Noise Risk Assessment Using Noise Mapping Analysis Method and Noise Control at a Steel Company in Cilegon

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ABSTRACT

Introduction: Physical factors found in the workplace can have an impact on occupational health and safety; one example of these physical factors is high noise intensity. One of the workplaces that have high noise intensity is a steel manufacturing company. The purpose of this study is to determine the noise risk based on noise mapping and analyse efforts that have been made in the Continous Tandem Cold Mill area in a steel company in Cilegon. **Methods:** The method used in this study was descriptive method. The variables used were the results of noise intensity measurements. The data were collected by means of literature study, field observation and noise measurements. The data obtained were then analysed using a descriptive method and were used as a basis in developing noise mapping. **Results:** Based on noise mapping, the welder area has the highest noise intensity of 91.1 - 94 dBA. Efforts to control noise intensity that have been carried out in the company are administrative control and personal protective equipment. **Conclusion:** From the results of noise intensity measurements in the Continous Tandem Cold Mill area of a steel company in Cilegon, it can be concluded that the measurement point is 76% - 100% and that the noise measurement points exceed the threshold value stipulated in the Regulation of the Minister of Manpower of the Republic Indonesia Number 5 of 2018. However, the steel company in Cilegon has made several efforts to reduce the noise intensity.

Keywords: noise, noise mapping, steel company

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INTRODUCTION

Occupational safety and health is a very important aspect to ensure the protection of workers and company assets, by controlling all aspects that endanger workers. This control is also aimed at preventing occupational accidents, occupational diseases and ensuring the compatibility between work equipment or work machines and workers (Nurmianto, 2018).

The above statement is in accordance with Law Number 13 of 2003 concerning Manpower in article 28 paragraph 2, which states that occupational safety and health efforts are carried out to protect workers / laborers in order to achieve optimal work productivity (Law of the Republic Indonesia, 2003). Based on this regulation, it can be seen that one of the important factors in the production process is labor, so efforts to prevent accidents in workers are highly needed (Andani, 2016).

Based on statistical data from the International Labor Organization (ILO), it is stated that in the world there are around 380,000 workers or 13.7% of the 2,780,000 workers who die due to work accidents each year. The main cause of work accidents is the low awareness of workers about the importance of implementing Occupational Safety and Health (OSH) in the workplace (International Labor Organization, 2018).

This is in accordance with research conducted by the National Safety Council which stated that 88% of work accidents are caused by unsafe behavior, 10% of work accidents are caused by dangerous conditions, while 2% of work accidents have no known cause. Unsafe behavior in workers occurs because of the perceptions and belief of workers who feel they are already experts, supported by the absence of work accident cases during work. Therefore, the level of concern to work according to the procedure reduces (Rinawati, 2018).

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In an industry with a large production capacity and a large number of workers, the potential for hazards will be higher. Directly or indirectly, these potential hazards will affect workers. One of the potential hazards is the potential for physical hazards that can cause health problems to workers, for example high noise intensity (Maulana, Jayanti and Suroto, 2016).

Noise is a sound that is unwanted and a stimulus to the auditory nerve cells that causes waves to propagate through the air or other conductors (Suma'mur, 2009). The sense of hearing will slowly decrease due to the high intensity noise. Factors that cause hearing loss include length of exposure, individual sensitivity and noise levels (Andriani, 2016).

The World Health Organization (WHO) stated that in 2000 about 250 million people worldwide had hearing problems and around 75 - 140 millions of them were from Southeast Asia. Thus, it is estimated that there are one million workers in Indonesia who are exposed to the intensity of noise at work (Hamid, 2020). According to the Regulation of the Minister of Manpower of the Republic Indonesia Number 5 of 2018 about Occupational Safety and Health at Work Environment, the threshold value for noise intensity in the workplace is 85 dB(A) for exposure for 8 hours/day or 40 hours/week.

A steel company in Cilegon is the first steel production company in Indonesia, which has been operating since 1970. This steel manufacturing company is a company that has the potential physical hazards in the form of high noise intensity, which can cause hearing loss to workers. This is because workers are in direct contact with machinery or production equipment that causes noise. To prevent a serious impact on workers, a steel company in Cilegon has carried out various control measures according to the control hierarchy such as engineering control, administrative control and procurement of Personal Protective Equipment (PPE). In order for the control measures to be effective, then the control must be adapted to noise mapping based on the results of the noise intensity measurement points. Noise mapping is a visual representation of the noise level that can be seen from each measurement point that has been made.

Based on the results of noise intensity measurements that were carried out by the safety officers in 2017 in each production process, it can be seen that the Continuous Tandem Cold Mill area had the highest noise level reaching 101.1 dB(A) compared to other areas at a steel company in Cilegon.

From this, the researchers are interested in conducting research on noise risk assessment based on noise mapping analysis along with control measures against noise intensity carried out by the Continuous Tandem Cold Mill area at a steel company in Cilegon. The purpose of this study is to determine the risk of noise using a noise mapping method and to analyze the control efforts that have been carried out in the Continuous Tandem Cold Mill areas at a steel company in Cilegon.

METHODS

The method used for this research was a descriptive method, which tries to describe and analyze objects according to what they are. This research was conducted in the Continous Tandem Cold Mill area at a steel company in Cilegon, from February to April 2018. The variables used in this study were the results of noise intensity measurements at work using a sound level meter, noise mapping and control measures against noise exposure. Guidelines for measuring the noise intensity were based on SNI 7231: 2009, including the calibration of the sound level meter.

This research took the objects of research in the Continous Tandem Cold Mill area at a steel company in Cilegon. The Continous Tandem Cold Mill area is divided into two measurement points, namely Entry-Welder Continous Tandem Cold Mill area and Exit Continous Tandem Cold Mill area. The Entry-Welder Continous Tandem Cold Mill area has a building area of 918 square meters and 34 measurement points. Meanwhile, the Exit Continous Tandem Cold Mill area has a building area of 232 square meters and 28 measurement points.

Sources of data used in this study were primary data and secondary data. Primary data were obtained through noise intensity measurements and direct observation about building area measurement, measurement points and identification of noise sources. Secondary data were obtained from company records and documents related to noise at a steel company in Cilegon. The results of the noise intensity measurements were compared with the noise threshold value based on the Regulation of the Minister of Manpower of the Republic Indonesia Number 5 of 2018. The data obtained were then analyzed descriptively and were used as a basis for making noise mapping so that it could be used to

compile control measures against noise intensity in the Continuous Tandem Cold Mill areas at a steel company in Cilegon.

RESULTS

The production process of the Continous Tandem Cold Mill area at a steel company in Cilegon is a process of reducing and diluting steel sheets as desired by customers through a cold rolling process which is carried out under temperature. The rolling process in the Continous Tandem Cold Mill area uses five functioning stands. The equipment is controlled by computers having a maximum rolling speed of 1980 meters/min and having the ability for diluting steel sheets by a maximum of 92%.

The Continous Tandem Cold Mill process is divided into two areas, namely the Entry-Welder Continous Tandem Cold Mill area and the Exit Continous Tandem Cold Mill area. The following is an overview of the production process of the Continous Tandem Cold Mill area at a steel company in Cilegon.

Noise Mapping in the Continous Tandem Cold Mill Area

Noise Mapping in the Entry-Welder Continous Tandem Cold Mill Area

The Entry-Welder Continous Tandem Cold Mill area has a building area of 51 × 18 meters. The following is a mapping image of the noise intensity measurement points in the Entry-Welder Continous Tandem Cold Mill area at a steel company in Cilegon.

Determination of the coordinate points was based on the area of research location. The X coordinate point is the length of the building, and the Y coordinate point is the width of the building. In the Entry-Welder Continous Tandem Cold Mill area, there are 34 measurement points with different results of noise intensity. The type of noise generated from the production machines in the Entry-Welder Continous Tandem Cold Mill area is a continuous type of noise.

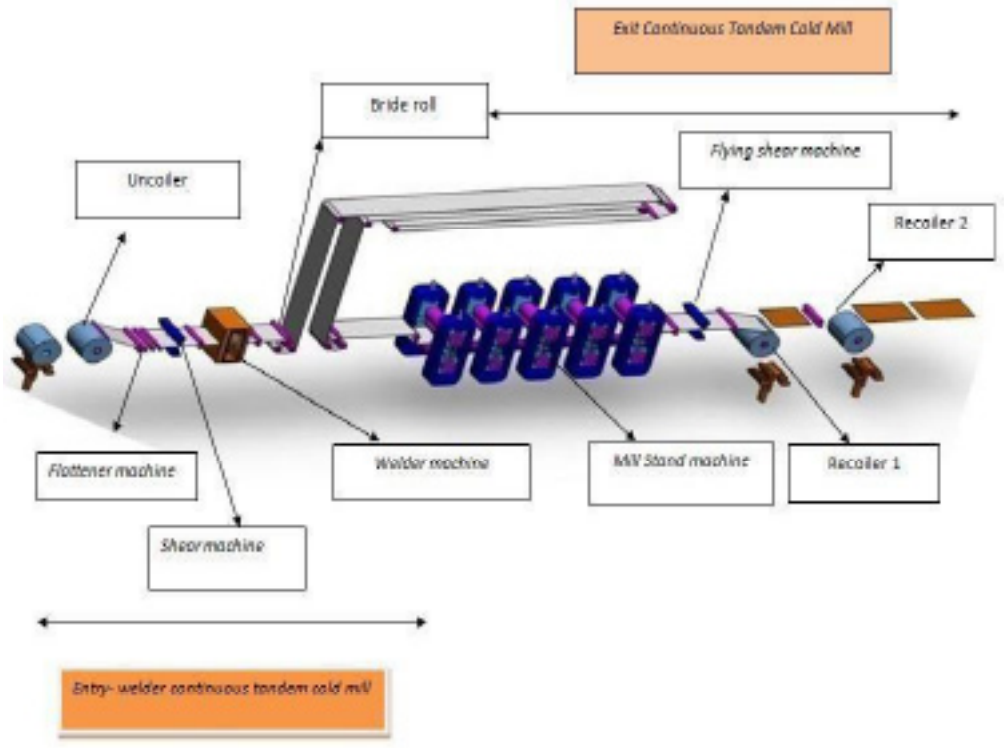

Figure 1. Production Process in the Continous Tandem Cold Mill Area of a Steel Company in Cilegon in 2018

From Table 1, it can be seen that the results of the noise intensity measurementsin the Entry-Welder Continous Tandem Cold Mill areas are very diverse. Based on the 34 measurement points, the noise measurement results range between 80.2 dB(A) to 93.1 dB(A). The following is the percentage distribution of the measurement results at the Entry-Welder Continous Tandem Cold Mill Areas at a Steel Company in Cilegon.

Table 1. Results of the Noise Intensity Measurements in the Entry-Welder Continous Tandem Cold Mill Area of a Steel Company in Cilegon in 2018

Coordinate Point		Noise Intensity dB(A)
X	Y	
0	0	83.5
1	0	80.2
2	0	83.4
3	0	87.9
16	0	81.8
0	1	86.8
1	1	84.5
2	1	83.2
3	1	85.2
16	1	84.7
4	2	91.8
6	2	88.0
7	2	90.0
10	2	91.8
11	2	88.0
12	2	88.0
13	2	88.0
14	2	88.0
16	2	80.8
5	3	90.3
6	3	93.1
9	3	88.0
10	3	88.0
14	3	92.1
15	3	88.6
16	3	84.1
13	4	88.0
14	4	88.0
16	4	80.9
14	5	83.9
15	5	82.5
16	5	83.1

Figure 2. Mapping of Measurement Points in the Entry-Welder Continous Tandem Cold Mill Area in a Steel Company in Cilegon in 2018

Table 2. Percentage Distribution of Noise Intensity at the Entry-Welder Continous Tandem Cold Mill Area of a Steel Company in Cilegon in 2018

Noise Intensity Measurement	Percentage
<82 dB(A)	12%
82.1 – 85 dB(A)	12%
85.1 – 88 dB(A)	24%
88.1 – 91 dB(A)	43%
91.1 – 94 dB(A)	9%

Table 2 is a percentage distribution of the measurement results of noise intensity in the Entry-Welder Continous Tandem Cold Mill area is. The measurement results of noise intensity below 82.1 dB(A) is 12%, noise intensity with intervals of 82 dB(A) to 85 dB(A) is 24%, noise intensity with intervals of 85.1 dB(A) to 88 dB(A) is 43%, noise intensity with intervals of 88.1 dB (A) to 91 dB(A) is 9% and noise intensity with intervals of 91.1 dB(A) to 94 dB(A) is 12%.

After knowing the percentage distribution of noise intensity measurements in the Entry-Welder Continous Tandem Cold Mill area, a noise mapping was made with the help of golden surfer software to find out which areas have a high risk of noise intensity. The following is a noise mapping image in the Entry-Welder Continous Tandem Cold Mill area in a steel company in Cilegon.

The color levels in the noise mapping of Figure 3 shows the noise intensity in each production area of the Entry-Welder Continous Tandem Cold Mill

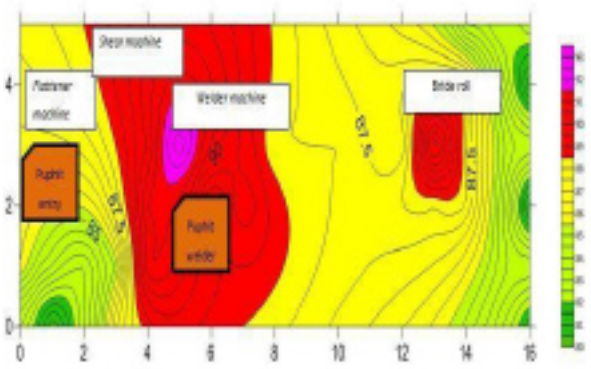

Figure 3. Noise Mapping in the Entry-Welder Continous tandem Cold Mill Area of a Steel Company in Cilegon in 2018

Area with certain noise exposure, as shown in the following colors:

- for noise intensity < 82 dB(A)
- for noise intensity 82 – 85 dB(A)
- for noise intensity 85.1 – 88 dB(A)
- : for noise intensity 88.1 – 91 dB(A)
- : for noise intensity 91.1 – 94 dB(A)

Based on the noise mapping in Figure 3, the welder area is the area with the highest noise intensity between the 91.1 – 94 dB(A) interval. The source of noise in the Entry-Welder Continous Tandem Cold Mill area comes from production machines, namely one flatenner machine, one shear machine, one welder machine and one bride roll machine.

Noise Mapping in the Exit Continous Tandem Cold Mill Area

From Figure 4, it can be seen that there are 28 points for the measurements of noise intensity in the Exit Continous Tandem Cold Mill area with a location area of 232 m2. The source of noise intensity comes from mill stand machines which serve in the production of thin sheet steels in the form of coils. Table 3 below shows the results of the measurements of noise intensity in the Exit Continous Tandem Cold Mill area in a steel company in Cilegon.

From 28 noise measurement points in Table 3, it can be seen that each production in the Exit Continous Tandem Cold Mill area has different noise intensities. The range of noise measurement results at the 28 points is between 85.3 dB(A) and 98.2 dB(A). The following is the distribution of the noise intensity measurements in the Exit Continous

Figure 4. Mapping of Noise Intensity Measurement Points in the Exit Continous Tandem Cold Mill Area of a Steel Company in Cilegon in 2018

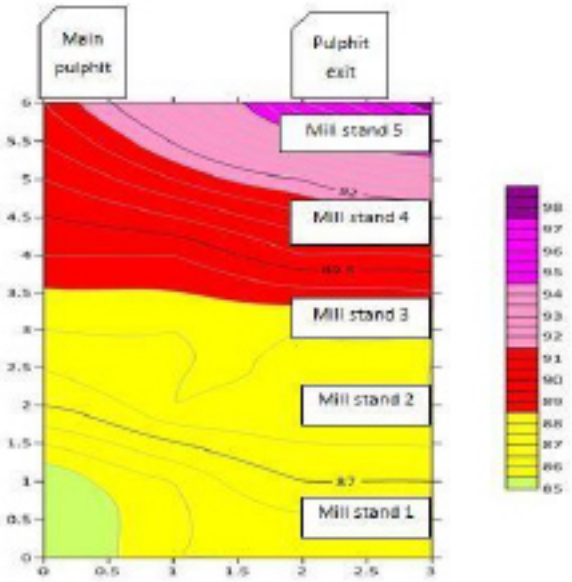

Figure 5. Noise Mapping in the Exit Continous Tandem Cold Mill Area of a Steel Company in Cilegon in 2018

Tandem Cold Mill Area of a steel company in Cilegon.

From table 4, it can be seen that the measurement results of noise intensity below 85 dB(A) is 0%, noise intensity with intervals of 85.1 - 88 dB(A) is 36%, intensity noise with an interval of 88.1 - 91.0 dB(A) is 39%, noise intensity with an interval of 91.1 - 94.0 dB(A) is 18%, noise intensity with an interval of 94.1 - 97.0 dB(A) is 3% and a noise intensity of more than 97 dB(A) is 4%.

The results of the noise intensity percentage distribution in Table 4 can be used as a basis for

Table 3. Results of the Noise Intensity Measurements in the Exit Continous Tandem Cold Mill Area of a Steel Company in Cilegon in 2018

Coordinate Point		Noise Intensity dB(A)
X	Y	
0	0	91.8
1	0	90.5
2	0	89.2
3	0	88.1
4	0	87.6
5	0	85.5
6	0	85.3
0	1	93.3
1	1	91.8
2	1	89.7
3	1	88.1
4	1	88.0
5	1	86.3
6	1	86.2
0	2	96.8
1	2	92.2
2	2	90.0
3	2	88.2
4	2	88.2
5	2	87.0
6	2	86.3
0	3	98.2
1	3	93.1
2	3	90.1
3	3	88.3
4	3	88.3
5	3	87.0
6	3	86.5
16	4	80.9
14	5	83.9
15	5	82.5
16	5	83.1

making noise mapping with the help of golden surfer software. The following is a noise mapping image in the Continous Tandem Cold Mill Exit area.

The exposure of noise intensity in the Exit Continous Tandem Cold Mill Area is shown in the following colors.

: for noise intensity <82 dB(A)
: for noise intensity 82 - 85 dB(A)
: for noise intensity 85.1 - 88 dB(A)

Table 4. Distribution of Noise Intensity in the Exit Continous Tandem Cold Mill Area of a Steel Company in Cilegon in 2018

Noise Intensity Measurement	Percentage
<85 dB(A)	0%
85.1 – 88 dB(A)	36%
88.1 – 91 dB(A)	39%
91.1 – 94 dB(A)	18%
94.1 – 97 dB(A)	3%
>97 dB(A)	4%

: for noise intensity 88.1 - 91 dB(A)
: for noise intensity 91.1 - 94 dB(A)
: for noise intensity 94.1 - 97 dB(A)
: for noise intensity <97 dB(A)

Based on the noise mapping in Figure 5, it can be seen that the Exit Continous Tandem Cold Mill area which has the highest noise intensity is the mill stand 5 area with a noise intensity >97 dB(A). The source of noise in the Continous Tandem Cold Mill exit area comes from production machines, including 5 stand mill machines and 1 flying shear machine.

Efforts to Control Noise Intensity in the Continous Tandem Cold Mill Areas of a Steel Company in Cilegon

One of the physical factors found in a steel company in Cilegon is noise intensity. To prevent occupational diseases and occupational accidents, a steel company in Cilegon has made several efforts to control noise intensity based on a hierarchy of controls. The hierarchy of control that is carried out is administrative control such as machine maintenance, isolation control, safety signs, audiometric examination, job rotation and HSE inspections. Another hierarchy of control is Personal Protection Equipment (PPE). The following is the hierarchy controls of noise intensity that have been carried out in the Continous Tandem Cold Mill Area of a Steel Company in Cilegon.

Machine Maintenance

A steel company in Cilegon carries out maintenance on production machines, especially in the Continous Tandem Cold Mill Area according to the schedule that has been made every day, once every two weeks and once a year for over hours. Maintenance activities are carried out to

keep machines from being easily worn and damaged. Machine maintenance is carried out by organic employees at the Rolling Mill Maintenance Service division in a steel company in Cilegon in collaboration with third parties.

Isolation Control

Control of noise intensity by means of isolation is done by making a pulpit / control room. This is done to minimize direct exposure to noise from workers / operators. In the Continous Tandem Cold Mill area, there are 3 control rooms, namely pulpit entry, pulpit welder and pulpit exit. The pulpit wall has also been installed with soundproofing materials such as asbestos or kawool. During field observations, noise exposure in the pulpit was still found to be below the threshold value (TLV).

Safety Signs

Safety signs for noise intensity are installed in strategic areas in the Continous Tandem Cold Mill area of a steel company. The installation of safety signs is used as warning signs that the noise intensity in the area exceeds a predetermined threshold value (TLV), and therefore workers must wear ear protection.

Audiometric Examination

To protect workers from potential noise hazards and work accidents, a steel company in Cilegon holds an audiometric inspection program. The inspection program is carried out regularly and is scheduled once a year, especially for workers with workplaces that have high noise intensity and have the potential to cause occupational diseases. The examination is carried out by the HSE division with doctors of industrial hygiene who work in a steel company in Cilegon.

Job Rotation

Control by means of work rotation conducted by a steel company in Cilegon is intended to limit workers from being exposed to continuous noise intensity. In the Continous Tandem Cold Mill area, work rotation system is implemented with four working groups. Workers leave the control room only to check and clean the remaining welding residue for only about 15 to 20 minutes.

HSE Inspection

HSE inspections are carried out by a steel company in Cilegon, especially in the Continous Tandem Cold Mill area with the aim of detecting and analyzing potential hazards in the workplace starting from production equipment or machinery, work procedures and production materials. The HSE inspections are scheduled once a week and are carried out by the safety officers and division representatives from each production area.

Procurement of Personal Protection Equipment (PPE)

In an effort to protect workers from potential hazards and occupational diseases due to noise intensity, a steel company in Cilegon provides ear protection that is adapted to working conditions, such as ear plugs and ear muffs. Workers in the Continous Tandem Cold Mill area are provided with ear plugs because the work location has a noise level of up to 100 dB(A). Meanwhile, ear muffs are given to workers in the Continous Tandem Cold Mill area in the Welder Continous Pickling Line and Welder Continous Tandem Cold Mill. However, there are still many workers who do not wear ear protection while working or leaving the control room.

DISCUSSION

Analysis of Noise Mapping Results in Continous Tandem Cold Mill Area

Analysis of Noise Mapping Results in Entry-Welder Continous Tandem Cold Mill Area

In the Entry-Welder Continous Tandem Cold Mill Area, there are 34 measurement points for noise intensity, and the average noise interval is 85.1 to 88 dB (A) of 43%. Based on this, it can be seen that the Entry-Welder Continous Tandem Cold Mill area of a steel company in Cilegon has a noise intensity that exceeds the predetermined threshold value of 85 dB(A). This result is not in accordance with the Regulation of the Minister of Manpower of the Republic of Indonesia Number 5 of 2018 concerning Occupational Safety and Health, which stated that the threshold value for noise intensity is 85 dB(A) for exposure for 8 hours / day or 40 hours

/ week (Minister of Manpower Regulation Number 5, 2018).

The type of noise generated from production machines in the Entry-Welder Continous Tandem Cold Mill area is a continuous type of noise, so t workers have the potential to experience hearing loss due to noise. This is in accordance with the research conducted by Putri and Martiana (2016), stating that the noise or sound coming from production equipment or machines is one of the factors that has the potential to cause health problems to workers in the production process.

Workers who are exposed to noise intensity continuously for a long time will experience physiological disturbances. These physiological disorders include disorders of the body's internal systems, sleep patterns and hearing loss (Hamid, 2020).

The coloring codes in the Entry-Welder Continous Tandem Cold Mill area is a description of the noise intensity conditions in the work area. This is in accordance with research of Khairuzzaman (2016) stating that to describe the state of noise intensity in the workplace, coloring codes are used, such as green for noise intensity <80 dB(A) and red for noise intensity ≥ 85 dB(A). In the Entry-Welder Continous Tandem Cold Mill area, the welder production section is the area with the highest noise intensity because the interval of noise intensity is 91.1 - 94 dB(A). Noise intensity that exceeds the threshold value is included in the hazard category. In order for production to continue normally, the company must regulate working hours by applying job rotation.

The high and low intensity of noise in the workplace can be caused by several factors, including distance, air temperature and sound sources. The closer the sound source, the higher the resulting noise intensity, as well as the higher the air temperature, the higher the noise intensity produced. Conversely, the farther the sound source and the lower the air temperature, the smaller the noise intensity (Saputra, Defrianto and Tengku, 2015).

Analysis of Noise Mapping Results in Exit Continous Tandem Cold Mill Area

From the results of 28 measurement points in the Exit Continous Tandem Cold Mill area in a steel company in Cilegon, it can be seen that noise intensity is above 85 dB (A) to more than 97 dB(A). Based on the Regulation of the Minister Manpower of Republic Indonesia Number 5 of 2018 concerning Occupational Safety and Health in the Work Environment, it is stated that the threshold value of noise intensity for exposure time of 8 working hours per day is 85 dB(A). SNI regulation 16-7063-2004 concerning Working Climate Threshold (Heat), Noise, Hand-Arm Vibration and Ultra Purple Light Radiation in the Workplace stated that the threshold value (TLV) for noise intensity is 85 dB(A) for exposure time of not exceeding 8 hours a day or 40 hours a week (Indonesian National Standardization Institute, 2004). Therefore, the results of the measurements of noise intensity at 28 points in the Exit Continous Tandem Cold Mill area exceed the threshold value and are at risk of causing health problems to workers, especially hearing loss.

Exposure to high intensity noise includes potential physical hazards that can cause health problems for workers. Health problems due to noise are classified into two, namely auditory disorders such as hearing loss and non-auditory disorders such as communication disorders, safety hazards, work stress, decreased work performance and work fatigue (Maulana, Jayanti and Suroto, 2016). This is in line with research conducted by Prayogo and Widajati (2015), suggesting that the main effect due to exposure to noise intensity in humans is that the inner sense of hearing can experience hearing loss.

From the results of noise mapping, the Cold Mill Continous Tandem Exit area which has the highest noise intensity is the stand mill 5 area with a noise intensity >97 dB(A). According to Septiana and Widowati (2017), noise mapping making by color coding of the work area according to the noise intensity is very necessary. This action is intended so that workers are more aware of the level of noise intensity and the length of exposure that has been recommended in each work area and to increase worker compliance in using ear protection.

Analysis of Efforts to Control Noise Intensity in the Continous Tandem Cold Mill Area of a Steel Company in Cilegon

Machine Maintenance

A steel company in Cilegon, especially in the Continous Tandem Cold Mill Area, has carried out maintenance on production machines on a regular basis according to the schedule that has been made. This is in line with research conducted by Sitanggang (2015) stating that one form of technical noise control is to perform machine maintenance by replacing, tightening loose engine parts and

regularly lubricating parts of the engine that are rubbing against each other so that the engine is not easily worn out and damaged. Maintenance of these production machines has schedules and work orders to guide machine monitoring and inspection.

According to Nabinatul (2015), the high intensity of noise really disturbs concentration at work and can cause work stress. One of the efforts to reduce noise exposure is to carry out regular machine maintenance by mechanics.

The above statement above is in line with Ariestyajuni (2019), asserting that old production machines and machine maintenance which are not carried out routinely can cause high noise that can interfere workers' communication. Communication disorders can eventually have an impact on work productivity and work accident problems.

Isolation Control

In the Continous Tandem Cold Mill area, there is a control room/pulpit to minimize direct exposure to noise from workers/operators. The pulpit wall has also been installed with soundproofing materials such as asbestos or kawool. This is in accordance with research conducted by Amalia, Jayanti and Kurniawan (2015), suggesting that control of noise intensity by engineering control can be done by providing a control barrier and isolation of machines with workers in order to reduce the spread of noise originating from the workplace to the surrounding environment. Sitanggang (2015) also stated that the impact that will be generated if workers are not isolated in a soundproof room is that workers will receive high noise exposure and have the potential to cause hearing loss.

Safety Signs

In the Continous Tandem Cold Mill area of a steel company in Cilegon, safety signs have been installed as warning signs that there are potential hazards, especially noise exposure hazards. This is in accordance with Law Number 1 of 1970 Article 14B which reads "the installation of all the required work safety images and all other guidance materials should be put in places that are easily seen and legible according to the instructions of supervisors or experts Regarding work safety" (Law of the Republic Indonesia, 1970).

The provision of safety signs containing the risk or danger of noise in the Continous Tandem Cold Mill area of a steel companies in Cilegon is also in accordance with the Government Regulation Number 50 of 2012 concerning the Occupational Safety and Health Management System in the audit criteria of clause 6.4.4 which reads "Signs regarding occupational safety and health must be installed in accordance with standards and technical guidelines " (Government Regulation, 2012).

Based on research conducted by Alfidyani, Lestantyo and Wahyuni (2020), a safety sign is one of the factors forming a safety culture in the company. The higher the intensity of communication between workers and companies, the better the behavior of workers to avoid the risk of work accidents.

Saputra (2016) in his research said that safety signs contain a description or information regarding the source of the hazard, the situation that may pose a danger, the consequences inflicted from these dangers, as well as preventive actions to cope with the source of the hazard. Safety signs also provide instructions in the form of directions or prohibitions to reduce the risk from the source of danger.

Audiometric Examination

A steel company in Cilegon has an audiometric inspection program that is carried out once a year specifically for workers with workplaces that have high noise intensity, especially in the Continous Tandem Cold Mill Areas. This is in accordance with the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia No. Per. 02 / MEN / 1980 Article 3 Paragraph (1) concerning Workforce Health Checkup and Work Safety Implementation, which stated that all companies must carry out periodic health checks for workers at least once a year (Ministry of Manpower Regulation, 1980).

Research conducted by Sitanggang (2015) stated that audiometric examination is very important for early detection of hearing loss in workers exposed to noise. If there is a hearing complaint from a worker, then an examination should be carried out so that it can be followed up by the company according to the results of the examination. The same result was revealed in research conducted by Maulana, Jayanti and Suroto (2016) stating that Kaltim Prima Coal company has conducted audiometric examination which prioritizes workers who work in environments with noise hazards. Workers who will carry out the audiometric examination are advised to be free of noise intensity 18 to 24 hours before the examination is carried out.

Job Rotation

In the Continous Tandem Cold Mill area, a work rotation system is implemented with four working groups with the aim of limiting workers from being exposed to continuous noise intensity. The application of the job rotation has complied with the Law of the Republic Indonesia Number 13 of 2003 concerning Manpower Chapter X Article 77 paragraph 1, which stated that every employer is obliged to implement the working time provisions (Law of the Republic Indonesia, 2003). Based on research conducted by Amalia, Jayanti and Kurniawan (2015), job rotation is one of the administrative controls recommended by occupational safety and health experts to reduce the accumulated impact of noise on workers.

Based on research by Auliya (2017), a slow shift rotation where shift changes occur once a week can make it easier for workers to manage their life patterns quite well. Likewise, it reduces the exposure of noise intensity in the workplace.

HSE Inspection

A steel company in Cilegon has carried out scheduled HSE inspections once a week, especially in the Continous Tandem Cold Mill area. This is in accordance with the Indonesian Government Regulation No. 50 of 2012 concerning the Implementation of the Occupational Health and Safety Management System (SMK3) Attachment II letter A point 7.1.1, which stated that "Inspections of workplaces and work methods must be carried out regularly" (Government Regulation, 2012).

Tarwaka (2014) stated that basic point in the implementation of work safety management system is inspection. An effective occupational safety and health inspection program is a very important preventive program to create a safe, healthy and safe work environment. Occupational safety and health inspection can find problems and assess work risks before work accidents actually occur.

This is in line with research conducted by Bando, Kawatu and Ratag (2020) stating that HSE supervision at workplace is one of the important programs in hospitals. A good work environment will create a comfortable atmosphere for patients and for employees. HSE supervision is carried out in rounds every week or every few days to control the work environment.

Procurement of Personal Protection Equipment (PPE)

A steel company in Cilegon provides ear protection that is tailored to the conditions of the work environment, namely in the form of ear plugs and ear muffs. This has complied with the Minister of Manpower and Transmigration Regulation Number 08 of 2010 concerning Personal Protective Equipment in Article 2 Paragraph (1) and (3), which stated that "Employers are required to provide Personal Protective Equipment for workers / laborers in the workplace and protective equipment. The personal protective equipment must be provided by the entrepreneur for free" (Minister of Manpower Regulation, 2010).

However, there are still many workers who do not wear ear protection when they leave the control room/pulpit. Based on research conducted by Khairuzzaman (2016), workers who do not use protective equipment have a higher risk of hearing loss compared to workers who use ear protection. This is also in line with research conducted by Prayogo and Widajati (2015) which stated that ear protection is an acoustic barrier that can reduce the intensity of sound to the receptors in the ear. Hence, if the level of the compliance with ear protection equipment is poor, the sound intensity to the ear receptors will be even greater, which eventually leads to the potential of hearing loss due to noise exposure.

Based on research conducted by Eryani, Wibowo and Saftarina (2017), Personal Protective Equipment (PPE) is an alternative in reducing hearing loss caused by noise, but based on research in Semarang it was found that there was no relationship between the use of personal protective equipment and hearing loss. This can be influenced by various factors such improper use of ear plugs, poor condition of ear plugs, improper installation of ear plugs and poor attitude of the respondents towards the use of personal protective equipment.

CONCLUSION

Based on the results of the measurement points of noise intensity in the Entry-Welder Continous Tandem Cold Mill area of a steel company in Cilegon, 64% is in threshold value (> 85 dBA) and 36% is below the threshold value (<85 dBA). Meanwhile, the noise intensity in the Exit Continous

Tandem Cold Mill area 100% exceeds the threshold value (> 85 dBA). To prevent exposure to noise intensity among workers, a steel company in Cilegon has carried out several programs such as administrative control and procurement of Personal Protection Equipment (PPE).

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