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Engineered Noise Control Strategy in Industrial Plant

Pradip Sankar Bhattacharyya

Technical Director -Energy, Mott Macdonald, Kanakia Wall Street, Wing A, Floor-4, Andheri Kurla Road, Andheri East, Mumbai 400 093, India. Email: pradip.bhattacharyya@mottmac.com

***Abstract* –Hearing impairment due to induction of noise is predominantly existing in occupational diseases. For this, noise reduction strategies are extremely important and should be actively in place to reduce risk of injury in industrial places. At high noise level, it is difficult to have oral or telephonic communication. Apart from permanent deafness, high noise level causes stress and lack of concentration for serious work. This article examines various engineering and administrative methods adopted by designers and engineering consultants at design stage itself to bring down the noise level within the stipulated parameters set by OSHA and local authorities.**

***Keywords*—Noise Control, OSHA, occupational hazard, engineering consultants.**

1. INTRODUCTION

Any, "unsolicited, displeasing or irritating sound causing discomfort to mankind or animal "is defined as noise. It is unpleasant to work in an environment that has noise more than the acceptable limit. There are different types of noise namely: Airborne, Ambient, Structural borne, Flanking, Impact, Impulsive, Masking, Pink, Random, White and other types of noise.

Development of high speed equipment has exposed millions of workers to noisy work environment.

DIN EN ISO 11690-1 provides guidelines for noise control strategy with A-weighted emission(dBA) as shown in Table 1.

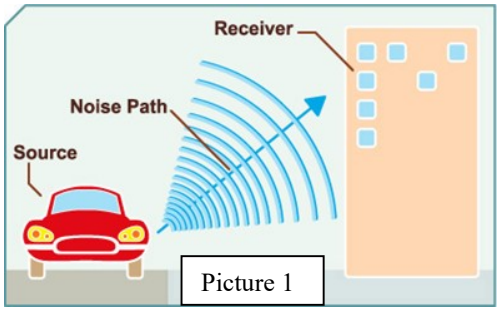
Noise Level	Exposure Limit
90 dBA	8.0 hours
92 dBA	6.0 hours
95 dBA	4.0 hours
97 dBA	3.0 hours
100 dbA	2.0 hours
102 dBA	1.5 hours
105 dBA	1.0 hours
110 dBA	30 minutes
115 dBA	15 minutes

Table 1. OSHA's Permissible Noise Exposure Limits.

Physics of Sound: There is relationship between vibration and noise. Sound is effect of vibrations in a medium. Alternating waves produced by vibration, behaves like ripples in water. Due to ambient temperature and pressure, there is variation in waves that reaches ear and that is termed as sound. Sound waves may be reflected, scattered or refracted.

Combination of **source**, **transmission path** and a **receiver** (e.g., worker) results in noise problem. Refer Picture1 for illustration.

Hence, acoustic designers have to tackle resultant effect of these three parameters for lowering noise level.



Picture 1

2 MATERIALS & METHODS

Physical methods of engineering noise controls are:

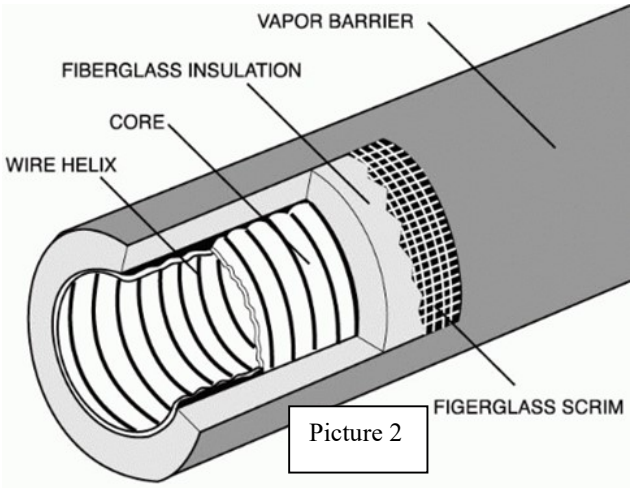
- Purchase Specification with noise controlling features
- Application of silencers, enclosures, barriers
- Application of screen, partitions, absorptive treatments.
- Application of damping materials or vibration isolators.

Some of the noise making equipment or areas are discussed here with the controlling techniques:

Gearbox: High power and high-speed gears have high noise level. Material specification should include precision dynamic balancing grade, tip relief, crowning, case hardening and grinding, higher class of accuracy as per DIN or AGMA or any other standard to control tooth geometry, increased transverse contact ratio and overlap ratio, use of cast housing, proper amount of backlash, gears with more number of teeth/smaller module. Lubricants with high viscosity will tend to reduce noise.

Open space (warehouse, office): Place sound dampening acoustical panels into the space in question. Instead of soundproofing the entire building or room, it is prudent to place absorption materials into the desired space.

Ducting work: Ductwork involves openings in walls and enclosures. Use lining of acoustic absorbent (like fiberglass) at the final bend in the ducting work. Refer Picture 2 for illustration.



Picture 2

Fan installation: For minimum noise and maximum fan efficiency, straight duct of 2 to 3 times duct diameter shall be ensured between any feature that may disturb the flow.

Fan Speed: Significant noise reduction is possible by reducing small drop of fan speed. As noise is roughly proportional to the 5th power of fan speed. It is possible to achieve a large noise reduction from a small drop in fan speeds as shown in Table 2

Fan speed reduction	Noise reduction
10%	2 dB
20%	5 dB
30%	8 dB
40%	11 dB
50%	15 dB

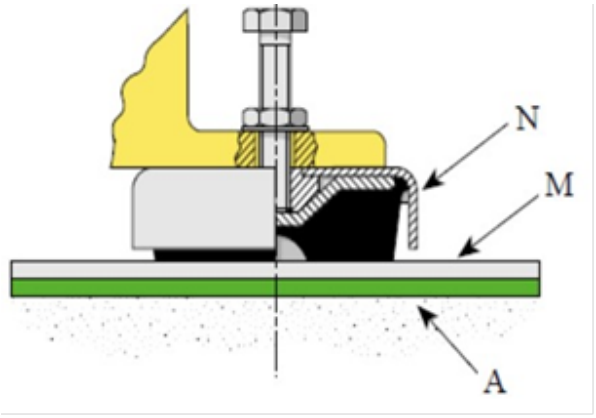
Table 2

Vibration Isolating pads: Fixing rotating equipment of plant on elastic mount is very effective to reduce vibration transmission and thus noise.

ASHARE (American Society of Heating, Refrigerating and Air Conditioning Engineers) specifies following formula to describe transmissibility(T) of vibration:

$$T = 1 / \{1 - (f/fn)2\}$$

Where, 'fn' is natural frequency and 'f 'is exciting frequency. Static deformation of the isolator to the equipment mass decides 'fn' value. Refer Figure 3 for vibration Isolation pad.



(Figure 3: example of vibration isolation pads)

Pneumatic Exhausts:

If we fit/fix silencer on pneumatic exhaust, noise will reduce drastically. In case of multiple exhaust, it is judicious to manifold them in to a single bigger diameter size exhaust at the rear end.

3. RESULTS AND DISCUSSION

Adopting all the methods during detail engineering stage as preventive action will make the plant quieter.

2 to 3 times duct diameters of straight run before and after the fan reduces noise level by 3-12 dB.

Silencer reduces noise in pneumatic exhaust permanently by 10-30 dB.

Acoustic absorbent reduces 10-20 dB noise in duct work.

Similar result is achieved by reducing duct velocity, avoiding sharp bend in ducting, use of vibration isolating pads, sound dampening panel etc.

4. CONCLUSION

Many International and National government have made legislation on limiting noise level at work places. Designers and Engineering Consultants can judiciously use the available material and techniques to control the noise level.

It is important to identify the most noise making equipment/devise and control it as first step to bring down the overall noise level.

We can put sound-proof materials on the walls surrounding the noisiest equipment. Steps are shown below:

- Identify the potential areas of sound pressure level exceeding 85 dBA (like high speed gearbox, compressor).
- Identify and inform the staffs those who are prone to have exposure to noise greater than allowable limit.
- Apply noise and vibration control measures in detail engineering stages.
- There is a source from which noise radiates. Hence, it is important, at the design stage itself to specify quietest operating device.
- Structural joints, doors and windows shall be sealed in an appropriate manner to restrict sound leakage.

If noise levels are still in excess of allowable limit, use administrative measures like hearing protectors, limited hour of exposure, staggering time of work, operation with remote control.

While designing the plant, care should be taken to bring down the cost and not to use high cost items like acoustic enclosures.

5. ACKNOWLEDGMENT

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