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ANALYSIS OF NOISE INTENSITY IN THE RAILWAY FACILITY MAINTENANCE WORK ENVIRONMENT

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Abstract:

One example of work that has a high risk of work in the world of railways is the maintenance of railway facilities. One of the risks posed comes from the noise generated from the maintenance activities carried out. This study used a Soundlevel Meter tool to measure noise intensity in the railway facility maintenance work environment. The measured noise level is the equivalent noise level. This study also seeks to find out the impact and what impact prevention steps have been taken. The equivalent noise level in the work environment, especially in the final test, is 90.82 dB. The impact of noise experienced includes physiological disorders, psychological disorders and social disorders. Common physiological disorders experienced by facility nurses are the appearance of nausea, insomnia and shortness of breath. This feeling of discomfort will diminish and become less and less felt after some time. In the sense of hearing is also not found permanent interference. Psychological disorders can be in the form of discomfort, lack of concentration, insomnia, emotional instability, feelings of irritability to colleagues and superiors, and feeling tired quickly. One form of social disorder that can appear is masking effect, which is a lack of clear communication due to sounds that cover hearing. Noise control carried out is by isolating (separating facility nurses from noise sources), periodic toolbox meetings, administrative arrangements (setting working hours and facility nurses), providing K3 training, routine health checks, and using PPE properly and correctly.

Keywords: noise intensity, maintenance facilities, trains

INTRODUCTION

Technological advances, the use of certain materials in the production process, how to detect work risks are some of the things that will affect occupational safety and health in the work environment (Putra, 2017). The opinion that accidents and occupational diseases are inevitable has been abandoned today. The company's management is currently competing to create a safe and comfortable work environment for its workers (Zein, 2019). This is in line with the need to create a safe, comfortable and hygienic work environment and a healthy, safe and productive workforce is increasingly needed (Gu et al., 2009)

Another thing that cannot be separated is the side effects caused by the work process. Noise is one example of things that cannot be separated from activities in the work environment (Fithri & Annisa, 2015). Noise cannot be separated from the development of industrialization because almost all production processes in industry will cause noise (Fithri & Annisa, 2015) Industrial noise has long been a problem that has not been completely overcome properly (SIMANJUNTAK, 2019). This of course can be a serious threat to workers because there is still the possibility of experiencing problems with the sense of hearing. The risk of hearing damage can be caused by high-intensity noise exposure or cumulative overexposure time (Susiyanti & Imanto, 2020). Noise can have an effect on exposed employees. According to Sasongko et al (2000) the effects caused are psychological effects, intervening in communication and physical effects resulting in decreased hearing ability and pain at a very high level.

One example of work that has a high risk of work in the world of railways is the maintenance of railway facilities. Daily maintenance of railway facilities is carried out ranging from daily maintenance to overhaul. Maintenance of facilities carried out on locomotives, carriages, diesel trains, electric rail trains and special equipment. Facility maintenance work using simple tools to equipment that has a high risk. Some facility maintenance jobs will force facility nurses to use equipment that may pose a health risk. One of them is noise. This is the background of the research entitled

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Research Objectives

a) Identify the noise level in the work environment.
b) Identify the impact of noise in the work environment.
c) Develop measures to prevent the impact of noise in the work environment.

Noise

The definition of noise according to the Decree of the Minister of Environment no 48 of 1996 is an unwanted noise from businesses or activities at a certain level and time that can cause problems with human health and environmental comfort (Hidup, 1996). (Fithri & Annisa, 2015) revealed that noise is an unwanted sound because it does not fit the context of space and time so that it can cause interference with human comfort and health. According to the International Labour Organization (ILO), noise is all unwanted noise originating from production process equipment and/or work equipment that to some degree can cause hearing loss (Faidah & Rahmandanti, 2022).

Menurut Arlan (2011) Noise is divided into 4 (four), namely :

a. Continuous noise

This noise is uninterrupted with fluctuations not exceeding 6 dBA. This noise is divided into 2, namely wide spectrum (noise with a wide frequency) and norrow spectrum (relatively

fixed noise with certain frequencies 500 Hz, 1000 Hz, 4000 Hz). Suppose a circular saw and a gas valve.

b. Intermittent noise

Noise that does not occur continuously but there is a pause period. For example, traffic of motor vehicles, airplanes and trains.

c. Impulsive noise

This type of noise has changes in noise intensity exceeding 40 DBA in a relatively fast period of time and tends to be unpredictable. Usually this will cause a shock effect for the listener.

d. Repetitive impulsive noise

This repeated impulsive noise is almost the same as impulsive noise but it happens repeatedly.

The source of noise in the workplace comes from the equipment and machinery that is in operation. (Rasmitadila et al., 2020) revealed several sources of noise among them.

a. Operate production machines that are quite old.

b. Too often operate working machines at a fairly high working capacity in a fairly long period of operation.

c. Maintenance and repair system of makeshift production machines. Usually repairs are carried out on machines that have suffered severe damage.

d. Make partial modifications/changes/replacements to production machine components without proper attention.

e. Installation and placement of engine components is incorrect, especially in the connecting parts between engine models (bad connection).

f. Use of tools that are not in accordance with their function.

Equivalent noise level

The equivalent noise level is one of the calculations of the sound pressure level where a certain value of sound that fluctuates over a certain time is equivalent to a steadystate sound level at the same time interval (Haryanto, 2011)

The average sound pressure level over time (Leq) can be found through the following equation:

$$\text{Leq} = 10 \log \frac{1}{N} \left(\sum nn * 10^{\frac{Li}{10}} \right)$$

Information:

Leq : equivalent noise level (dB)

N : number of parts measured

Li : noise level (dBA)

Nn : frequency of occurrence of Ln (noise level

According to the International Labour Organization (ILO), noise is a source of unwanted sound originating from production process equipment and / or work equipment at a certain level can cause hearing loss (Laziardy, 2017). According to (Septiana, 2017) There is a relationship between noise intensity and noise-induced hearing loss in workers exposed to noise. According to the Minister of Manpower and Transmigration (2011) on NAB in the workplace, the noise NAB of 85 dBA is set as the highest intensity and is a value that is still acceptable to workers without

causing illness or health hearing loss in daily work for a time not exceeding 8 hours a day or 40 hours a week.

Noise impact

Unwanted sounds will cause interference to comfort and health. Sound is a mechanical wave delivered by a medium. The usual medium of conduct is air. The quality and quantity of sound is determined by, among others, loudness, frequency, interstitial period and duration. Noise can cause disturbances including:

1. Physiological disorders

In general, noise can be very annoying both intermittent and sudden coming. According to Hendiana, et al (2015) this disorder can cause an increase in blood pressure by ± 10 mmHg, increased pulse, contraction of peripheral blood vessels, especially in the hands and feet. Another complaint that can be felt is the complaint of dizziness spinning and felt extraordinary (vertigo). It is caused by a balance disturbance centered in the area of the labyrinth or cochlea in the ear area (Firmadani, 2020).

Another disorder that can occur is a problem with hearing. This hearing problem can be divided into 2 (two) types, namely:

a. Hearing damage

Hearing damage results from damage to the organs in hearing. Hearing loss (deafness) is the most serious hearing loss. Deafness can be progressive or initially temporary, but if it works continuously then hearing will be lost permanently / deaf (Soetirto, 1998).

b. Hearing loss

Hearing loss is indicated by shifting a person's hearing threshold to be higher than the normal human threshold.

This hearing loss can be progressive or constantly exposed to noise so that hearing disappears permanently.

2. Psychological disorders

(Manurung et al., 2022) revealed that psychological disorders are caused by various factors, one of which is socio-psychological factors, namely work and life, social environment, life events. Physical environments that are too stressful, such as noise, temperature or heat that is too high, humid air, lighting in a poor work environment can be a trigger factor for high psychological disorders in workers. Buchari (2007) explained that psychological disorders can be in the form of discomfort, irritation, confusion, fear, increased emotions, difficulty concentrating, reduced motivation to think and work. Exposure to noise in the long term will cause psychological effects including:

a. Sleep disturbance

Sleep disorders experienced by a person are characterized by shifting levels of deep feelings during sleep to be lower. Reduced comfort and a feeling of restful sleep will affect the decline in fitness.

b. Feeling disturbed (annoyance)

Disturbed feelings are a person's response to the noise around them. The high level of interference and the length of time a person is in an environment where the noise level is large enough will cause someone to assume that noise is not too important.

c. Stress

Noise that exceeds 85 dBA can cause stress to a person. This stress is characterized by enlarging the pupils of the eyes, rising blood pressure and increased stomach acid. In more severe cases, noise can also cause mental pain, restlessness and a feeling of red easily.

3. Social disorders

Noise can also affect a person's socializing patterns. One of them is the pattern of communication that must be carried out between people in the work environment. This is prone to causing misunderstandings in work and causing other social problems.

Train Facility Maintenance

According to (Hidayat, 2015) the principles of care activities are:

1) Reduce downtime as small as possible,

2) Avoid unplanned breakdowns.

The classification of maintenance is divided into planned maintenance and unplanned maintenance. Planned care is care that is organized and carried out with forethought, control and recording with a predetermined plan.

METHOD

Variable

The first measurement variable is noise. This noise is measured with Soundlevel Meters in locations that are expected to have high noise levels. The second measurement carried out is a measurement of the presence or absence of the impact felt by the facility nurses in the Final Test section. The next data collection is what Occupational Safety and Health program has been implemented as a measure to prevent and overcome the impact of noise.

Research subjects

The subjects of this study were railway facility nurses in the Final Test section of Balaiyasa Yogyakarta.

Time and place of research

The time of conducting the research is planned to be 5 (five) days starting from noise measurement, data collection on the impact and noise impact prevention measures that have been and will be carried out.

Measuring instruments

The first measurement carried out is the measurement of noise intensity using a Soundlevel Meter. This measurement is carried out at the maintenance place of railway facilities that are estimated to have high noise levels, namely the Final Test. The next measurement is the measurement of the impact of noise received by railway facility nurses. This measurement uses observation and interviews with personnel Nurse Facilities. The next measurement is the prevention method that has been and will be carried out by Balaiyasa Yogyakarta.

Procedure

The first stage in this study is to measure noise in the railway facility maintenance work environment. The location of the noise measurement was selected several places that have high noise potential. Some of these measurements will be compared to find out which facility maintenance has the highest noise. After the procedure, it was found that the part that had the highest noise level was the Final Test.

The second stage is the collection of data on the impact of noise experienced by facility nurses. This data collection was carried out by questionnaires containing items of noise impact

both physiologically, psychologically and socially. Trials were carried out on measuring instruments used with the used tryout method.

The third stage is to develop a program to prevent the impact of noise experienced by facility nurses. This prevention program will look again at what noise impacts are most experienced by railway facility nurses.

Analysis techniques

The first step of analysis is to measure noise in the railway maintenance work environment. This measurement uses the Soundlevel Meter.

The second analysis was conducted on questionnaires regarding the impact of noise experienced by railway nurses. This step is carried out through the process of collecting, managing, classifying and interpreting the data that has been obtained.

The next step of analysis is to compile a noise impact prevention program based on the results of the impact questionnaire analysis that has been carried out previously.

RESULTS AND DISCUSSION

Noise Measurement

Noise measurement is carried out with the following stages:

1. Make sure the Soundlevel Meter tool is ready to use.

2. Set the measurement scale of the Soundlevel Meter tool.

3. Place the Soundlevel Meter 1 (one) meter away from the sound source and there is no obstruction between the microphone and the sound source.

4. Take measurements for 10 (ten) minutes and record every 5 (five) seconds.

5. Take measurements during the required time span.

Based on the results of these measurements, the noise intensity is then known. The noise measurements made are day noise and night noise.

Noise equivalent noise is done to determine the noise intensity of steadystate noise in a certain time range. Noise equivalent can be calculated by the following formula:

$$\text{Leq} = 10 \log \frac{1}{N} \left(\sum nn * 10^{\frac{Li}{10}} \right)$$

Based on measurements that have been made, it is known that the equivalent noise in the maintenance area of railway facilities is 90.82 dB. This noise intensity applies in the Final Test section in the railway facility maintenance area. The final part of this test carries out the task of checking the initial facilities that have been completed carrying out maintenance at Balaiyasa Yogyakarta. The final part of this test will perform a static test on the facility. Dynamic testing of facilities will be carried out in track running tests and cross tests. The final part of this test will carry out Quality Control (QC) on the maintenance of facilities that have been carried out. Testing will be carried out on each component of the facility to ensure all aspects are running properly. The activities that take place in this final test will be closely related to machines and equipment

that emit noise risks. Therefore, this final test requires people who are committed to preventing the impact of noise that is vulnerable to experience.

Noise impact

The noise level in the final test was 90.82 dB above the normal threshold of workplace noise of 85 dB. The impact of noise includes several aspects, including: physiological disorders, psychological disorders and social disorders.

1. Physiological disorders

Physiological disorders are usually associated with aspects of the health of railway facility nurses. Other physiological disorders affected are blood pressure, pulse, peripheral blood vessels, especially hands and feet which can cause dizziness / headaches. This is because noise can stimulate the situation of vestibular receptors in the ear causing the effect of dizziness / ear pain.

The nurse responds to noise with nausea, insomnia and shortness of breath in response to noise stimuli to the nervous system, organ balance, endocrine glands, blood pressure, digestive system and electrolyte balance. This discomfort is usually felt by the facility nurse at the beginning of working in this section. This feeling of discomfort will diminish and become less and less felt after some time.

Another physiological disorder that is feared is problems with the sense of hearing. This disorder begins with a slow decrease in hearing and this interference will decrease as it leaves the source of the noise. However, if you work continuously in areas exposed to noise, there will be persistent hearing loss and cannot return to normal. The means nurse initially felt discomfort in the sense of hearing. But it diminishes and doesn't feel like a nuisance after some time. This is due to the use of Personal Protective Equipment (PPE) properly.

2. Psychological disorders

This psychological disorder can be in the form of discomfort, lack of concentration, insomnia and emotional instability. If this noise is received for a long time, then this psychological disorder can become a psychosomatic disease in the form of gastritis, heart, stress, fatigue and others.

One of the psychological disorders that is felt is a disturbance of concentration at the beginning of work. Concentration disorders can include lack of accuracy or thoroughness, difficulty focusing, difficulty in completing work, often asking colleagues, and unsatisfactory work results. This concentration disorder will decrease and become increasingly neglected. Another psychological disorder is feeling irritable to colleagues Work or superiors, irritable, and feel tired quickly. In this case, this noise will disrupt the emotional stability of workers. The seriousness of a person's psychological disorder will vary depending on the attitude in responding to it. Facility nurses use breaks to socialize with colleagues to reduce psychological disorders that may arise.

3. Social disorders

One form of social disorder that can arise is the masking effect, which is a lack of clear communication due to sounds that cover hearing. Communication will usually be done by shouting. This interference will allow for the mistake of not hearing any cues or danger signs.

Noise control

It is very unlikely that the facility nurse will leave the facility care center when the maximum time limit for exposure to noise has almost passed while the facility maintenance work is still ongoing. This shows that the nurse of the facility is very likely to be exposed to noise. Noise control is carried out by Balaiyasa Yogyakarta as an effort to minimize the risk of exposure to noise in railway facility nurses. Control is carried out in various ways to minimize the impact caused. Reducing the impact of noise is most effective by eliminating noise sources. But this of course cannot be done because the source of noise comes from maintenance machines and the facilities themselves.

One way of noise control is done by doing insulation. This method is used by separating the noise source from the facility nurse who performs the test. The placement of facility nurses in a soundproof place will reduce the perceived noise. Occasionally the facility nurse will come out of the soundproof room to check the facility being treated. This is when Personal Protective Equipment (PPE) in the form of earplugs is used. This PPE is even still used in a soundproof room to ensure it is not exposed to noise during the final test. The use of PPE is required for use during the final test which is static. Meanwhile, in the dynamic final test, the use of PPE can adjust to needs.

Another control carried out is to clarify and reinforce the need for the use of PPE. In this case, the PPE used is an earplug. The selection of PPE is adjusted to the possibility of noise exposure received. Each section has PPE needs that are tailored to the ongoing treatment. This control will be accompanied by training on Occupational Safety and Health (K3) related to the use of PPE in the work environment. This K3 training is given regularly by raising several issues that are happening. The implementation of the toolbox meeting is also an important agenda to be held at the beginning of starting work. Toolbox meetings are specific to their respective work environments and do not require a special area or room. This is done simply by conducting briefings in open areas. This meeting toolbox contains communication for the introduction or reminder of all types of procedures / rules in terms of occupational safety and health. Toolbox meetings are useful for anticipating and making more aware of the importance of occupational safety and health related to facility maintenance work in the work environment. This activity is carried out in each section by taking into account the maintenance work of facilities and needs regarding K3 equipment. One example is the correct use of PPE in the work environment. The use of PPE in the work environment will always be under the supervision of the Occupational Health and Safety Management System.

Arrangements for facilities nurses exposed to noise must also be carried out by the agency/company. Facility nurses who are exposed to high intensity noise for a long time will pose a high risk as well. This is the background of the policy in regulating the placement of facility nurses who do work in one particular section. If the part is felt to have a high potential for exposure, it will be replaced with another facility nurse. This also applies to facility nurses who feel the effects of noise both physiologically, psychologically, and socially. One of the impacts of this noise can be seen by the implementation of health assessments carried out regularly for all facility nurses.

CONCLUSION

Based on the research that has been done, it can be concluded as follows:
The equivalent noise level in the work environment, especially in the final test, is 90.82 dB. The final part of this test will carry out Quality Control (QC) on the maintenance of facilities that have been carried out before.

The impact of noise experienced includes physiological disorders, psychological disorders and social disorders. Common physiological disorders experienced by facility nurses are the appearance of nausea, insomnia and shortness of breath. This feeling of discomfort will diminish and become less and less felt after some time. In the sense of hearing is also not found permanent interference. Psychological disorders can be in the form of discomfort, lack of concentration, insomnia, emotional instability, feelings of irritability to colleagues and superiors, and feeling tired quickly. One form of social disorder that can arise is the masking effect, which is a lack of clear communication due to sounds that cover hearing.

Noise control carried out is by isolating (separating facility nurses from noise sources), periodic toolbox meetings, administrative arrangements (setting working hours and facility nurses), providing K3 training, routine health checks, and using PPE properly and correctly.

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