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The Instensity Measurement and Noise Mapping in Fatty Acid Plant Area at PT. XYZ

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Abstract PT. XYZ is a factory engaged in processing of palm oil derivatives in producing a fatty acid. The machines used in the processing process at PT. XYZ KIM II Mabar generate the noise. This research aimed to find out the existing noise level and noise mapping, also the proposal of noise control on the production floor. Then, the data collection method conducted through observation using the equivalent noise level (Leq) method and noise mapping was through surfer 14. The data collection conducted in 16 points on the production floor. Furthermore, the result and noise distribution pattern showed that the high noise level was in several points, those were point 5 (85.77); point 6 (86.82); point 7 (86.33), point 8 (88.18); point 10 (86.96); point 13 (86.85); point 14 (87.67). The allowed threshold value refers to the Decree of the Minister of Manpower and Transmigration No.Per.13/MEN/X/2011 is 85 dB. Thus, the company needs to perform noise control among others by using engineering control or administrative control such as barrier usage, regularly and scheduled machine maintenance to prevent and decrease the effect of the noise

Keyword: Equivalent Noise Level, Noise Mapping, Noise Reduction, Noise Control, Surfer 14

Abstrak. *PT. XYZ merupakan pabrik pengolahan turunan minyak kelapa sawit yang memproduksi fatty acid/asam lemak. Dalam proses pengolahannya PT. XYZ KIM II Mabar menggunakan mesin-mesin yang menimbulkan kebisingan. Penelitian ini bertujuan untuk mengetahui tingkat kebisingan yang ada dan pemetaan kebisingan serta usulan pengendalian kebisingan di lantai produksi. Metode pengumpulan data secara observasi dengan metode perhitungan tingkat kebisingan ekuivalen (Leq) dan pemetaan kebisingan dengan surfer 14. Pengumpulan data dilakukan di 16 titik yang ada di lantai produksi. Hasil penelitian dan pola sebaran kebisingan menunjukkan tingkat kebisingan yang tinggi di beberapa area yaitu titik 5 (85.77), titik 6 (86.82), titik 7 (86.33), titik 8 (88.18), titik 10 (86.96), titik 13 (86.85), titik 14 (87.67). Nilai ambang batas yang dizinkan berdasarkan Peraturan Menteri Tenaga Kerja Dan Transmigrasi Republik Indonesia Nomor PER.13/MEN/X/2011 adalah sebesar 85 dB. Dengan demikian perusahaan perlu melakukan pengendalian kebisingan antara lain dengan menggunakan engineering control ataupun administrative control seperti penggunaan barrier/penghalang, pemeriksaan mesin-mesin yang teratur dan terjadwal untuk mencegah dan mengurangi akibat dari kebisingan tersebut*

Kata Kunci : *Tingkat Kebisingan Ekuivalen, Pemetaan Kebisingan, Pengurangan Kebisingan, Pengendalian Kebisingan, Surfer 14*

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1 Introduction

Noise in the industry has long been a concern and a problem. Noise exposure in the workplace is estimated at 120 million people have hearing loss in the United States, in 1981 more than 9 million people exposed to noise at work at the level of 85 dB or more every day, at in 1990 this figure had risen to 30 million, mostly workers in the manufacturing industry, while Germany and other developing countries as many as 4-5 million people, 12-15% of all workers are exposed to noise at level of 85 dB or more [1]

Based on Regulation of The Minister Of Health Of The Republic Of Indonesia Number 70 Of 2016 Concerning Standards And Requirements For The Health Of Industrial Work that the noise threshold value is and the Minister of Manpower and Transmigration No.Per.13/MEN/X/2011 is 85 db (A) [2],[3]

Noise levels that exceed threshold values can be encouraging the onset of hearing loss and the risk of damage to the ear are good temporary or permanent after being exposed for a certain period of time without use of adequate protection [4] . This potential risk drives the government in various countries make a regulation that limits the exposure of workers' votes industry [5]
In some industries there are various noise intensities, for example [6]:

1. 85-100 dB available in textile factories and fatty acid plant, mechanical workplaces such as milling machines, the use of pressurized air, electric drills, mechanical saws.
2. 100-115 dB available in factories. canning, boiler room, drill.
3. 115-130 dB are available on large diesel engines, turbo engines, compressors, sirens.4.130-160 dB are available on jet engines, blasting rockets.

In supporting the production process to meet the demands of increasing productivity and decreasing labor, the PT. XYZ has implemented mechanization systems on industrial tools and machines that have the potential to cause noise. The noise can disturb the work environment and spread through the air to the workforce. Some complaints arising from noise that occur based on interviews conducted with several employees, namely disruption of work concentration, lack of comfort at work and disturbed communication.

Noise problems were found in the Fatty Acid Plant production section, that is, after the preliminary study by conducting initial measurements it was found that the noise level of the production floor area ranged from 80 to 90 dB for 8 working hours. It can be seen that this exceeds the permissible noise threshold value in the Indonesian government regulation on industrial estates, namely the permissible noise threshold value (NAV) of 85 dB for 8 working hours.

2 Research Method

This type of research is descriptive research (descriptive research) where research aims to describe sitematically, factually and accurately about the facts and properties of a particular object or population. The type of descriptive research in question is survey research. This research is called survey research because in this study conducted collecting data and information directly from operators who work in the noise area. This research is also an action review that is research that aims to get a solution that will be applied to the company as a form of improvement of the original system.

The data collection mechanism is:

1. Prepare the Sound Level Meter tool.
2. Measuring the noise level at 16 points in accordance with KepMenLH N0.48 / MenLH / 11/1996 [7]
3. Interviews of several employees
4. Calculation of noise level
5. Mapping of noise levels with surfers

Measurement refers to KEPMENLH No.48 / MenLH / 11/1996. Calculation of Leq data for 1 minute, calculated using the formula:

$$L_{eq}(1\ \text{menit}) = 10 \log \left[\frac{1}{60} \left(10^{0.1 L_1} + 10^{0.1 L_2} + \ldots + 10^{0.1 L_{60}} \right) 5 \right] \text{dB} \quad (1)$$

Calculation of Leq data for 4 minutes, calculated using the formula:

$$L_{eq}(4\ \text{menit}) = 10 \log \left[\frac{1}{4} \left(10^{0.1 L_1} + 10^{0.1 L_2} + \ldots + 10^{0.1 L_4} \right) 1 \right] \text{dB} \quad (2)$$

After the 4 minute Leq value is obtained, then it is entered in the table. Data entered in the measurement column L1 through L7. If the data table is complete in accordance with Minister of the Environment Decree No. 48 / MenLH / 11/1996 concerning Noise Level Standards, the average value of Leq measurements will be obtained for 24 hours. For daytime Leq (Ls) measurements are taken from 06.00-22.00 hours, while nighttime Leq (LM) measurements are carried out from 22.00-06.00. The results of these measurements are added to the weighting factor, which is 5 dB (A).

For day and night Leq can be calculated by the formula:

$$L_s = 10 \log \left[\frac{1}{16} \left(T_1 10^{0.1 L_1} + \ldots + T_{16} 10^{0.1 L_{16}} \right) \right] \text{dB} \quad (3)$$

And

$$L_{SM} = 10 \log \left[\frac{1}{8} \left(T_a 10^{0.1 L_a} + T_b 10^{0.1 L_b} + T_8 10^{0.1 L_8} \right) \right] \text{dB} \quad (4)$$

The measurement results during the day and night are then combined to get the noise level in one day with decibels. Following is the formula used:

$$L_{SM}=10\log\left[\frac{1}{24}\left(16\times10^{0.1\,L_s}+8\times10^{0.1\,(L_M+5)}\right)\right] d \quad (5)$$

3 Result and Discussion

3.1 Equivalent Noise Level Calculation

After measuring, the average noise measurement data are obtained as follows:

Table 1 Average Noise Level Measurement Results (dB)

	L1	L2	L3	L4	L5	L6	L7	Average
Point 1	82.43750	82.38750	82.44792	82.51458	82.48750	82.48542	82.47292	82.46190
Point 2	84.01250	83.97292	84.09792	84.09375	84.07500	84.07083	84.08333	84.05804
Point 3	85.13333	85.18542	85.17917	85.2000	85.17708	85.16458	85.17083	85.17292
Point 4	84.75000	84.79792	84.77917	84.85208	84.81458	84.76875	84.77083	84.79048
Point 5	85.73750	85.72083	85.72917	85.81667	85.77500	85.77292	85.75000	85.75744
Point 6	86.79167	86.79792	86.81458	86.85208	86.82708	86.78333	86.83125	86.81399
Point 7	86.27500	86.27292	86.31875	86.36667	86.34792	86.32708	86.34583	86.32202
Point 8	88.08958	88.18333	88.13958	88.17083	88.19167	88.13750	88.19583	88.15833
Point 9	83.81042	83.86250	83.86667	83.82083	83.74167	83.84375	83.87083	83.83095
Point 10	86.89375	86.95625	86.93125	86.94792	86.94583	86.95625	86.98333	86.94494
Point 11	85.00625	84.97500	85.00833	85.03958	85.03958	85.02500	85.05208	85.02083
Point 12	82.68333	82.67083	82.70833	82.68333	82.71458	82.70000	82.70417	82.69494
Point 13	86.81250	86.80833	86.87708	86.86250	86.87292	86.82292	86.84792	86.84345
Point 14	87.78958	87.80625	87.87292	87.86875	87.84792	87.84583	87.88750	87.84554
Point 15	84.96458	84.99375	85.03750	85.01042	85.03333	84.97917	84.98958	85.00119
Point 16	83.97917	84.00208	84.07083	84.03542	84.08542	84.04583	84.03542	84.03631

Equivalent Noise Level Calculation, From the calculation of $L_{eq}(1\ minute)$ 82.4198 dB (a) data is obtained, then the data is entered into $L_{eq}(4\ minute)$to obtain 82.4433 dB data (A). The results of $L_{eq}(4\ minute)$for each point from L1 to L7 are presented in the following table:

Table 2 Equivalent Noise (dB) (Leq)

Measurement Point	Equivalent Noise (dB) (Leq)							
	L1	L2	L3	L4	L5	L6	L7	Average
Point 1	82.44330	82.39145	82.45338	82.52158	82.49398	82.49241	82.48023	82.46805
Point 2	84.02494	83.98187	84.11403	84.11034	84.08980	84.08802	84.09944	84.07263
Point 3	85.13540	85.18823	85.18312	85.20360	85.17672	85.16847	85.17265	85.17546
Point 4	84.78720	84.82906	84.81754	84.89296	84.85465	84.80826	84.80617	84.82798

Point 5	85.75014	85.73331	85.74107	85.83552	85.78841	85.78938	85.76650	85.77205
Point 6	86.80291	86.80678	86.82771	86.86692	86.84256	86.79928	86.84762	86.82768
Point 7	86.28453	86.28184	86.33112	86.38124	86.36013	86.34224	86.35520	86.33376
Point 8	88.11698	88.20769	88.16506	88.19169	88.21295	88.16152	88.21993	88.18226
Point 9	84.12603	84.17342	84.18364	84.05888	83.95955	84.16873	84.19294	84.12331
Point 10	86.90427	86.97683	86.94949	86.96655	86.96279	86.97240	86.99766	86.96143
Point 11	85.01160	84.99080	85.01581	85.05116	85.05112	85.03392	85.06715	85.03165
Point 12	82.69354	82.68257	82.72170	82.69323	82.72683	82.71079	82.71553	82.70631
Point 13	86.81490	86.82522	86.88229	86.86826	86.88601	86.83558	86.85688	86.85273
Point 14	87.79180	87.80280	87.87460	87.87231	86.66455	87.84566	87.88995	87.67738
Point 15	84.96868	85.00104	85.04887	85.02072	85.05714	84.99516	85.00098	85.01323
Point 16	83.97807	84.00536	84.06889	84.03438	84.09536	84.04533	84.03942	84.03812

As for the results of the calculation include the following:

1. Calculations for daylight hours (L_s) with a time span of 6:00 to 10:00 p.m. obtained a value of "81.57 dB (A)".
2. Calculations for the night (L_M) with a time span of 22:00-06.00.00 obtained a value of "82.5" dB (A).
3. The last calculation is to determine the total environmental noise (L_{SM}) (24 hours) obtained a value of "84.5" dB (A).

For each data presented in the following table:

Table 3. Noise Level (dB) Equivalent (Leq) Total 24 hours

Measurement Point	**Equivalent Noise (dB) (Leq)**		
	Leq Siang (L_S)	**Leq Malam (L_M)**	**L_{SM}**
Point 1	81.57	82.5	84.5
Point 2	83.17	84.1	86.1
Point 3	84.28	85.2	87.2
Point 4	83.94	84.8	86.9
Point 5	84.88	85.8	87.8
Point 6	85.93	86.8	88.9
Point 7	85.43	86.4	88.4
Point 8	87.27	88.2	90.2
Point 9	83.22	84.1	86.2
Point 10	86.05	87.0	89.0
Point 11	84.12	85.1	87.1
Point 12	81.80	82.7	84.7
Point 13	85.95	86.9	88.9
Point 14	86.94	87.6	89.7
Point 15	84.11	85.0	87.0
Point 16	83.12	84.1	86.1

Based on table 3 can show the equivalent noise level from each measurement point on the production floor of PT. XYZ Making the graph will find out which points have the highest and lowest noise levels.

Based on the data obtained, noise mapping is done using Surfer 14 software, so we can see areas that have high and low noise levels.

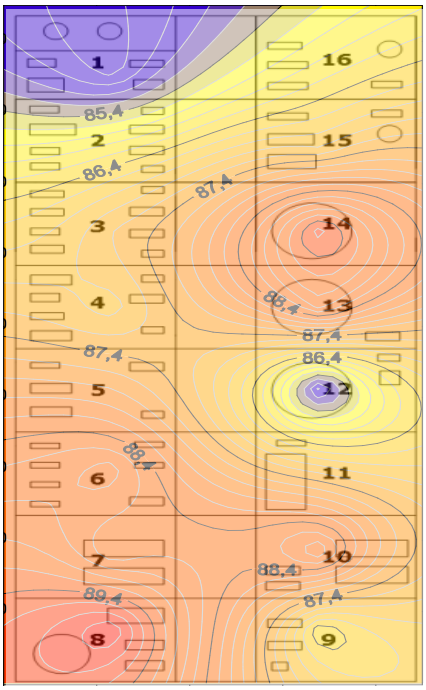

Figure 1 Noise Mapping

Based on Regulation Of The Minister Of Health Of The Republic Of Indonesia Number 70 Of 2016 Concerning Standards And Requirements Of Health Environment Industry that the noise threshold value is 85 db (A) from figure 1 and table 3 is produced from 16 points there are 15 points that exceed government regulations where the noise calculation results range. between 86-90.2 db (A), so it needs to be followed up to be able to reduce the noise

3.2 Proposed Control of Noise Sources

3.2.1 Subtitution

Reduce noise by replacement of worn engine parts

3.2.2 Engineering Control

1. Isolate the machine by making a damper / barrier
2. Lubricating the moving parts

3.2.3 Administrative Control

1. Reducing production capacity by following the design of production capacity set to maintain engine conditions so that the lifetime of the engine is maintained.
2. Rearranging the scheduling system for the inspection of existing machines and pumps such as preventive maintenance, predictive maintenance and corrective maintenance which so far have not been carried out optimally in the hope that the engine conditions can be maintained and work properly so as to reduce the noise level generated from the engine.
3. Rearranging the current employee shift system to reduce the time of noise exposure received by employees.

3.2.4 Personal Protective Equipment

Provide a sign board at points that have a high noise level to warn employees to use the required PPE in that area / point.

4 Conclusion

The several things that can be conclusions from the discussion of this paper include :

1. Based on the calculation of equivalent noise intensity (Leq) on the production floor of PT. XYZ, it is found that some points exceed the threshold values that have been set in the industrial environment of 85 dB which refers to Peraturan Menteri Tenaga Kerja Dan Transmigrasi Republik Indonesia Nomor PER.13/MEN/X/2011 Point 2 (86,1), Point 3 (87,2), Point 4 (86.9), Point 5 (87,8), Point 7 (88,9), Point 8 (90,2), Point 9 (86,2) Point 10 (89), point 11 (87), Point 13 (88,9), point 14 (89,7), Point 15 (87) and Point 16 (86,1).
2. Based on the calculation of 24 hour noise intensity (**L_{SM}**) then only 2 points meet the specified threshold value, namely point 1 (84.5) and point 12 (84.7) while the other 14 points exceed the threshold value.
3. Based on noise distribution maps with surfer software, it can be seen that there are 14 points that have noise levels that have exceeded the threshold so that further action is needed to reduce noise exposure that occurs.
4. To reduce noise at PT. XYZ can be done by substitution of components that have been damaged, doing engineering control with the description of the barrier, for administrative control by means of one of which is to periodically maintenance and provide personal protective equipment to workers

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