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Research Article

Noise Level Reduction in Machine Shop using Kaizen Techniques

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Abstract

Noise is simply the unwanted and displeasing sound that disrupts the activity or balance of human or animal life. The Automobile Industries are having several machineries that produce noise. The study in the paper is based to reduce the noise levels of these machines. The noise levels are identified and monitored for several machines and compared with its actual acceptable limits. The noise limits are be smoothened by certain techniques like providing silencers, sealing the air leakages, preventive maintenance schedule and once again noise level is measured for the machines to get the result of acceptable noise. This report summarizes best practice in noise and vibration measurement, prediction and assessment methodologies for noise reduction in the machine shop.

Keywords: *Noise Reduction, Kaizen Techniques, and Machine Shop Noise.*

1. Introduction

It has become widely recognized that the economic and social costs of high levels of noise in the workplace require significant action to reduce the exposure of workers to noise. The scope of this paper is to concentrate on the shop floor noise levels that are generated largely by machineries and equipments. There are up to 75 machines in the Machining Shop which operate on engine components that are cylinder head, cylinder block and crankcase performing several operations like pre cleaning, boring, honing, washing, drying, milling, air blowing, leak test, quality check, spinning and dispatch.

All the above operation can be very noisy. The noise can be a potential hazard above noise levels of 85 dB and where exposure is over very long periods of time (NIOSH and OSHA Norms, 2013). The ill effects of noise can cause physiological and behavior effects on a person. The physiological effects include hearing losses and other biological and health responses. The behavioral effects include distractions, disturbances, sleep problems, and annoyance (S Mitchell, 2001).

In India, according to the OSHA Norms, the occupational permissible exposure limit for 8 h time weighted average is 85 dB (NIOSH and OSHA Norms, 2013). The exposures are based on 3 dBA exchange rates.

The following diagram depicts a comparison chart of everyday noise levels ranging from about 20 dB to 130 dB.

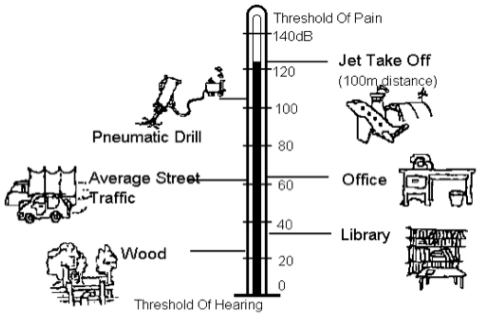

Fig 1.1: Comparison of everyday noise. (S Mitchell, 2001)

Therefore, Kaizen Techniques (Alex Smith, 2012), which are practices for continuous improvement can be used to take up this project of noise reduction. A typical Kaizen Project in noise reduction goes in the following way:

1) Set goals and provide any necessary background.
2) Review the current state and develop a plan for improvements.
3) Implement improvements.
4) Review and fix what doesn't work.
5) Report results.

2. Procedure for Noise Reduction

The procedure and Kaizen Methodology:

a) To Check the Noise level of Shop Floor
b) Concentrate on High Noise Areas
c) Monitor the equipments, machines and processes of that area

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d) Implement the required techniques in desired areas
e) Monitor the feasibility of it
f) Check the noise level of Shop floor
g) Evaluate the difference in noise level

Based on the machines that emit high noise, numerous kaizen techniques can be shortlisted for effective noise reduction of each machine according to the following criteria:

a) Acoustic Performance
The efficiency for the noise can be reduced.
b) Description
It consists the comparison of the Advantages and Limitations of each of the technique.
c) Application
Describes how many types of application can a technique have for noise reduction.
d) Durability
e) Cost

The noise level mapping on the shop floor can be analyzed using the Pareto's Principle (JK Liker 2004). It suggests that there would be 20% noise causing factors that contribute to the 80% of noise on the shop floor. In regard to the principle, the machines and operations that distinguish to 80% of the noise level above accepted limit; are mainly CNC, Leak tests, washing, drying, air blowing operations. The following diagram shows the Pareto's analysis chart for the shop floor.

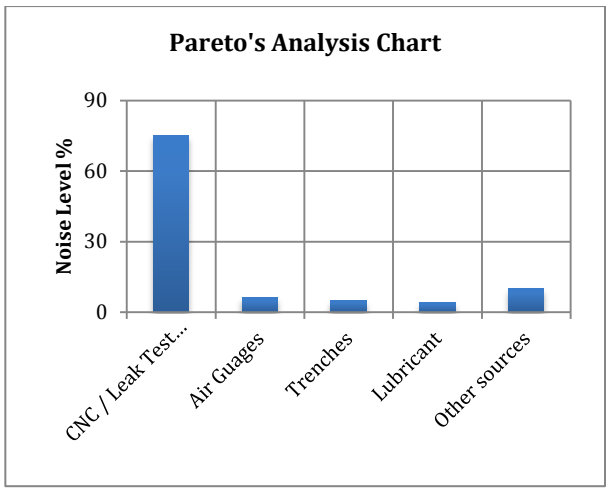

Fig 2.1: Pareto's Analysis Chart

The shop floor noise level mapping is done and high noise areas are identified in the table below:

Table 2.1: Noise Level Measurement of Shop Floor.

Sr. No.	Cell Area	Machines / Operations	Noise Level (dB)
1	Cylinder Block	Washing and Drying	110
2	Crank Case	Washing and Drying	92
3		CNC Operations - FRD	85
4		CNC Operations - Makino	86
5	Cylinder Head	Washing and Drying	92
6		VF2	92
7		Spinning	95

3. Kaizen Techniques for Noise Reduction

The following techniques can be used for noise reduction in the machine shop.

1. **Installation of Air Nozzles and Silencers on the Air blower Machines:** Installation of Air Nozzles and Silencers on the opening of the air blower can effectively reduce noise level by 15% - 20%. The nozzles are generally made up of Acrylic materials, which have perforated openings that direct the air at a high velocity but at a lower noise. However the limitation of this solution is that it causes air clogging which decreases the machine efficiency in the long term.

2. **Enclosure of Acoustic Curtains around the Washing Machines:** Enclosure of Acoustic Curtains around the washing machines can be used to successfully absorb noise and it also blocks escaping noise. This solution can decrease noise from 10% to 15% but again causes air clogging, thus decreasing machine efficiency.

3. **Acoustic Paneling and Damping around Machines:** Acoustic Paneling and Damping around the machines helps to absorb noise and does not let the noise pass through a lot of gaps and holes. On the Acoustic Panels, the damping material can be stuck onto its surface to enable the operation. The noise reduction can be achieved from 5% to 18%. However, the disadvantage of this solution is that it requires a lot of space around the machine and also much of planning the layout needs to be done.

4. **Noise Filters:** CNC machines with noise operations such as Fanuc RoboDrills and Makinos have an additional support of addition of noise filters. The noise filters have negative amplitude, which superimposes with the machine's high amplitude. Therefore, It decreases the noise level of the CNC before it emits noise out.

5. **Sealing Air Chambers and Joints of Machines:** Shop floors usually have air chambers that produce a lot of high noise; it is also found that there are air leakages from the joints. So the joints can be sealed to control the air leakage, thereby reducing the noise level.

6. **Preventive Maintenance Scheduling.**: The Air Gun daily monitoring should be incorporated in

the daily checklist of associates, so that air tool condition is being checked and any deviation can be captured immediately and rectified.

7. **New Machine Pass Off Checklist Modification.** While purchasing new machinery, the machine is released by Safety Department on the basis of Checklist. The point of acceptable noise level condition by the supplier should be added in the checklist so that noise-reducing measures will be provided at the Manufacturer's end too.

4. Comparison of Noise Levels

Table 4.1: Application of Kaizen Techniques and Comparison of Noise Levels (Vrushali Jain, 2012)

Sr. No.	Kaizen Technique	Average Noise Level Before (dB)	Average Noise Level After Expected (dB)	% Decrease in Noise
1	Air Nozzles and Silencers (App: Air Guns)	110	92	**17%**
2	Acoustic Curtains (App: Washing & Drying M/c)	98	85	**14%**
3	Acoustic Paneling and Damping (App: CNCs)	91	83	**9%**
4	Sealing Air Chambers and Joints (App: Coolant Pipes)	86	80	**7%**
Average Noise Level		**96**	**85**	**12%**

The above comparison of noise levels can be depicted in the following graph showing the permit noise levels, Average noise levels before and after with comparison to Average dB.

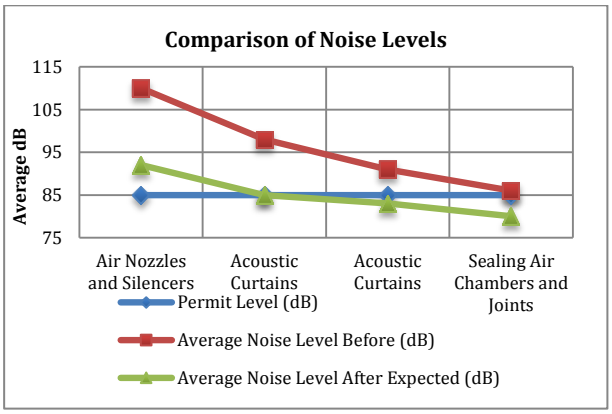

Fig 4.1: Application of Kaizen Techniques and Comparison of Noise Levels before and after

Conclusions

The aim of this research was to concentrate on high noise areas in the machining shop of the plant and suggest optimal measures to avoid it or reduce it by certain measures and techniques. The average noise level measured earlier was 96 dB. After proposing suitable kaizen techniques for noise reduction, the average noise level can be successfully decreased to an average 85 dB, which is about 12% of reduction. This provides a significant improvement in noise reduction.

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