

A Study on Assessment of Noise Exposure in the Port Industry: Implications for Occupational Health and Safety

Sankara Bhavani Budi

Guest Faculty at Jawaharlal Nehru Technological University, Kakinada, Andhra Pradesh, India., Ph.D. Scholar at University of Rome – Tor Vergata, Rome, Italy.

DOI: <https://doi.org/10.52403/gijhsr.20240103>

ABSTRACT

The workplace today is getting more complex, as exposure to chemical, physical, and biological substances at work poses an increasing range of hazards and risks. Industrial hygiene is "that science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses arising in or from the workplace". Exposure assessment is the heart of industrial hygiene initiatives, which serves as the foundation for all other functional elements, including medical surveillance, exposure monitoring, engineering controls, administrative controls, and hazardous materials management.

Ports are key hubs for worldwide trade, handling a wide range of cargo types with various machinery and equipment. The operational activities within these environments frequently generate high levels of noise, posing a potential hazard to the well-being of the workforce. The purpose of this study is to conduct a comprehensive assessment of noise exposure in the port industry at different locations and to propose appropriate mitigation strategies.

The methodology involves the use of sound level measurements using a sound level meter in various port environments. A thorough examination was carried out to identify specific locations for the purpose of conducting noise monitoring. The survey facilitated the quantitative assessment of noise exposure. Based on the findings of this study, necessary recommendations are proposed to minimize noise exposure and protect the well-being of port workers. The insights gained will not just assist port workers but will also contribute to a broader

awareness of sustainable and responsible industrial practices.

Keywords: *Noise exposure, Port industry, Noise assessment, Noise control methods, Personal protective equipment.*

INTRODUCTION

The port industry is essential for worldwide commerce, enabling the transportation of goods and promoting economic growth. However, operational characteristics of ports such as container handling, machinery, material handling, transportation activities, and other work areas generate a significant amount of noise. The exposure of port personnel to high levels of noise raises concerns about potential health and safety implications.

Addressing noise exposure in the port industry is essential for several reasons. The safety of the workforce comes first and foremost, and evaluating the extent of noise exposure is an important step in providing a safe working environment. Also, noise-induced health issues can have major economic consequences, such as increased healthcare expenditures and decreased worker productivity. Long-term exposure to elevated noise levels can cause stress, hearing loss, and other physiological and psychological health issues among workers. Because of the wide range of equipment and processes involved, the port industry poses particular challenges in monitoring and controlling noise exposure.

At every workplace, the exposure assessment approach has to be a cyclical process with continual improvements. This evaluation needs to look at any new information about the dose-response relationship in the workplace, as well as the wide range of working conditions that are seen there now or by chance at the workplace level. The first step in assessing exposure will be to collect readily available information that is relatively easy to obtain.

The data obtained from the initial exposure assessments will then be utilized to prioritize follow-up control and information-gathering efforts. As a result, the allocated resources have to be focused on specific exposures, with a priority assigned to the potential health risk. This way, the exposures are better understood and controlled; they will drop in priority, and therefore the industrial hygienist will move on to the next cycle of the plan, addressing the next tier of priority exposures.

The assessment method involves the monitoring and evaluation of noise exposure in the workplace by an industrial hygienist from the Environment, Health, and Safety (EHS) department.

The industrial hygienist is responsible for conducting two types of assessments:

- The preliminary noise survey is conducted as an in-depth assessment of noise exposure. It includes a "walk-through" survey of the facility with a sound-level meter. Variations in noise levels due to the operation of noise-generating equipment or machinery are taken into consideration.
- The detailed noise survey is conducted in cases where the preliminary survey data suggests the need for specific monitoring. This survey uses a sound level meter to obtain precise information on the noise levels at each individual workplace. That involves an assessment of the level of employee exposure over the course of an 8-hour workday and determining the specific areas that should be identified as noise-risk areas and require the use of hearing protection.

Objectives of this study:

- Identification and assessment of noise levels across different port operational zones
- Evaluation of the potential health effects of noise exposure on port personnel.
- Propose recommendations to minimize noise exposure in the port environment.

This study's findings contribute by giving useful information that may be used to develop and implement specific measures aimed at reducing noise levels and safeguarding the well-being of port workers.

LITERATURE STUDY

The port industry is an important part of global trade since it enables the transportation of goods and commodities around the world. However, port operations can generate significant levels of noise, posing risks to the health and well-being of workers. The purpose of this literature review is to thoroughly analyse existing research on noise exposure in the port industry.

A diverse range of activities, such as cargo handling, ship operations, and machinery usage, result in elevated noise levels in the port industry. Port workers have been recognized as a high-risk group for occupational noise exposure in multiple studies [1][2]. Understanding noise sources and levels is crucial to establishing effective noise management strategies. Smith [9] revealed that port workers are frequently exposed to noise levels that exceed recommended occupational limits. This exposure has been linked to a variety of sources, including container handling equipment, ship engines, and vehicle traffic at port facilities (Chang [6]). The adverse effects of prolonged exposure to elevated noise levels are well-documented, ranging from hearing loss to stress-related disorders (Kang [8]).

The adverse health effects of noise exposure in the port industry have become a growing concern. Davis and Qiu's [10] study found a link between occupational noise exposure in ports and a higher risk of cardiovascular

disease among workers. Furthermore, Li., M. [7] found that noise had a psychological impact on port workers, with increased stress levels and decreased job satisfaction.

Multiple techniques are used for the evaluation of noise exposure within the port sector. The use of sound level meters is widely employed to assess the noise levels in various port areas. EU-OSHA [4]. Various control measures are established and used to manage noise exposure in the port industry. Engineering controls, administrative measures, and personal protective equipment are among these. The effectiveness of these measures varies depending on the port environment and activities (Pinto, Themann & Masterson [5]).

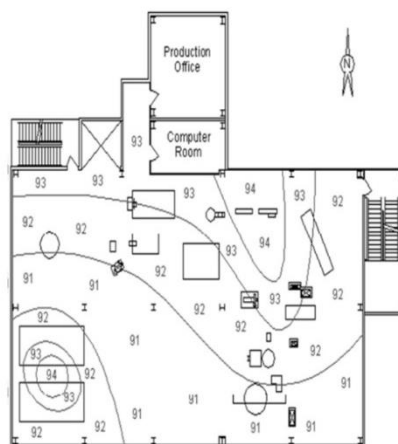
National and international regulatory bodies have established legal frameworks and standards to address noise exposure in the workplace, including ports. Compliance with those requirements is essential for protecting port workers' health and safety. However, challenges exist in effectively implementing and enforcing those requirements (EU-OSHA [4]). The American Conference of Governmental Industrial Hygienists (ACGIH) [12] is one such widely recognized organization that plays a crucial role in developing standards to safeguard workers from occupational risks. The ACGIH provides comprehensive recommendations that cover all areas of industrial hygiene, including noise exposure, acknowledging its importance in safeguarding worker health.

MATERIALS & METHODS

The methodology for assessment was formulated based on international guidelines provided by the American Conference of Governmental Industrial Hygienists (ACGIH), USA. A sound level meter and a noise contour map were used to conduct a quantitative assessment of noise exposure. Based on the assessments, the necessary recommendations for noise exposure control have been provided.

Every noise map is the outcome of a noise model that is based on several fundamental inputs, including a list of all the noise sources

and their locations and a model of the area under investigation.



(Figure 1: Noise contour map)

The monitoring was carried out using an integrated sound level meter. Prior to and subsequent to the readings, the sound level meter was properly calibrated using a calibrator. A company based in the United States of America called Quest Technologies manufactured the equipment. Sampling was carried out on an area-by-area basis at selected workplaces.



(Figure 2: Sound Level Meter)

The noise measurement results were compared to the Permissible Exposure Limits (PELs) stated in the Andhra Pradesh Factories Rules 1950 and the Threshold Limit Values (TLV) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for an 8-hour exposure to noise, which were 90 dB (A) and 85 dB (A), respectively.

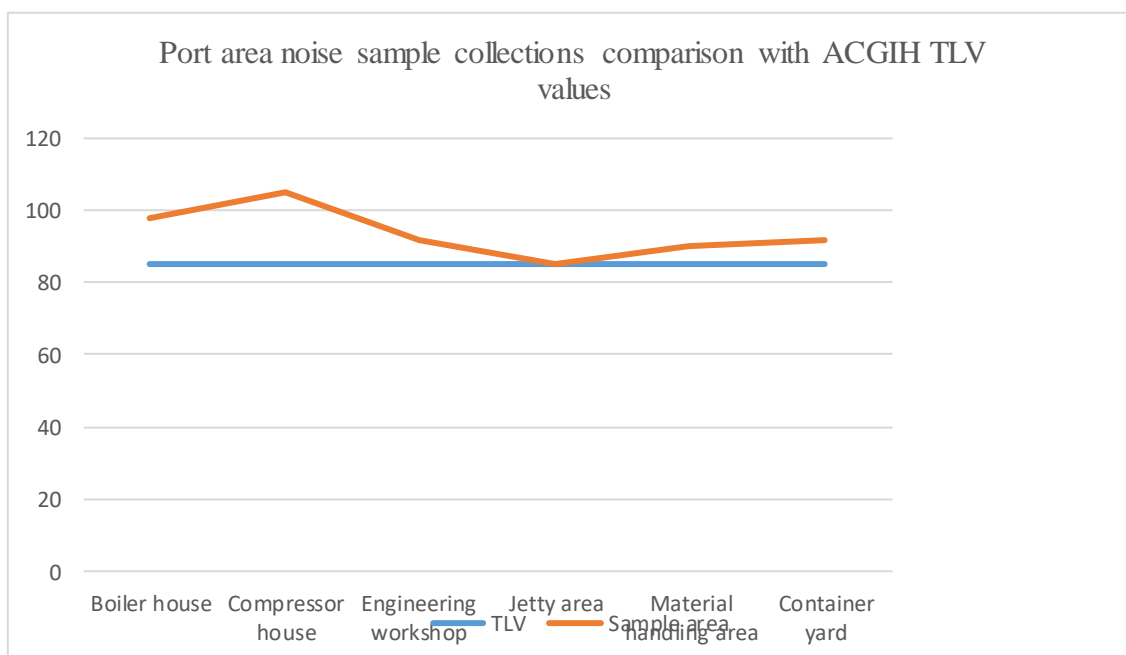
Different noise sources at port industry:

- Internal port traffic;
- Port related external traffic
- Cargo handling
- Boiler house
- Engineering work shop
- Container yard
- Material handling area
- Compressor house
- Jetty area

RESULT

(Table 1: Results of high noise sources at port industry in comparison with ACGIH threshold limit values.)

S.no	Location	Minimum (dB)	Maximum (dB)	Average (dB)	TLV	Comments
1	Boiler house	88	100	98	85	Above TLV
2	Compressor house	99	108	105	85	Above TLV
3	Engineering work shop	88	96	92	85	Above TLV
4	Jetty area	72	88	85	85	Equal to TLV
5	Material handling area	88	92	90	85	Above TLV
6	Container yard	90	95	92	85	Above TLV



(Figure 3: Graphical representation of Noise levels)

SPECIFIC RECOMMENDATIONS FOR CONTROL OF NOISE EXPOSURE

To avoid the harmful health consequences of excessive noise exposure in those mentioned areas, the following recommendations are proposed for implementation:

- When noise reverberates around a room, the only method for reducing it is by absorption. Absorption panels and baffles absorb a high percentage of sound energy and dissipate it as kinetic heat energy. The maximum noise reduction potential is 4 to 6 decibels, resulting in a 20 to 30% reduction in noise intensity.
- Treat the wall nearest to the source of the noise by using the acoustic foam panels.
- Construct a barrier or shield, which can be used as "instant walls" that isolate noisy machinery. The most effective method of preventing single-source noise from echoing around the room is to build an acoustic barrier around the machine that blocks the sound energy.
- Build an acoustic enclosure around the machine to contain noise at the source. The maximum noise reduction potential is between 20 and 30 decibels.

The maximum sound reduction ranges from 2 to 6 decibels. This economical solution reduces noise levels by 10 to 30%.

RECOMMENDATIONS FOR NOISE EXPOSURE CONTROL IN GENERAL

Excessive noise is one of the most common workplace hazards in industries. Prolonged noise exposure in the workplace can lead to impaired verbal communication, fatigue, lower productivity, and work-related hearing loss.

The following are the general recommendations for controlling noise exposure:

- Ensure that workers follow safety procedures and wear appropriate personal protective equipment while performing their duties.
- Workers should be trained on the importance of personal protective equipment, as well as its proper use, storage, and maintenance. It should be stated that the majority of hearing-protective equipment provides only about 15 dB of protection to workers.
- It is recommended that suitable hearing protection equipment selection be based on the attenuation rates provided by the manufacturer of personal protective equipment (PPE).
- Workers exposed to noise levels exceeding 100 dB may suffer hearing loss even though they wear hearing protection regularly. As a result, the length of exposure should be reduced to the shortest amount possible for such workers to avoid overexposure to noise.
- Workers must undergo an audiometric evaluation annually to detect early signs of hearing impairment.

DISCUSSION

The assessment of noise exposure at various locations has provided valuable insights into the potential risks and effects of occupational noise exposure. This study revealed significant variations in noise levels across different locations within the port. High noise levels have been observed in the boiler house and compressor house areas, highlighting the need for remedial measures in those specific areas.

This study assessed the extent to which noise levels met existing regulatory limitations. It is essential to determine whether the noise levels documented are in compliance with the relevant occupational safety and health regulations. In order to maintain noise exposure within acceptable levels, noncompliance might necessitate establishing and carrying out specific strategies. To effectively mitigate noise exposure, it is recommended to use a comprehensive approach that integrates engineering controls, administrative measures, and the use of personal protective equipment (PPE). Engineering controls may involve the implementation of noise barriers, the enclosure of noisy machinery, and regular maintenance to reduce equipment-related noise emissions. Administrative measures include several strategies, such as the establishment of specified quiet zones, the adoption of rotating work schedules, and the provision of employee training programs to promote awareness about the risks of noise exposure.

Training programs should prioritize providing information to employees concerning the potential hazards and risks related to noise exposure, the proper use of personal protective equipment (PPE), and the significance of adhering to safety protocols. These programs have the potential to enable workers to actively participate in minimizing their own occupational noise exposure. By prioritizing the reduction of noise exposure, the industry can enhance the well-being of its workers, improve overall productivity, and ensure regulatory compliance.

LIMITATIONS

While this study on the assessment of noise exposure at various locations in the port industry provides useful information, it is essential to acknowledge its limitations.

- The findings of this study may not be universally applicable to all port facilities because noise levels vary depending on the specific activities, equipment, and infrastructure present at each facility.

- The scope of the study is limited to specific places within the port facility, and the findings may not be fully indicative of the different working conditions seen throughout the industry.
- Noise levels in the port industry vary with operational schedules, maintenance activities, and cargo volume. Since the data was collected over a particular period of time, this study may not fully represent those variations.
- The study's findings may be influenced by changes in noise rules, regulations, or industry practices. Changes in rules, regulations, or industry standards that occur after this study could have an impact on the applicability of the findings.

CONCLUSION

This study focuses on the evaluation of industrial noise exposure, aiming to provide insights into the complicated challenges associated with high levels of noise in work environments. The findings of this study emphasize the significance of giving priority to initiatives aimed at promoting occupational health and safety. The noise levels observed in this study, specifically within the compressor house (105 dB) and boiler area (98 dB), highlight the immediate need for specific measures to mitigate the impact on workers.

One significant finding is the identification of high-risk zones within industrial environments where noise exposure exceeds the recommended thresholds. The use of engineering controls, such as the implementation of effective guarding, closed enclosures, and system redesign, has the potential to significantly mitigate noise-related health hazards among workers in those identified zones.

This study further emphasizes the need for personal protective equipment (PPE) to reduce exposure. It is important to realize that PPE alone is not a comprehensive solution. Combining it with engineering controls and administrative measures like

rotating work shifts or implementing quiet zones will contribute to a stronger and effective noise management strategy. As industries evolve, it is essential that regulatory bodies update noise exposure standards. By implementing evidence-based methodologies and adopting innovative approaches, safer and healthier industrial environments can be created, thereby safeguarding the well-being of the workforce and promoting sustainable industrial practices.

Declaration by Authors

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Jeebhay, M. F., et al. (2012). Occupational noise exposure and hearing loss of workers in two plants in the South African textile industry. *Noise & Health*, 14(59), 127–133.
2. Themann, C. L., & Masterson, E. A. (2019). Occupational noise exposure: A review of its effects, epidemiology, and impact with recommendations for reducing its burden. *The Journal of the Acoustical Society of America*, 146(5), 3879–3905.
3. Lee, B., et al. (2017). Noise-induced hearing impairment in shipyard workers with unilateral conductive hearing loss. *Journal of Occupational and Environmental Medicine*, 59(12), e271–e276.
4. EU-OSHA. (2020). Occupational safety and health in the ports sector. European Agency for Safety and Health at Work. Noise in Figures – Elke Schneider/Page 20,21.
5. Pinto, L. S., et al. (2015). Assessment of noise in workplaces: Evaluation, control, and prevention measures. *Noise & Health*, 17(76), 68–76.
6. Chang, S., et al. (2019). Occupational noise exposure in container terminals. *International Journal of Environmental Research and Public Health*, 16(2), 230.
7. Li, M., et al. (2017). Psychological health of dock workers exposed to noise pollution in a container terminal: a cross-sectional study in China. *BMC Public Health*, 17(1), 72.
8. Kang, Y., et al. (2020). A review of occupational noise-induced hearing loss in

- dockyard workers. *Journal of Occupational Health*, 62(1), e12079.
9. Smith, A., et al. (2018). Noise exposure in a container terminal: A case study. *Noise Mapping*, 5(1), 117-130.
 10. Davis, R. R., & Qiu's, W. (2021). Cardiovascular effects of occupational noise in dock workers. *Journal of Occupational and Environmental Medicine*, 63(5), 431-437.
 11. Smith, A., Acute effects of noise exposure: An experimental investigation of the effects of noise and task parameters on cognitive vigilance tasks. *Int Arch Occu Environ Health* (1988) 60:307-310. Jones, B., A criterion for evaluation of noise exposures. *American Industrial Hygiene Association Journal* 1960 Vol.21 No.6 pp.481-5.
 12. American Conference of Governmental Industrial Hygienists – (ACGIH): Threshold Limit Values Discussion and Thirty-Five Year Index with Recommendations Volume-9/Edited by Marshall E. Lanier-Noise Exposure Assessment and Exposure Control Methods/Page 213.
 13. OSHA. (2021). Occupational noise exposure standard - 29 CFR 1910.95. Occupational Safety and Health Administration.
 14. Andhra Pradesh Factories Rules 1950. Operations Involving High Noise Levels, Permissible Exposure Levels in Cases of Continuous Noise -Schedule XXVII/Page282.

How to cite this article: Sankara Bhavani Budi. A study on assessment of noise exposure in the port industry: implications for occupational health and safety. *Gal Int J Health Sci Res.* 2024; 9(1): 19-25. DOI: [10.52403/gijhsr.20240103](https://doi.org/10.52403/gijhsr.20240103)
