NOISE ASSESSMENT: A CASE FOR AN AUTOMOTIVE MANUFACTURER

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ABSTRACT: Noise-induced hearing loss remains one of the most prevalent occupational problems in manufacturing sectors. This study explains noise assessment, exposure, and sure and suggestions for noise improvement at an automotive manufacturing company. The data were obtained from observations and technical measurements. A digital sound level meter was used for measuring the noise exposure levels. The data were collected, analyzed statistically and compared to the international standard. It is found that several machines produced noise that exceeds the international hearing protection permitted level and other machines were operating at the permitted limit. It is suggested that the use of ear-muff as the right Personal Protective Equipment （PPE） and the instalment of the silencers at the machine. The recommendations are believed to assist the management in setting up a new plan to reduce the hearing loss risk in the selected company.

Keywords: *Noise Assessment; Stamping Die Company; Noise Level; Hearing loss; OSHA*

1. INTRODUCTION

Over 430 million people, or 5% of the world's population, require rehabilitation to address their "disabling" hearing loss. Over 700 million individuals, or one out of every 10 people, are expected to experience hearing loss by 2050. [1]. Being a developing country, Malaysia's occupational noise-induced hearing disorders were the highest proclaimed occupational disease, with about 75% reported compared to other diseases [2]. Noise-induced hearing loss is a type of hearing loss produced by loud noise. (NIHL)[3].

If employees are exposed to noise exceeding a time-weighted average sound level of 90 dBA for eight hours, administrative or engineering measures must be implemented. Furthermore, whenever worker noise exposures equal or exceed an 8-hour, time-weighted average sound level of 85 dBA as permitted by the Occupational Safety and Health Administration (OSHA) in the Hearing Protection OSHA's Noise Standard (2000), workers should implement a continuous, applicable approved conservation program.[4].

The use of heavy types of machinery in the workplace area may produce harmful noise levels. The continues exposure to elevated levels of sound pressure can cause irreversible changes in co-workers' hearing thresholds. [5]. As the issues are critical, one local leading automotive company specializing in automotive tooling engineering, design and manufacturing is selected as a case to execute the noise assessment. Their business includes manufacturing special dies, tools, jigs, and fixtures with production lines involving heavy-loud noise machines. In this company, the noise assessment has never been done before and it is captured that the workers did not wear any personal protective equipment during the operation.

2. METHODOLOGY

The potentially high-risk noise-exposed groups of the company workers identified were among workers at the production lines involving six machines that performing various processes. A Digital Sound Level Meter Model 407730 was used to measure the accurate noise level as recommended according to International Standard AS IEC 61672. The ten noise readings during the operation were taken for each machine and repeated for two days for consistency. The data were analysed using a statistical approach including mean, Analysis of Variance (ANOVA) and two samples T-test.

ANOVA was done to capture the differences between the sample means for more than two groups. The single-factor ANOVA with six levels were used, where the factor is the machine and the levels are six different machines. The null hypothesis is that the means of the noise produced between the machines are all equals ($H_o: \mu_{machine\,1} = \mu_{machine\,2} = \cdots = \mu_{machine\,6}$) vs. alternative hypothesis is that not all the means of the noise produced are equals ($H_a: \mu_i \neq \mu_j$). The T-test was used to assess whether the means of two groups either is statistically the same or different from each other. In this study, the T-test was used to determine the differences in the two days' noise. The hypotheses are $H_a: \mu_{day1} = \mu_{day2}$ vs $H_a: \mu_{day\,1} \neq \mu_{day\,2}$.

3. RESULT AND DISCUSSION

Figure 1 illustrates the bar-charts of the noise level that generated in the company by comparing two-day noise record for the average 10-readings of six different machines. The horizontal line is drawn at 85dBA as a benchmark of the highest permissible noise level for eight continuous working hours. It is found that, from six machines, Machine 4 (100.1 dBA) was consistently

exceeding the acceptable noise level while Machine 1 and Machine 3 were sometimes exceeding the permitted noise level with 91.4 dBA, respectively. At the same time, the rest of the machines were at the boundaries and possible to exceed the limit anytime in the future. The highest type of noise generated is continuous noise, which has negligibly small fluctuations of sound level within the period of observation. Throughout the work duration (exceeded eight working hours), the workers were exposed to continuous noise. Tables 1 and 2 show the summary of the analysis of variance for single-factor. The means of noise level for Day 1 and Day 2 comprising the average of measurement for the six machines were analysed.

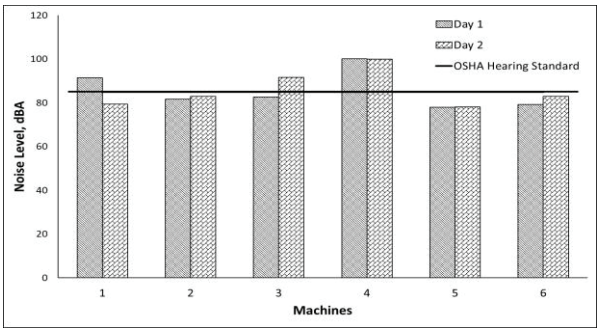

Figure 1: Graph of comparison between average measured noise level and OSHA permitted noise level for Day 1 and Day 2

Both results in the tables rejected the null hypothesis (p-value <0.05). Thus, it can be concluded that the means of the noise produced are different between the six machines on day 1 and day 2.

Table 1: ANOVA Result of Day 1

Source of Variation	SS	df	MS	F	P-value
Between machines	22158	8	4431.6	85.3495	1.1525E-58
Within machines	1838.7	354	51.923		
Total	40538.7	359			

Table 2: ANOVA Result of Day 2

Source of Variation	SS	df	MS	F	P-value
Between machines	20855.7	8	4171.15	94.5956	4.66466E-63
Within machines	15609.5	354	44.0945		
Total	36465.2	359			

Referring to Table 3, in comparison between the two days, there is no evidence rejecting the null hypothesis (p-value >0.05). Therefore, it can be concluded that the means of the noise produced are equals between the two days.

Table 3: T-test

	Day 1	Day 2
Mean	91.40833	91.61667
Variance	2.490946	2.405141
Observations	60	60
Pooled Variance	2.4480	
	118	
df		
	0.4672	
P(T<=t) two-tail		
t Critical two-tail	1.9802	

Three recommendations are proposed to improve the worker's working conditions: hearing protection, enforcement by the administration, and machine improvement. The earmuff should be made available at every section or machine's area on the manufacturing floor. The workers currently exceeding the permitted 85 dBA (refer to Figure 1) such as Machine 1, Machine 3 and Machine 4 should immediately use the earmuff as personal protection equipment. Regular monitoring is needed to make sure the workers follow the requirement and wear earmuffs. There is the tendency of the workers to on and off in using the hearing protection. Thus, the awareness and enforcement of the administration are in need to reduce the hearing loss risk to the worker. Lastly, the highly potential machines for generating the risk can be improved further by installing the silencers to absorb the loud noise. This silencer usually is attached to the machine's exhaust and can reduce the intensity of the noise.

4. CONCLUSION

The noise assessment was done with six machines captured as the source of the noise, where the statistical analysis indicated differences between the noise produced between the machines. Fifty percent of them are classified as dangerous as the noise limit exceeded the OSHA's Hearing Protection Noise Standard. The rest were possible to exceed the limit at any time in the future. The use of earmuffs, administration monitoring at the production line and silencer installments was proposed to reduce the hearing loss risk to the workers. The finding could be beneficial to the management in assisting them in developing awareness plans and driving to some appropriate intervention for preventing NIHL among workers, which will increase the company's productivity.

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