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Exposure Analysis of Noise Intensity in the Manufacturing Area at The Job Training and Development Center Serang

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ABSTRACT

Machines in manufacturing areas often cause noise. The noise comes from machine tools such as lathes, milling machines, grinder machines, and other tools that cause sound and vibration so they are prone to causing physical and psychological disorders. This study was to determine and analyze the noise level in three areas and ten points in the manufacturing room of The Job Training and Development Center Serang by the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number PER.13/MEN/X/2011 with the maximum noise limit that has been set is 85 dBA. As for the results of the ten points, there is a point that exceeds the threshold value, namely at point 6 (85.8) dBA in the lathe area. Every operator in the manufacturing room that has a noise level that exceeds the threshold value must wear personal protective equipment in the form of earplugs or ear muffs that have been provided by the workshop to reduce the noise level.

Keywords: Machine tools**,** manufacturing, milling machine, lathe, noise intensity,

ABSTRAK

Mesin-mesin pada ruangan manufaktur seringkali menimbulkan suara bising. Sumber bising yang dihasilkan tersebut berasal dari mesin-mesin perkakas seperti mesin bubut, mesin frais, mesin gerindra dan alat-alat lain yang menimbulkan suara dan getaran sehingga rentan mengakibatkan gangguan fisik maupun psikologis. Penelitian ini dilakukan untuk mengetahui dan menganalisa tingkat kebisingan di tiga area dan sepuluh titik pada ruangan manufaktur Balaii Besar Latihan Kerja dan Pengembangan Serang sesuai dengan Peraturan Menteri Tenaga Kerja dan Transmigrasi Republik Indonesia Nomor PER.13/MEN/X/2011 dengan batas maksimum kebisingan yang telah ditetapkan adalah 85 dBA. Adapun hasilnya dari sepuluh titik terdapat satu titik yang melebihi nilai ambang batas yaitu pada titik 6 (85,8) dBA pada area mesin bubut. Setiap operator pada ruangan manufaktur yang memiliki tingkat kebisingan yang melebihi nilai ambang batas harus mengenakan alat pelindung diri berupa ear plug/ear muff yang telah disediakan workshop untuk mengurangi tingkat kebisingan.

Keyword: Peralatan mesin, manufaktur, mesin frais, mesin bubut, intensitas kebisingan

1. Introduction

Noise is an unwanted sound that can cause discomfort to the listener. Noise can be defined as unwanted sound that comes from natural activities such as speech and man-made activities such as the use of machines[1]. Noise is defined as a vibration value that is irregular, and shows an uncharacteristic shape. The factors that influence it are intensity, frequency and generation patterns[2].

The level of annoyance depends on the quality of the sound and our attitude towards it. The sound can damage and destroy too. Sound measurements permit to determinate the level of the sound which may cause damage, or indicate a fault,and is a useful tool in noise reduction[3]. Decree of the Minister of Environment

No. 15 of 1996 also explains that noise is unwanted sound from a business or activity at a certain level and time that can cause human health problems and environmental discomfort[4].

Environmental noise is a natural part of human activity, at present, it is possible to talk about noise pollution. Its existence in the environment is related to different work, non-work activities, industries, or transport[5]. In general, the human ear has sensitivity to sound with a frequency of 20-20.000 *Hz*. In addition, there is a range of frequencies below 20 Hz, called infra-sounic (infra-sōl) and above 20.000 *Hz* is called an ultra sounic sound[6].

In the industrial sector, the noise of a company is caused by the production process and the use of machinery. Where the noise level exceeds the limit will cause hearing loss and the risk of damage to the ears both temporarily and permanently when exposed for a certain period without the use of adequate protection equipment. The intensity of noise (sound) is the energy flow per unit area expressed in decibels (dB), by comparing it with the basic power of 0.0002 dyne/cm2 which is the power of sound with a frequency of 1000 Hz that can be heard by normal humans.

Exposure to noise triggers a disturbance in the physiological system of the body's muscle tissue that causes emotional instability that spurs the heart's work in pumping blood throughout the body. This is what makes a person's blood pressure increase and causes hypertension[7]. Noise can cause disturbance to the work that is being done by a person through psychological disturbance and concentration disturbance to reduce work productivity[8].

In this potential risk, governments in various countries make regulations that state the noise levels in the industrial sector. The Indonesian government regulating noise levels in the industrial sector is regulated in the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number PER.13/ MEN /X/2011 concerning threshold values in the workplace, namely the regulated noise threshold value of 85 Db in exposure for 8 hours a day and 40 working hours a week or 5 working days, this is a standard provision of control guidelines so that workers can deal with it without causing disease or health problems in everyday workers[9]. The maximum of daily working time can be seen in table 1[10].

Table 1. Maximum Working Time

No	Noise Level (dBA)	Daily Exposure
1	85	8 hours
2	88	4 hours
3	91	2 hours
4	94	1 hours
5	97	30 minutes
6	100	15 minutes

The Job Training and Development Center Serang is a government Job Training Institution under the auspices of the Directorate General of Training and Productivity Development of the Ministry of Manpower. The Job Training Development Center Serang has several facilities and several workshop rooms including Manufacturing, Mechatronics, Welding, Electrical Workshops, and Destructive Test (DT) and Non-Destructive Test (NDT) testing laboratories. The training and technology programs developed at Job Training and Development Center Serang refer to European technology systems and standards.

Many machines cause noise in the manufacturing areas. The source of the noise produced is from machine tools such as lathes, milling machines, grinder machines, and other tools that cause sound and vibration so that they are prone to causing hearing loss and the risk of damage to the ears both temporarily and permanently when exposed to a certain period without the use of adequate protection equipment. As a result of the many work activities, the use of machinery, and the types of raw materials used, noise is an inseparable factor of work environment hazards in the manufacturing areas. Seeing the magnitude of the impact that can be caused, the role of K3 to maintain health, safety and labor productivity at work is very important to implement[11].

This study was conducted to determine the noise level in the manufacturing room of BBPLK Serang and analyze the noise level in the manufacturing room of BBPLK Serang by the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number PER.13/MEN/X/2011.

2. Method

This research was conducted in the manufacturing workshop at The Job Training Development Center Serang. The room area is 15 x 35 m. There are three areas and ten noise points that will be carried out. This is based on general analysis through preliminary interviews and observations, the measurement sampling points are known, and several places where there are sources of sound that are not subjectively desired by any party are called noise. The layout of the manufacturing workshop is presented in Figure 1.

Figure 1. Layout of Manufacture Workshop

Figure Description:

● is the noise point

1. Area A is the milling machine area and there are three measurement points, point 1, point 2, and point 3.
2. Area B is the lathe area and there are three measurement points, namely point 4, point 5, and point 6.
3. Area C is the milling machine and lathe area and there are four measurement points, point 7, point 8, point 9, and point 10.

After the measurement location is obtained, the noise intensity data is collected. Noise level measurement uses a tool in the form of a Sound Level Meter (SLM), as shown in Figure 2. The Sound level meter is a measuring instrument that is designed to be able to respond that similar to the human sense of hearing and can show a measure of the sound level[12]. Noise measurement data was carried out at the designated location with readings taken every 5 seconds for 5 minutes at each point. The data obtained were 60 data at each point which were then calculated to determine the equivalent noise value (Leq) from the measurement results using the formula.

Figure 2. Sound Level Meter (SLM)

Perhitungan data Leq 1 menit, dihitung dengan menggunakan rumus berikut:
Calculation of 1-minute Leq data, calculated using the following formula:

$$\text{Leq (1 Menit)} = 10\ \text{Log}\frac{1}{60}\left[\left(10^{0,1.L1} + 10^{0,1.L2} + \cdots + 10^{0,1.L12}\right)5\right]\text{dB (A)}$$

This formula is used for each minute until the 1-minute to 5-minute Leq data is obtained. After each 1-minute

Leq value is obtained, then proceed with the calculation of 5-minute Leq with the formula:

$$\text{Leq (5 Menit)} = 10\ \text{Log}\frac{1}{5}\left[\left(10^{0,1.\text{LI}} + 10^{0,1.\text{LII}} + \cdots + 10^{0,1.\text{LX}}\right)1\right]\ \text{dB(A)}$$

The measurement results at each point are then combined to get the total noise level in the manufacturing room, from the measurement data there are 10 noise points. The following is the formula used:

$$\text{Leq total} = 10\ \text{Log}\frac{1}{10}\left[\left(10^{0,1.\text{La}} + 10^{0,1.\text{Lb}} + \cdots + 10^{0,1.\text{Lz}}\right)1\right]\ \text{dB(A)}$$

Description:

Leq : Noise Equivalent (dBA)
L_1....L_{12} : Noise Every 5 Seconds for 1 Minute
L_I....L_X : Noise Every 1 Minute for 5 Minutes
La....Lz : Total noise at each point

After obtaining the Leq value at each point, the average noise in each work area is calculated. The average value of noise in each work area compared with the threshold value that refers to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number PER.13/MEN/X/2011 concerning Threshold Values for Physical Factors in the workplace and is an Indonesian National Standard (SNI). This regulation discusses the permissible working hours about the sound pressure level of the work environment that the operator is exposed to.

The last step is noise mapping using the Surfer 21 application. Surfer 21 is one of the software used for making contour maps and three-dimensional modeling (cut and fill) based on a grid. This software plots irregular XYZ tabular data into a regular rectangular sheet of points (grid). Surfer does not require high hardware or operating system requirements. Therefore, surfer is relatively easy to apply[13].

3. Result and Discusion

Noise level measurements have been carried out in three areas at ten points in the manufacturing room. The results of the calculation of the noise value of each point are presented in Table 1.

Table 2. Data of Noise Value

No	Kebisingan	Leq Kebisingan 1 Menit (dBA)					Rata-rata (dBA)
		Menit ke 1	Menit ke 2	Menit ke 3	Menit ke 4	Menit ke 5	
1	Titik ke 1	77,9	77,7	77,4	76,5	72,9	76,7
2	Titik ke 2	81,4	83,9	81,3	80,7	83,2	82,2
3	Titik ke 3	81,3	81,1	81,1	80,9	81,4	81,1
4	Titik ke 4	79,2	78,1	78,0	76,7	77,3	77,9
5	Titik ke 5	79,5	79,6	79,0	79,3	77,8	79,0
6	Titik ke 6	85,7	85,1	85,9	86,7	85,9	85,8
7	Titik ke 7	75,2	76,2	75,3	74,7	76,8	75,5
8	Titik ke 8	76,9	76,9	75,9	76,5	77,6	76,7
9	Titik ke 9	75,3	75,9	75,3	79,1	76,3	76,6
10	Titik ke 10	76,2	77,9	75,3	75,9	76,7	76,4

To find out the distance data for each noise point in the manufacturing room with a room area of 15 x 35 meters and 10 noise measurement points can be seen in Table 2.

Table 3. Distance data of noise points

No	X (meter)	Y (meter)	Kebisingan (dbA)
1	33	15	76,7
2	33	9	82,2
3	33	3	81,1
4	27	15	77,9
5	27	9	79,0
6	27	3	85,8
7	18	9	75,5

8	14	9	76,7
9	18	11	76,6
10	12	11	76,4

Based on the calculation of the equivalent noise level (Leq) in the manufacturing room at Serang, it was found that one point out of a total of ten measurement points in the workshop area exceeded the threshold value referring to the regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia No. PER.13/MEN/X/2011 with the maximum limit that has been set is 85 dBA, the point that exceeds the threshold value will be displayed with a graph in Figure 2. The calculation results in each area are:

1. In Area A (milling machine) there are 3 points, all three of which do not exceed the threshold value, namely point 1 (76.7) dBA, point 2 (82.2) dBA, and point 3 (81.1) dBA.
2. In Area B (Lathe) 2 points do not exceed the threshold value, namely point 4 (77.9) dBA and point 5 (79.0) dBA and there is a point that exceeds the threshold value at point 6 (85.8) dBA.
3. In area C (Lathe and milling machine) there are 4 points, all four of which do not exceed the threshold value, namely point 7 (75.5) dBA, point 8 (76.7) dBA point 9 (76.6) dBA and point 10 (76.4) dBA.

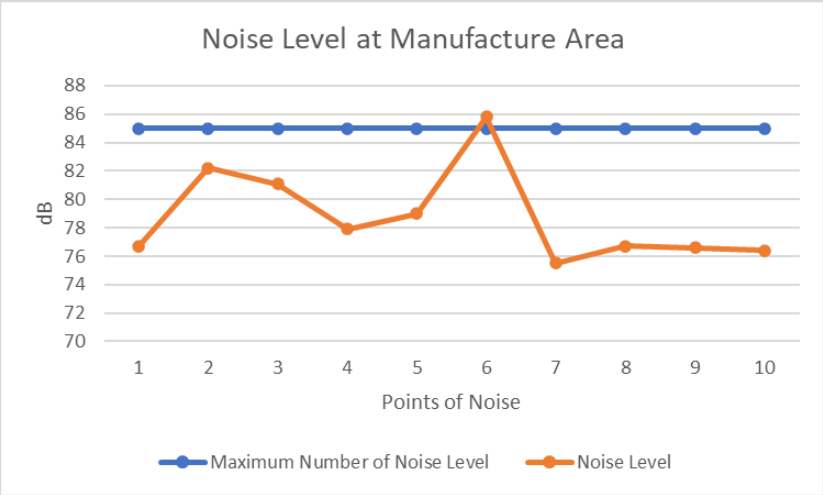

Figure 3. Noise Level in Manufacturing Area

After obtaining noise level data at ten points, processing is done using Surfer 21 software in the form of contour maps (Figure 4). The depiction of noise levels with contour maps is visualized in color levels, namely black, blue, green, orange, red, and white. The white color represents the area where the point exceeds the noise threshold value. The noise map developed provides enough information for technical controls and interim legislation against noise levels[14]. Several previous studies have revealed that noise mapping is an ideal approach for enlisting noise level mitigation strategies[15].

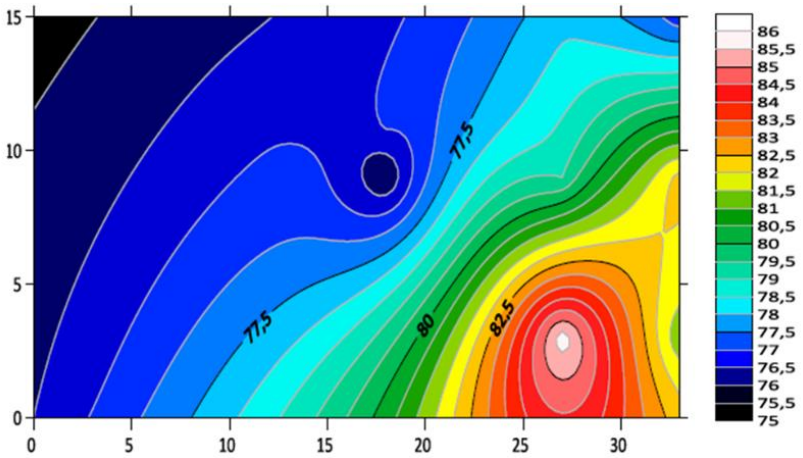

Figure 4. Noise Exposure Map

From the results of the analysis, the solutions are given as noise control, in area A, point 3 (milling machine), maintenance of the milling machine should be carried out on point 2 if at any time the noise level increases. In area B point 6 (lathe), preventive maintenance of lathe machines should be carried out on certain machine parts to reduce the impact of noise generated by the production machine. To reduce the noise level, it is expected that every operator in the manufacturing room that has a noise level that exceeds the threshold value must wear personal protective equipment in the form of earplugs/ear muffs that have been provided by the workshop.

4. Conclusion

The conclusions of this research are:

1. In the Regulation of the Minister of Labor and Transmigration of the Republic of Indonesia Number PER.13/MEN/X/2011 the maximum limit that has been set is 85 dBA, as for the results of the ten points there is 1 point that exceeds the threshold value at point 6 (85.8) dBA in the lathe area.
2. Every operator in the manufacturing room that has a noise level that exceeds the threshold value must wear personal protective equipment in the form of earplugs/ear muffs that have been provided by the workshop.

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