Noise and Lighting Measurement and Analysis for Industrial Work Area X, Jakarta City

Disfiatri Kusumaningtyas, Betanti Ridhosari, Ariyanti Sarwono, and I Wayan Koko Suryawan
[1]Department of Environmental Engineering, Faculty of Infrastructure Planning, Universitas Pertamina, Jakarta, 12220, Indonesia
*Corresponding author: i.suryawan@universitaspertamina.ac.id

Diterima : 15 Mei 2023 Disetujui: 30 Juni 2023

Abstract

Noise and lighting are some of the factors that affect occupational health in the industry. The manufacturing industry needs to look at the quality of noise and lighting to determine efforts to prevent health risks. This study aims to analyze industry noise and lighting values and compare them with the established standards. Measurements in this study were carried out using interviews with workers to determine the dominant location providing noise and lighting values. The average noise in the work area in the study industry shows a value that exceeds the standard. The noise value in the work area shows a value of 86.56 - 89.79 dB(A), while in the rest, it can reach a value that meets the quality standard, which is 74.65 dB(A). The lighting at one work station shows a value that does not meet the standard, namely 168.7 LUX, while in other work areas it meets the value of 201.3 – 203 LUX.

Keywords: Noise, Lighting, Workstation, Occupational Health

Introduction

Health problems experienced by workers have a direct impact on work and indirect effects. The immediate effect can be felt when workers are carrying it out and will affect workers' performance. Indirect is a health disorder experienced by workers for a certain period and usually when the condition affects many aspects such as a decrease in productivity (Lestari, 2018). Health problems encountered can be permanent and not permanent (Simanjuntak, 1994). The different organs depend on each other and play a specific role in effectively carrying out the body's functions. The effectiveness of each of these organs can be influenced by the conditions and substances found in the surrounding environment, including in the work environment and at home (Ridley, 2008). The company must consider occupational health because it affects the performance of employees in the long term.

Physical factors can affect physical labor activities caused by machines, equipment, materials, and environmental conditions around the workplace that cause work-related disorders and diseases, including work climate, vibration, microwave radiation, magnetic fields, air pressure, and lighting. Sustained continuous or impulsive can cause damage to the ear, with an exposure that is not up to the standard, which will damage the hearing system without any problems that occur trivially and allowed an industry. Noise is one of the causes of occupational diseases in the physical group (Widyastuti, 2018).

In addition to the noise that occurs, the lighting presented by the industry also receive special attention from the industry. In this case, lighting also affects a conducive work environment. (Purwanti et al., 2013) state that lighting that does not follow applicable standards will reduce the quality of vision and most often occurs in ocular problems. Noise and lighting applicable standards are different problems that all components in the industry must overcome. This study aims to determine the quantification of noise and lighting values in an industrial system. By knowing this value, the matter can be compared with the standards set in Indonesia.

Excessive noise can have detrimental effects on the environment and human health. Noise pollution disrupts wildlife habitats, leading to behavioral changes and stress in animals. In urban areas, noise pollution affects human well-being, causing sleep disturbances, stress, and even hearing loss. Novel environmental protection practices focus on reducing noise emissions through better urban planning, noise barriers, and promoting quieter technologies. Protecting natural habitats and minimizing noise and light disturbances support biodiversity conservation efforts. By preserving and minimizing environmental impact, we safeguard the diverse ecosystems crucial for the planet's health (Suryawan & Lee, 2023; Sutrisno et al., 2023).

The existing literature on occupational health in the manufacturing industry often focuses on broader aspects of workplace safety and health, but there needs to be more specific studies that comprehensively examine the impact of noise and lighting on occupational health within this particular industry. While some studies may touch upon noise and lighting issues, they need to not provide a detailed analysis of their values compared to established standards. This study aims to bridge this gap by conducting a comprehensive analysis of noise and lighting levels in the manufacturing industry and comparing them with relevant standards.This study's novelty lies in its approach to assessing noise and lighting in the manufacturing industry through interviews with workers to determine dominant locations. By incorporating the perspectives of workers, who experience these conditions firsthand, the study gains valuable insights that go beyond mere technical measurements. Additionally, the study's focus on comparing industry noise and lighting values with established standards adds novelty to the research, as it contributes to developing more targeted and effective preventive measures to safeguard occupational health.

Method

This research was conducted in Industry X, located in the City of Jakarta. Primary data collection measures occupational health and safety parameters at two points: the office space and the fabrication area. The measurement method used is classified based on the sampling period and location placement. The period for sampling is carried out using the short time method carried out when workers are resting. Lighting measurement refers to S.N.I. 16-7062 of 2004. Lighting measurement uses Lux meter (Lutron 4001). The tool is placed on the workbench and does not let anything block the light. Wait for 1-2 minutes so that it produces a stable value on the tool. All measurement results are recorded and then compared with the NAV in the standard or regulation. Lighting measurements were carried out using local measurement methods at three sampling points. The sampling point location can be seen in Figure 1.

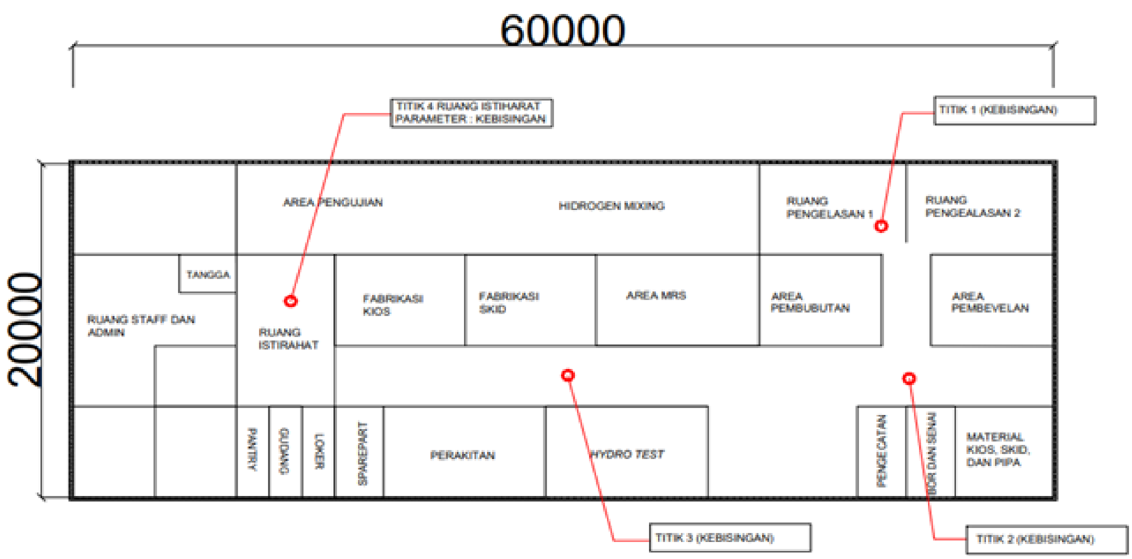

Figure 1. Study Location Plan in Noise and Lighting Measurement

This research was carried out in the Manufacturing Department, whose main focus was on the fabrication of M/RS in the workshop area. M/RS fabrication activities were carried out when orders came from consumers or requests. The manufacturing department also does side work such as making plates, container boxes, and others if customers receive special requests. There are two types of M/RS, namely for the housing scale and the company scale. M/RS work lasts for three weeks from the beginning until the product is ready to be finished, which can be shipped immediately. The manufacture of M/RS involves physical work that can endanger the safety and health of workers. In the manufacture of M/RS, there are three parts of work, namely the main job of making a series of M/RS pipes. Second, the manufacture of skids or supports so that the pipes can stand. Third, making a kiosk is a place to store lines to avoid rainwater.

Measurement of workspace noise refers to SNI 7231 of 2009 concerning the intensity of noise measurement in the workplace. It was using the Lutron SL-4001 version of the sound level tool. Noise measurement is carried out on the work process that is the source of the noise. In the manufacturing area, work processes that have high noise intensity are work processes that use grinding machines, hammers, and cutting wheels. The work process is in the welding room because it uses a grinder to make slopes. Then, it uses a cutting and grinding machine in the turning and cutting area, finally, on the sanding site, which also uses a grinder and wire for the pipe brushing process. The last noise measurement was carried out in the employee rest area to compare the noise intensity with measurements made close to the noise source.

Result and Discussion

The noise measurement carried out in the M/RS fabrication activity in the Manufacturing Department includes four sampling points. The sampling point was chosen because it is close to the work process that produces noise potential. The first measurement (point 1) is carried out in the welding room, in which there is an angle and welding process. The results of the noise measurement at point 1 can be seen in Figure 2.

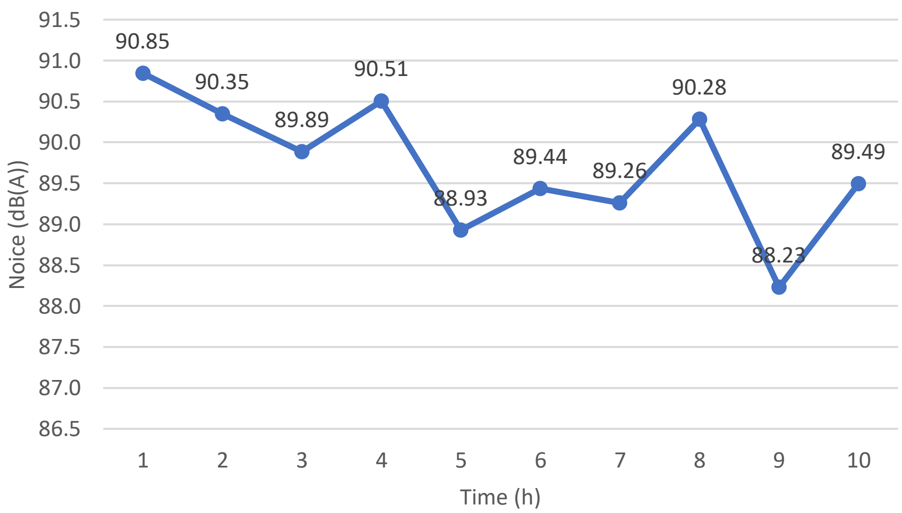

Figure 2. Noise Measurement Results in 1st Station

From 10 measurements in the welding room, all noise values exceed the threshold value. Noise in this area is caused using grinders for bevel making. In addition, according to (Satwiko, 2004), the room factor affects the noise intensity because sound waves are trapped, bounce, penetrate the walls, propagate, and propagate through the walls and floors of the room. Therefore the noise value in this area is high. The noise sample's second measurement (2nd station) is carried out at the intersection between the pipe cutting process, turning, and material storage area. The results of the noise measurement at 2nd Station can be seen in Figure 3.

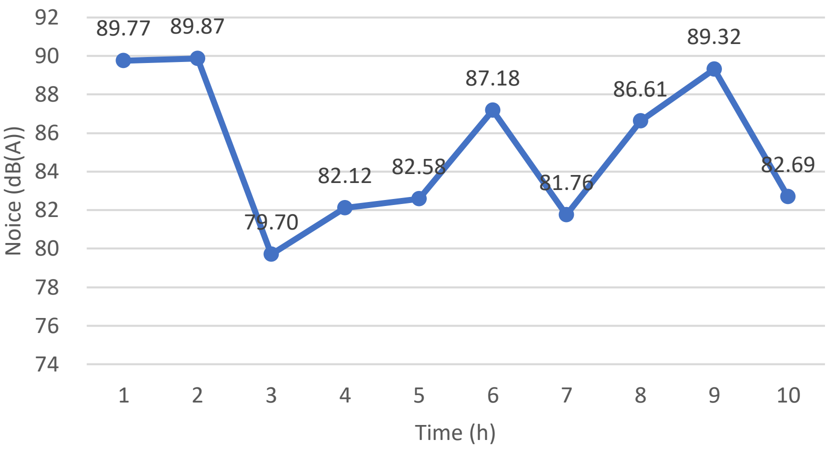

Figure 3. Noise Measurement Results in 2nd Station

2nd Station is 5 meters from the first measurement in the welding chamber. At this point, the measurement results tend to fluctuate at the threshold value. Unstable noise can be caused by the many tools used in this area, such as cutting wheels, drilling machines, and lathes. The maximum value obtained in this area is 89.77 dB(A) caused by using the cutting wheel to cut the pipe because when the cutting wheel is in use, the noise intensity increases. Pipe cutting is done intermittently. Therefore, the noise value in this area is unstable. Furthermore, the results of the noise measurement at 3rd Station can be seen in Figure 4.

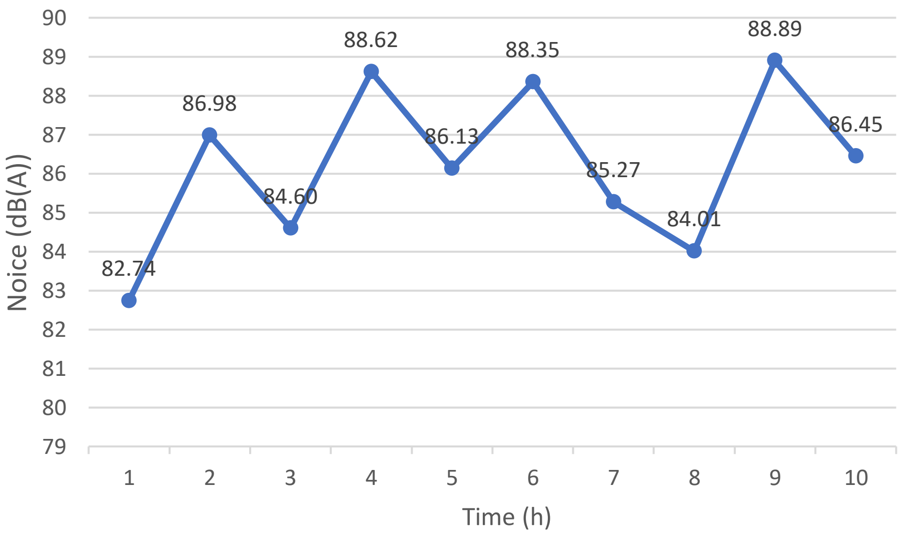

Figure 4. Noise Measurement Results in 3rd Station

The noise measurement at this point is carried out by a sanding/brushing work process using a wire grinder and sandpaper with a measurement distance of 6 meters from the previous one. This process is located near the side exit of the fabrication area; there is a possibility that sound waves can escape, which causes the noise intensity that is read on the sound level meter to decrease. The sanding process is carried out continuously with a short lag time. The value in this area is not much different from the measurement at 2nd Station, which is 0.07 dB(A). The location and measure results at the last point can be seen in Figure 5.

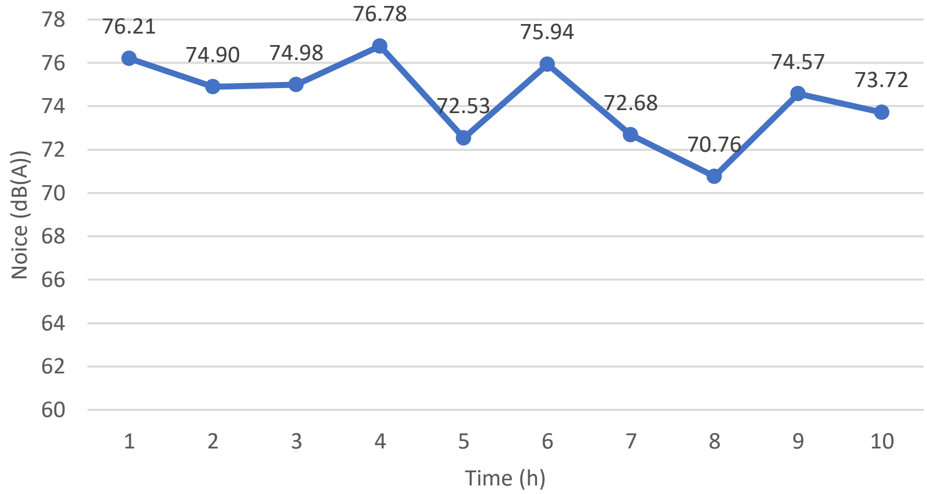

Figure 5. Noise Measurement Results in 4th Station

The measurement at 4th Station has a location far enough from 3rd Station, which is about 10 meters. This measurement has a value below the threshold value, and this can be caused in the restroom no activity makes noise and adds noise intensity. Measurements are intended to compare noise values when close to the noise source, and there is no noise source in the M/RS fabricated area. The overall noise measurement results can be seen in Table 1. An equivalent value is a value that represents the sound level concerning time. The 1st Station has the highest noise intensity of 89.79 dB with an exposure time of 8 hours. Point 1 is a welding place with a small area so that noise exposure occurs continuously. The lowest point is at 4th Station, with a noise intensity of 74.65 dB. This happens because the 4th Station is a restroom with minimal activities and is far from noise sources so that the noise intensity is more diminutive. Noise in the M/RS fabrication area is caused by grinding wheels, cutting wheels, tapping pipes, and drills. The use of grinders causes the most significant noise contributor. Three work processes use subs, namely cutting iron, making bevels, and brushing. These three processes have noise values above the threshold value.

The three work processes have a large quantity of work, so that they contribute more noise. Noise analysis on the use of grinders in the fabrication area has been carried out previously by Setyaningrum (Setyaningrum & Widjasena, 2014), who explained that the fabrication area that uses grinders, iron hammers, electric drills, and compressors has high noise values. The result of noise measurement in the fabricated area by Setyaningrum has a value of 95.6 dB. There is a slight difference with the measurement results in the M/RS fabrication. This can be caused by the shape of the building in the larger fabrication area, and the grinding process is carried out near the door so that sound waves can come out and the number of noise-causing tools used by M/RS fabrication is less than the equipment.

Tabel 1 Equivalent Value of Noise Measurement Results

Location	**Noise Intensity**		**Standard**	**Exposure Time**
Welding room	89,79	dB(A)	85 dB(A)	8 hours
Cutting & turning area	86,63	dB(A)	85 dB(A)	8 hours
Sanding area	86,56	dB(A)	85 dB(A)	8 hours
Rest area	74,65	dB(A)	85 dB(A)	8 hours

Prolonged and high-intensity noise exposure can cause noise-induced hearing loss (NIHL), a gradual loss of hearing. Noise that occurs in the fabrication area has a value of 74 - 90 dB (A). This is a high value, and the damage that occurs is in the heavy category so that the effects caused can only be heard when shouting. A decrease in health levels caused by noise can decrease work productivity due to the disruption of good communication between fellow workers (Rahmawati, 2016). The company's control is that it is mandatory to wear earplugs, but many workers do not wear earplugs in the fabrication area. From the interview results, workers who do not wear earplugs are discomfort in the ears, have difficulty communicating with other workers, and disrupting work activities. It is necessary to supervise the control efforts that have been carried out by the company so that its implementation is effective.

The manufacturing area has a building form that can take advantage of natural lighting, namely sunlight. The sun's rays enter through the ventilation and doors on the side of the building, but when the weather is cloudy and raining, the lighting switches to lights. A building that uses natural lighting will look more significant and livelier and increase productivity and occupational health. The standard used in the measurement is a minimum of 200 Lux according to use for work with machines and rough assembly (Menteri Ketenagakerjaan, 2018). Good lighting will affect the quality of work and accuracy. Lighting measurements are carried out using the local lighting method at 3 location points requiring sufficient lighting.

Based on Table 2, the lighting measurements measured three times did not affect the lighting intensity in the M/RS fabrication area. This is supported by the sunny weather so that the sunlight entering the M/RS fabrication area is quite good. The first measurement (1st station) of lighting is carried out in the welding room. The welding room has an area of 12 m^2 in which there is a process of welding work and making angles. The lighting in this room significantly affects workers because the bevel manufacturing process requires accuracy. The erosion at the end of the pipe forms a suitable angle so that it affects the strength of the connection when it is welded. The measurement results show that point 1 has the smallest Lux result value compared to other stations with an average of 168.7 lux. This is because point 1 is in the room, so it has a light that depends on the presence of sunlight. The lamp used in the welding room is an L.E.D. Lamp, which has a light flux of 1050 lm. The cause of dim lighting in the welding room can be caused by dirty lamp conditions or damage to the electrical network so that the light released is not optimal. This follows Fayrina (Ramadhani, 2012), which states that lighting levels that do not meet standards can be influenced by working environmental conditions such as broken lamps. The cause of a dirty lamp is due to welding dust and welding fumes attached to the light.

Tabel 2 Equivalent Value of Lighting Measurement Results

Location	**LUX**			**Average**	**Standard**
	10.03 WIB	**13.27 WIB**	**15.12 WIB**		
1	169	168	169	168,7	200 Lux
2	203	205	201	203,0	200 Lux
3	202	201	201	201,3	200 Lux

Lack of light can cause eye fatigue caused by the intensive tension in the muscles that occurs due to prolonged meticulous work and stress on the eye's retina caused by local light contrast (Sastrowardoyo, 1985). 2nd station lighting measurements are carried out on a lathe because the turning process requires sufficient lighting. The results of the lighting measurement at 2nd Station get an average value of 203 lux, which follows the threshold value of a minimum of 200 lux. The lighting at this point affects the intensity of natural light that enters the fabrication area so that it can take advantage of natural lighting during the day. The benefits of natural lighting include increasing visual comfort, avoiding nesting mosquitoes, and increasing health because morning sunlight is good for body health (Nugroho, 2018). Local lighting measurements on the rated lathe must have lighting according to standards. Permenaker no. 5 of 2018 states that turning work is included in careful work; lathes require accuracy. The manufacture of the shaft on the pipe follows the size and design.

Conclusion

The results showed a discrepancy between the noise values in the three work areas, which did not meet the quality standards. For this reason, the use of personal protective equipment is significant to avoid damage to the workers' sense of hearing. In addition, the lighting in the work area also meets the standard, which is above 200 LUX.

Reference

Lestari, N. A. (2018). *Perlindungan Hukum Terhadap Keselamatan Dan Kesehatan Kerja Karyawan Dalam Proses Produksi Pada Pt. Asia Citra Di Kabupaten Rokan Hilir*. Universitas Islam Negeri Sultan Syarif Kasim Riau.

Menteri Ketenagakerjaan. (2018). *Peraturan Menteri Ketenagakerjaan RI Nomor 5 Tahun 2018 tentang Keselamatan dan Kesehatan Kerja Lingkungan Kerja*.

Nugroho, A. M. (2018). *Arsitektur Tropis Nusantara: Rumah Tropis Nusantara Kontemporer*. Universitas Brawijaya Press.

Purwanti, I., Poerwanto, P., & Wahyuni, D. (2013). Analisa Pengaruh Pencahayaan Terhadap Kelelahan Mata Operator Di Ruang Kontrol Pt. Xyz. *Jurnal Teknik Industri USU*, *3*(4), 43–48.

Rahmawati, F. N. (2016). *Hubungan intensitas kebisingan dengan penurunan daya dengar tenaga kerja bagian produksi di PT Wijaya Karya Beton Tbk ppb Majalengka*.

Ramadhani, A. F. (2012). *Analisis Tingkat Pencahayaan dan Keluhan Kesehatan Mata Pada Pekerja di Area Produksi Pelumas Jakarta. PT Pertamina (Persero)*. Universitas Indonesia.

Ridley, J. (2008). *Ikhtisar Kesehatan & Keselamatan Kerja Edisi Ketiga*. Erlangga.

Sastrowardoyo, S. (1985). *Meningkatkan Produktivitas Dengan Ergonomi*. Pt. Pustaka Binaman Pressindo.

Satwiko, P. (2004). *Fisika Bangunan, edisi ke-2*. Andi Offset.

Setyaningrum, I., & Widjasena, B. (2014). Analisa Pengendalian Kebisingan pada Penggerindaan di Area Fabrikasi perusahaan Pertambangan. *Jurnal Kesehatan Masyarakat (Undip)*, *2*(4), 267–275.

Simanjuntak, P. J. (1994). *Manajemen Keselamatan Kerja*. HIPSMI.

Suryawan, I. W. K., & Lee, C.-H. (2023). Citizens' willingness to pay for adaptive municipal solid waste management services in Jakarta, Indonesia. *Sustainable Cities and Society*, *97*. https://doi.org/https://doi.org/10.1016/j.scs.2023.104765

Sutrisno, A. D., Chen, Y.-J., Suryawan, I. W., & Lee, C.-H. (2023). Building a Community’s Adaptive Capacity for Post-Mining Plans Based on Important Performance Analysis: Case Study from Indonesia. In *Land* (Vol. 12, Issue 7). https://doi.org/10.3390/land12071285

Widyastuti, A. D. (2018). Hubungan Stres Kerja Dengan Kelelahan Kerja Pada Pekerja Area Workshop Konstruksi Box Truck. *The Indonesian Journal of Occupational Safety and Health*, *6*(2), 216. https://doi.org/10.20473/ijosh.v6i2.2017.216-224