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Determination of Noise Hazard in Automobile Industry

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ABSTRACT: This paper help the safety personnel of Automobile Industry to improve as well as maintain their Safety and good Hygienic condition. Total safety management system in an automobile Industry is an integrated effort of the occupier, manager, safety manager, supervisors, and workers. In This paper we discuss about various tool to monitor and measure the Industrial Hygiene and Safety Practices in Automobile Industry. Hearing loss is a major occupational health problem among industrial workers. Repetitive exposure to loud noise increases the risk of hearing loss. An administrative noise control such as job rotation can help to reduce workers daily noise exposures. In a case where noise levels are excessively high, it is often necessary to assign additional workers to the current workforce to alleviate daily noise exposures that individual workers receive. This paper represents three cases to determine a minimum number of workers and their work assignments to attend noisy workstations without noise hazard exposure (that is, daily noise exposure does not exceed 90 dBA). Therefore To improve Safety and maintaining the good Hygienic condition. Such type of monitoring or evaluating techniques helps us to identify the deficiencies in implementation of safety program in industries, with the intention to improve the safety system in future.

Keywords: Industrial hygiene, Industrial Noise, Safety practices

I. INTRODUCTION

According to OSHA Industrial hygiene is the science of anticipating, recognizing, evaluating, and controlling workplace conditions that may cause worker's injury or illness. Industrial hygienists use environmental monitoring and analytical methods to detect the extent of worker exposure and employ engineering, work practice controls, and other methods to control potential health hazards.

It is known that a cumulative effect of repetitive exposure to loud noise is occupational hearing loss. According to the National Institute for Occupational Safety and Health (NIOSH, USA), there are approximately million workers are currently exposed to noise hazard on the job and an additional few million are at risk of hearing loss. Noise-induced hearing loss is one of the most common occupational diseases and the second most self-reported occupational illness or injury.

For Automobile Industry where jobs are done on the Press Shop. There are loud noise is generated during press operation on the shop floor. For these type industrial facilities having high noise levels, appropriate noise controls must be implemented to prevent workers' daily noise exposures from exceeding a permissible limit. Engineering controls are the most effective noise hazard prevention, which can be done through proper design, maintenance, lubrication, and alignment of machines. The use of barriers or shields can reflect high-frequency noise. Isolating machines from areas where workers are likely to be present also helps to reduce noise levels. The use of hearing protection devices (HPDs) is another common noise control approach. Earplugs and earmuffs are widely used in industry. In many manufacturing facilities, workers choose not to use HPDs unless strictly enforced and routinely monitored. Comfort seems to be a major factor that influences whether or not HPDs are worn by workers. Other than using engineering controls or HPDs, job rotation is popularly recommended to reduce workers' daily noise exposures. Job rotation is an administrative noise control that offers a trade-off between safety concern and cost effectiveness. Briefly, job rotation requires workers to rotate among workstations within one workday in order to reduce their daily noise exposures. In a few special situations, job rotation not only helps to reduce noise hazard exposure but also increases productivity by sharing very demanding tasks among workers. Despite being an effective yet inexpensive noise control, job rotation has not received much attention from industrial engineers and/or safety practitioners. This is perhaps due to difficulty in implementing job rotation to achieve its optimal level of effectiveness. In practice, the number of workstations where individual workers will attend, work duration at each workstation, and the order of assignment must be defined. Since a major goal is to reduce workers' daily noise exposures, it is necessary to search for a feasible set of work assignments such that none of the workers receives daily noise exposure exceeding 90 dBA. In a case where there is no feasible set of work assignments with the current number of workers (which is usually equal to the number of workstations), the number of workers must be increased.

Worker	Work Period's				TWA_2
	0-2	2-4	4-6	6-8	dBA
X	98	95	95	92	93.13
Y	95	98	92	95	93.13
Z	92	92	98	98	**95.00**

However, the number of workers who are exposed to high noise levels should be minimized.

In this paper, we consider an optimization problem of finding the minimum number of workers and their daily work assignments to attend a set of workstations such that none of the workers receives daily noise exposure exceeding 90 dBA for Automobile Industry. In any Automobile Industry there are multiple press shop working concurrently for various job. There are three or more press machines working concurrently, they are of 450T, 600T and 1000T respectively. We will perform noise monitoring on each machines individually shown in Table A.

II. METHODOLOGY

In any Automobile Industry the press shop area is most noisy area. In this area the worker is mostly exposed to noise and suffer hearing loss.

Daily noise exposure is measured in terms of an 8 hour time-weighted average (8 hour TWA, dBA) sound level. Letting hj be work duration (in hour) at workstation j, n be number of workstations, and Lj be combined

Noise level (dBA) measured at workstation j, the 8-hour TWA can be determined using the following formula. (Adapted from OSHA, 1983)

$$\text{8-hour TWA} = 16.61\left\{\log_{10}\left[\sum_{j=1}^{n}\frac{hj}{8}\left(2^{\frac{Lj-90}{5}}\right)\right]\right\}+90$$

Note that the permissible daily noise exposure is equivalent to the 8-hour TWA of 90 dBA.

The applicability of job rotation to reducing daily noise exposure can be illustrated as follows.

Suppose that a facility consists of three workstations with noise levels of 98, 95, and 92 dBA, respectively. Three workers (X, Y and Z) are assigned to attend the three workstations during an 8-hour day which is divided into four equal work periods.

Table A shows work assignments of the three workers when

(1)Job rotation is not implemented, and

(2) Job rotation is implemented.

In Table 1, workers X, Y and Z (or three workers who are assigned to the first, second and third workstations) receive daily noise exposures that exceed 90 dBA, with the maximum being 98 dBA. After implementing job rotation, the maximum daily noise exposure is reduced to 95 dBA. However, the three workers are still exposed to noise hazard since their daily noise exposures exceed 90 dBA.

Table 1.

Table 2.

Worker	Work Period's				TWA_1
	0-2	2-4	4-6	6-8	dBA
X	98	98	98	98	**98.00**
Y	95	95	95	95	95.00
Z	92	92	92	92	92.00

Table 2, shows the work assignments with job rotation and an additional worker (Z'). The maximum daily noise exposure is now reduced to 94.00 dBA. With worker Z' joining the workforce, none of the four workers is exposed to noise hazard. Note that there are some workers who are not assigned to attend any workstation in some work periods. (In practice, they can be assigned to do other jobs in their free work periods.) If two additional workers are added to the original workforce (of three workers), it is obvious that the maximum daily noise exposure will be even less than when only one additional worker is added. However, the number of free work periods will also increase, resulting in decreased work productivity.

III. ANALYSIS/CALCULATION

(1)Work assignment solutions: without job rotation

We know that the OSHA, 1983 formula:

$$\text{8-hour TWA} = 16.61\left\{log_{10}\left[\sum_{j=1}^{n}\frac{hj}{8}\left(2^{\frac{Lj-90}{5}}\right)\right]\right\}+90$$

8-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left[\sum_{1}^{4}\frac{2}{8}\left(2^{\frac{98-90}{5}}\right)\right]\right\}+90$$

=**98.00**

8-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left[\sum_{1}^{4}\frac{2}{8}\left(2^{\frac{95-90}{5}}\right)\right]\right\}+90$$

=95.00

8-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left[\sum_{1}^{4}\frac{2}{8}\left(2^{\frac{92-90}{5}}\right)\right]\right\}+90$$

=92.00

(2)Work assignment solutions: with job rotation

2-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left(2^{\frac{98-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

=92

4-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left[\sum_{2}^{3}\frac{4}{8}\left(2^{\frac{95-90}{5}}\right)\right]\right\}+90$$

=95.00

2-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left(2^{\frac{92-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

=90.50

Total (8-hour TWA of Worker X) =
(92+95×2+90.50) 4=93.13

Similarly For Worker Y,
Total (8-hour TWA of Worker Y) =
(92+95×2+90.50) □ 4 = 93.13

Similarly For Z,
4-hour TWA of Worker Z =

$$16.61\left\{\log_{10}\left[\sum_{1}^{2}\frac{4}{8}\left(2^{\frac{92-90}{5}}\right)\right]\right\}+90$$

=92.00

4-hour TWA of Worker Z =

$$16.61\left\{\log_{10}\left[\sum_{2}^{3}\frac{4}{8}\left(2^{\frac{98-90}{5}}\right)\right]\right\}+90$$

=98.00

Therefore,
8-hour TWA of Worker Z = (92×2+98×2) 4 =**95.00**

Table B
Work assignment solution with job rotation and one additional worker

2-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left(2^{\frac{98-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

=92

2-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left(2^{\frac{95-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

=91.25

2-hour TWA of Worker X =

$$16.61\left\{\log_{10}\left(2^{\frac{92-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

= 90.50

Total (8-hour TWA of Worker X) =
(92 + 91.25 + 90.50) □3 = 90.92

Similarly,
4-hour TWA of Worker Y =

$$16.61\left\{\log_{10}\left[\sum_{1}^{2}\frac{4}{8}\left(2^{\frac{95-90}{5}}\right)\right]\right\}+90$$

= 95.00

2-hour TWA of Worker Y =

$$16.61\left\{\log_{10}\left(2^{\frac{98-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

= 92

Total (8-hour TWA of Worker Y) =
(95×2+92) □ 3=**94.00**

Similarly,
4-hour TWA of Worker Z =

$$16.61\left\{\log_{10}\left[\sum_{1}^{2}\frac{4}{8}\left(2^{\frac{92-90}{5}}\right)\right]\right\}+90$$

=92.00

2-hour TWA of Worker Z =

$$16.61\left\{\log_{10}\left(2^{\frac{98-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

=92

Total (8-hour TWA of Worker Z) =
(92×2+92) 3=92.00

Similarly,
2-hour TWA of Worker Z' =

$$16.61\left\{\log_{10}\left(2^{\frac{95-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

=91.25

2-hour TWA of Worker Z' =

$$16.61\left\{\log_{10}\left(2^{\frac{92-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

=90.50

2-hour TWA of Worker Z' =

Worker	Work Period's				TWA_3
	0-2	2-4	4-6	6-8	dBA
X	98	E	95	92	90.92
Y	95	98	E	95	**94.00**
Z	92	92	98	E	92.00
Z'	E	95	92	98	91.25

$$16.61\left\{\log_{10}\left(2^{\frac{98-90}{5}}\right)\times\frac{2}{8}\right\}+90$$

=92

Total (8-hour TWA of Worker Z) =
(91.25+90.50+92) 3=91.25

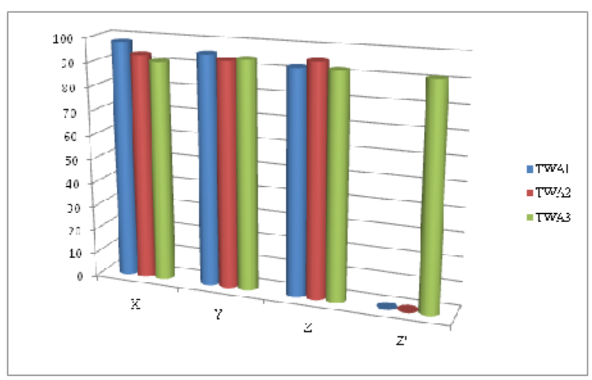

Fig. 1. TWA (dBA).

IV. CONCLUSION

This paper can help to determine the Noise exposure during different operation on any shop floor. To employ these techniques, we can reduce noise exposure hazards and occupational diseases in any Automobile Industry. This technique can also provide information to each and every worker about the various noise hazards at the Shop floor and provide the best solutions for controlling noise hazards. Provide proper training to the every employer to use HPDs and control noise hazards. To control noise hazards, there are three cases discussed. First are Work assignment solutions: without job rotation, Second is Work assignment solutions: with job rotation, and Third is Work assignment solution with job rotation and one additional worker. We can see that the last method is more successful in compared to two methods. If we want, we can apply work assignment solution with job rotation and two or more additional worker but it cannot be feasible due to decreased in work productivity. Because the number of free works period will also increase. The purpose of this paper to determine the noise hazard exposure in any automobile industries, with view to improve the safety system and protect workers from noise hazard exposure in currently and future.

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