checklist for each area. The three areas have a work area where excessive noise is being made. The presence of tools or equipment that can emit sound level pressure levels as high as 140 dB(C) and 82 dB(A) is one of the factors that classify these three areas as regions with excessive noise. Area 3 is the one with the highest noise levels due to operations involving machinery such as the ripple mill, nut kernel polishing drum, kernel dryer fan, and kernel transfer pump. To protect their hearing, workers around the clock must constantly be prepared with PHP and must wear the equipment because there is signage "Warning: Loud Noise Area".

Neat for the questionnaire, assesses the hearing function of workers exposed to excessive noise at work, identifying factors that can affect audiometric tests. Factors such as ear disease, family history, medication use, and recreational activities involving noise are considered. Kementerian Kesihatan Malaysia (KKM) emphasises the importance of addressing hearing problems in the workplace. The questionnaire asks about workers' health level and family history, as hearing problems can be inherited if one family member has a history of hearing problems. All workers are wearing a Personal Hearing Protector (PHP) and have received suitable PHP for their work. The results show that workers do not have any family history of hearing disease or are deaf, nor take medicines that can damage hearing. Despite work areas producing strong noise, their hearing health is not affected. The company ensures that all employees conduct audiometric tests annually, emphasizing the health and safety of employees under their care and responsibility. The graph shown in Table 2 is the result obtain from questionnaire and checklist.

Table 2 *Result of checklist and questionnaire*

Item	Graph
Checklist	 a)  b)



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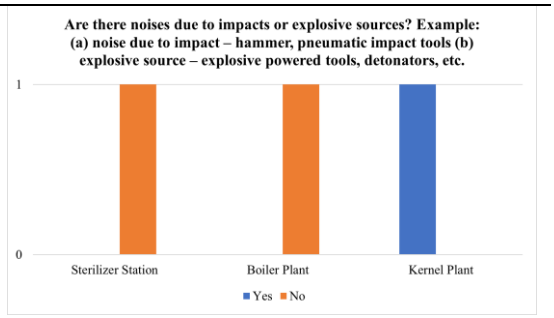

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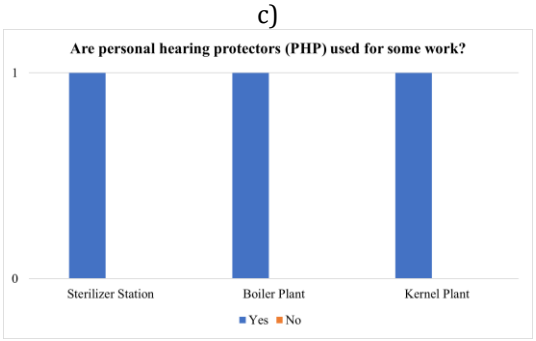

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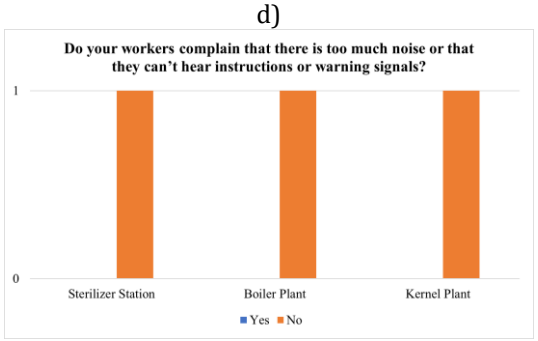

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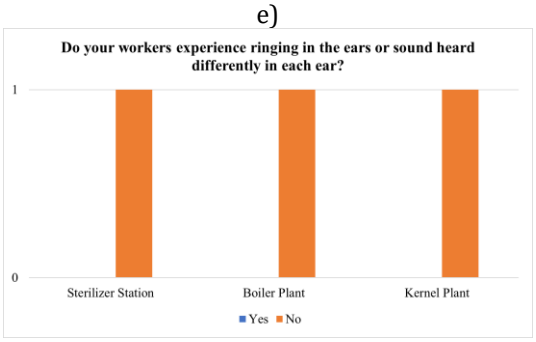

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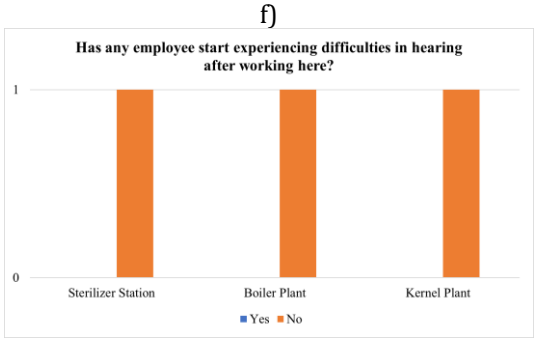

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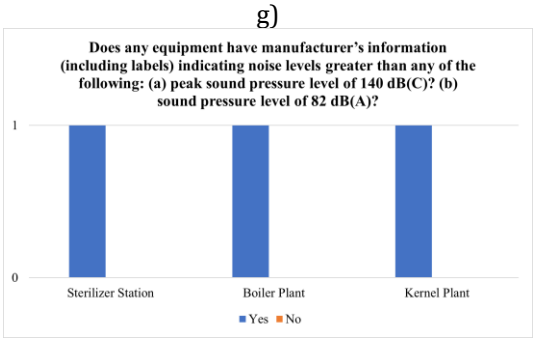

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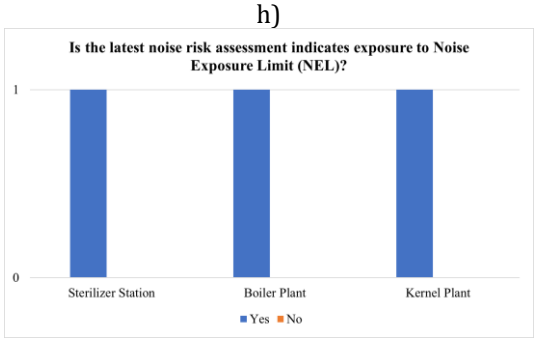

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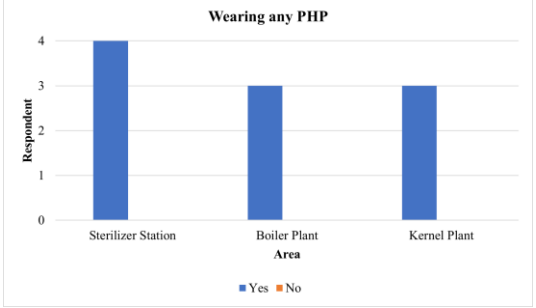
Questionnaire



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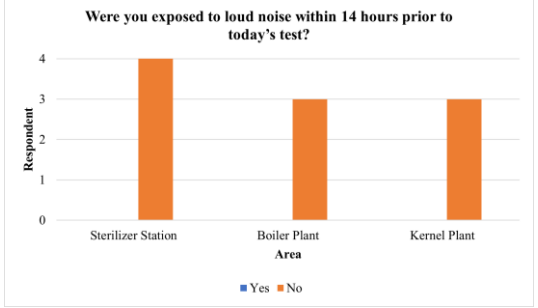

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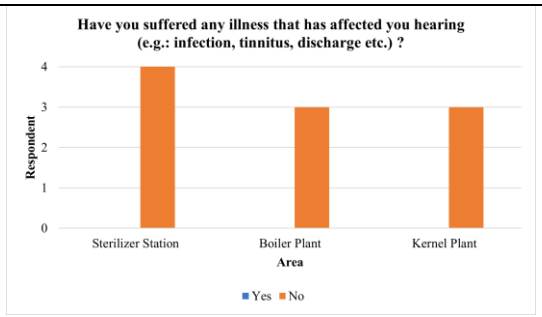
Progress in Engineering Application and Technology Vol. 5 No. 1 (2024) p. 624-634



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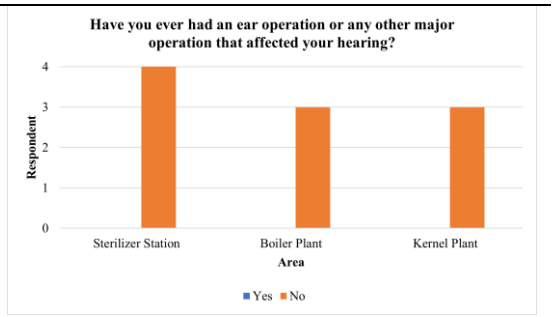

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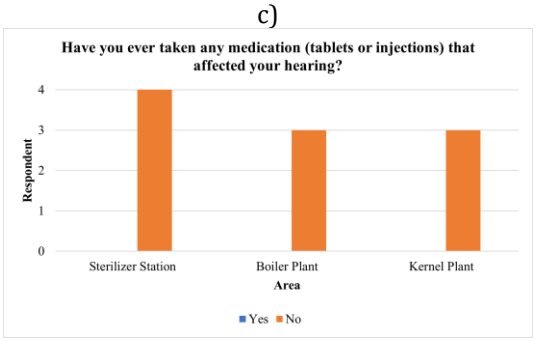

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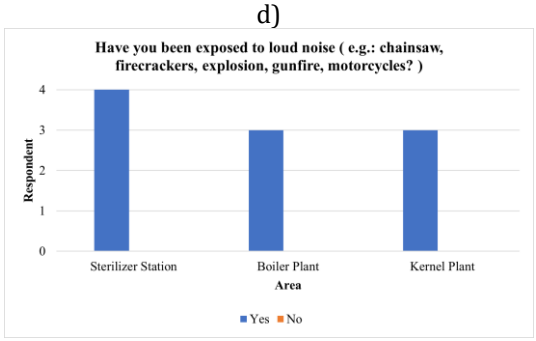

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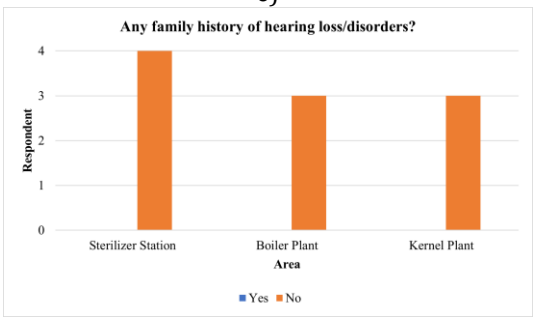

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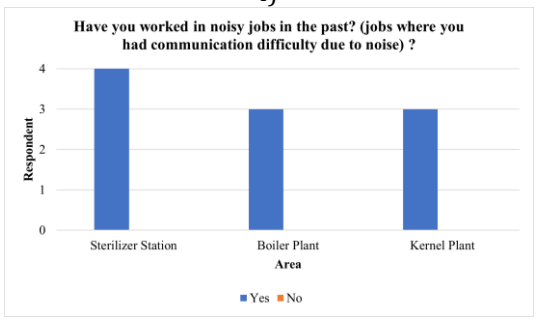

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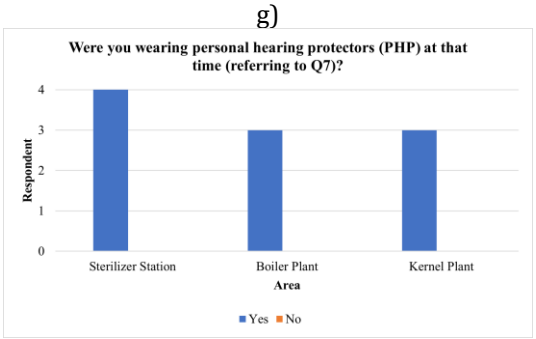

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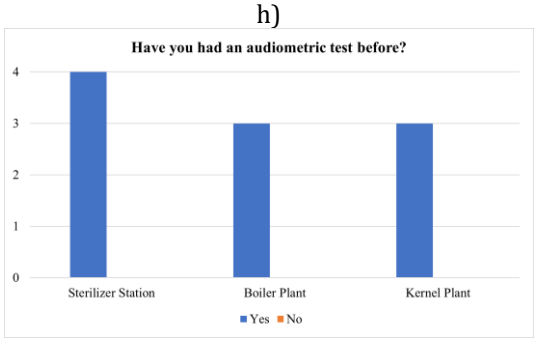

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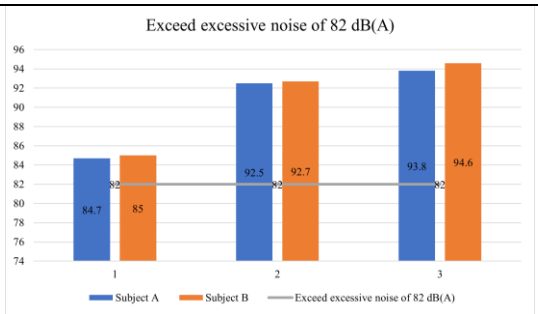
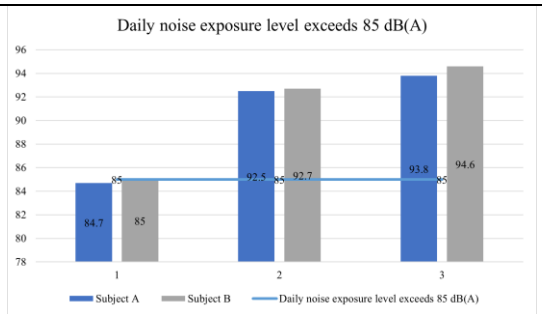
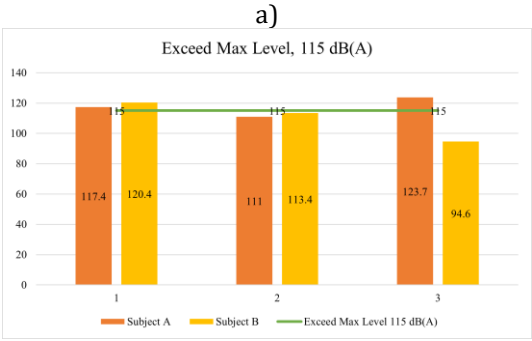
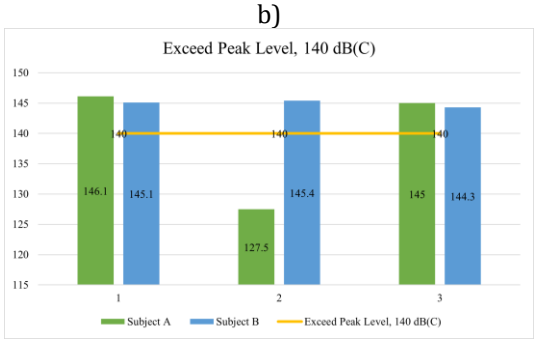
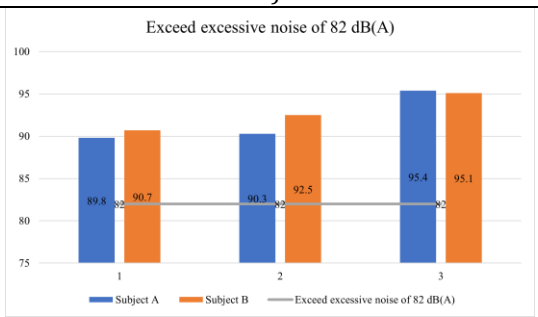
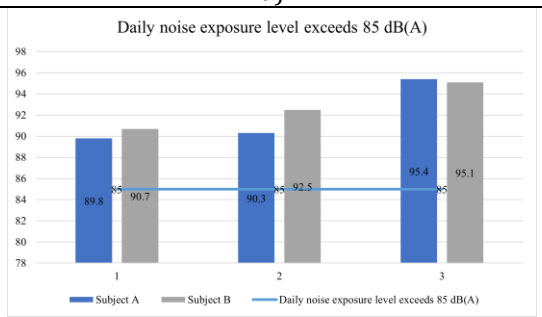
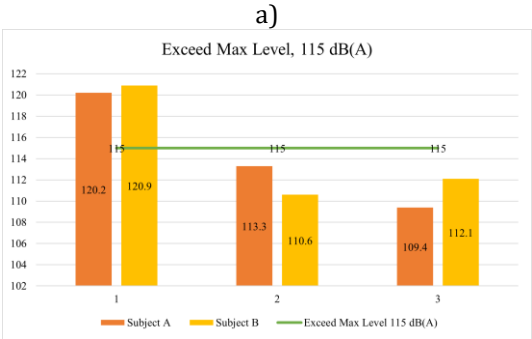
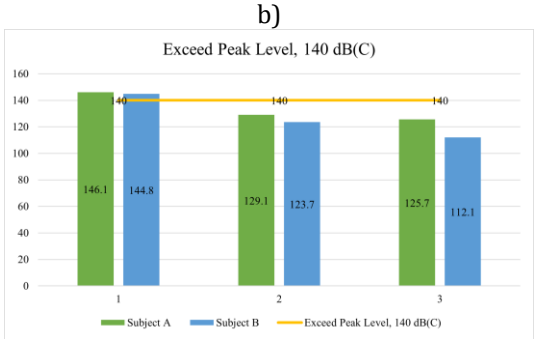
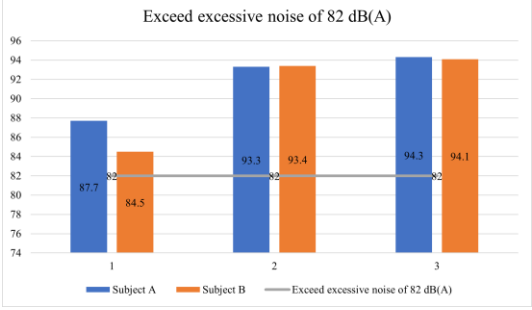
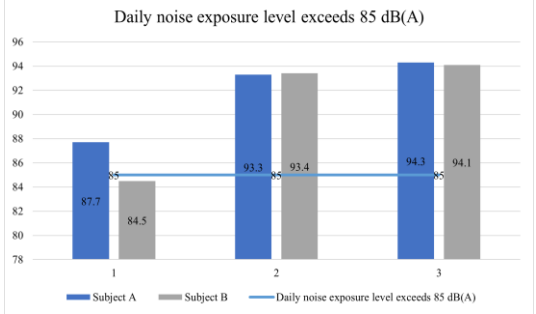
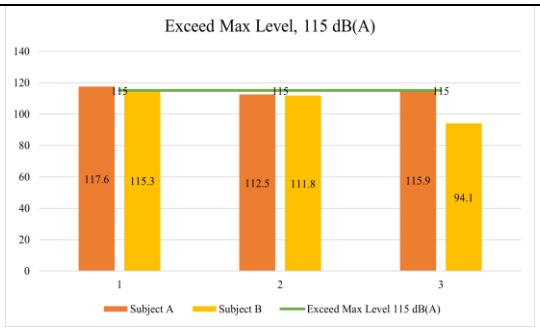
4.3 Summary of Findings for Personal Monitoring

The researcher conducted a study that focused on noise levels in the three main areas as stated in Table 1. The data collected showed that all monitored areas had noise levels exceeding 82 dB(A), which is the maximum limit allowed by DOSH Malaysia for industrial areas. This means that workers in these areas are exposed to excessive noise, and have the potential to cause hearing damage. To comply with DOSH standards, workers must use Personal Hearing Protector (PHP) such as ear plugs or muffs. Most areas do have exceeding 85 dB(A), which is the maximum limit allowed by DOSH for workers working for 8 hours a day. The factory has prepared scheduled breaks for workers in these areas.

Table 1 *Summary of personal monitoring result*

Time (Hour)	Graph
1	 a)  b)  c)  d)
2	 a)  b)  c)  d)
3	 a)  b)

Progress in Engineering Application and Technology Vol. 5 No. 1 (2024) p. 624-634



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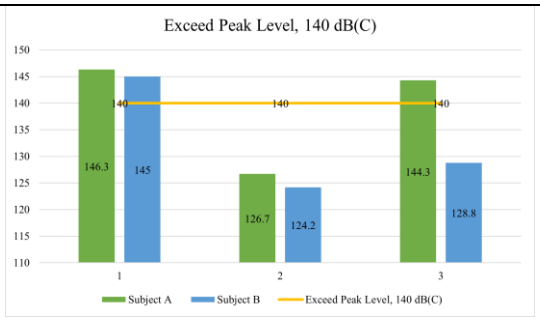

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4.4 Suggestion for Findings

Based on the research findings obtained, the researcher has divided three types of control measures which is Engineering, Administrative, and Personal Hearing protection (PHP) which will be used as reference if the factory wants to make any changes to the relevant personal protection equipment (PPE). According to the Occupational Safety and Health (Noise Exposure) Regulations 2019 of Malaysia, engineering control refers to the use of physical or mechanical means to reduce the noise level at the source or along the transmission path. For example, installing sound barriers, mufflers, silencers, or dampers. While for administrative control, refers to the use of organizational or managerial methods to limit the exposure time or intensity of the workers to noise. For example, rotating workers, scheduling noisy tasks, or providing rest breaks, and lastly, for personal hearing protection (PHP), refers to a device worn by a person to prevent unwanted auditory effects from acoustic stimuli. PHP is the last resort when engineering or administrative control is not practicable or sufficient. Some examples of PHP are ear plugs, ear muffs, and canal caps.

Table 2 *Recommendations for control measures*

SEG	Type Of Control Measure	Existing Control Measure	Recommended Control Measure
1	Engineering	Applied a system of predictive or preventive maintenance to control noise hazard sources. Installation of tilting sterilizer at different sites from the process plant. Installation of a quiet room for the sterilizer operator.	To advise the workers to increase the distance from the noise source if the job task is complete.
	Administrative	Limit working hours of workers via shift work when operating in noise-hazard areas. - During lunch, workers will not stay at the process plant. General safety training has been conducted. The audiometric testing program is annually for this SEG. Signage with the words “Hearing Protection Zone”.	Limit plant worker time in or next to noisy equipment and switch high-exposure occupations with lox-exposure occupations if possible. Establish Health Care Professionals (HCP) training annually for this SEG.

	PHP	The company has supplied Conie-1 reusable earplugs with NRR 21 dB.	To supply the PHP to the workers and ensure it is DOSH or SIRIM approved. Recommended PHP with NRR range 25-30 dB Upgrade awareness and administer its usage onsite.
2	Engineering	Minimizing the number of noisy machines or pumps running at any one time. Only one boiler and one turbine will be in operation at one time. Applied a system of predictive or preventive maintenance to control noise hazard sources. Installation of a quiet room (quiet area) for workers	Update maintenance program. Recommended to do balancing for all fans. Consider replacing the new plate if broken.
	Administrative	Limit working hours of workers via shift work when operating in noise-hazard areas. - During lunch, workers will not stay at the process plant. General safety training has been conducted. The audiometric testing program annually for this SEG. Signage with the words "Hearing Protection Zone".	Limit plant worker time in or next to noisy equipment and switch high-exposure occupations with lox-exposure occupations if possible. Establish Health Care Professionals (HCP) training annually for this SEG.
	PHP	The company has been supplied with Conie-1 reusable earplugs with NRR 21 dB.	To supply the PHP to the workers and ensure it is DOSH or SIRIM approved. Recommended PHP with NRR range 25-30 dB Upgrade awareness and administer its usage onsite.
3	Engineering	Applied a system of predictive or preventive maintenance to control noise hazard sources.	Update maintenance program. Consider doing fan balancing for the kernel blower.

		Consider installing an isolation box of the ripple mill with plywood to reduce the noise emission if possible. Consider installing a noise insulator at the polishing drum using fiberglass material.
Administrative	Limit working hours of workers via shift work when operating in noise-hazard areas. - During lunch, workers will not stay at the process plant. General safety training has been conducted. The audiometric testing program annually for this SEG. Signage with the words "Hearing Protection Zone".	Limit plant worker time in or next to noisy equipment and switch high-exposure occupations with lox-exposure occupations if possible. Establish Health Care Professionals (HCP) training annually for this SEG.
PHP	The company has been supplied with Conie-1 reusable earplugs with NRR 21 dB.	To supply the PHP to the workers and ensure it is DOSH or SIRIM approved. Recommended PHP with NRR range 25-30 dB Upgrade awareness and administer its usage onsite.

5. Conclusion

The results showed that the workers in Area 1 and Area 2 were exposed to noise levels that exceeded the limits set by the ICOP 2019, while the workers in Area 3 were within the acceptable range. This study contributes to the existing literature on occupational noise exposure and hearing conservation in the palm oil industry. It provides empirical evidence of the noise levels faced by the workers in different areas of the mill and the potential; risks to their hearing health. It also offers practical recommendations for improving noise management and control in the factory. The study has limitations, such as the small sample size, and the short duration of observation. Future research could address these limitations by conducting a larger and longer study to make this kind of research more variable.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The author alone is accountable for the following: creating and planning the study, gathering, and analysing the data, concluding the findings, and writing the manuscript.

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