TRADE OF

Industrial Insulation

PHASE 2

Module 4

Insulation – Materials, Science and Application

UNIT: 14

Acoustics/Noise Abatement

Produced by

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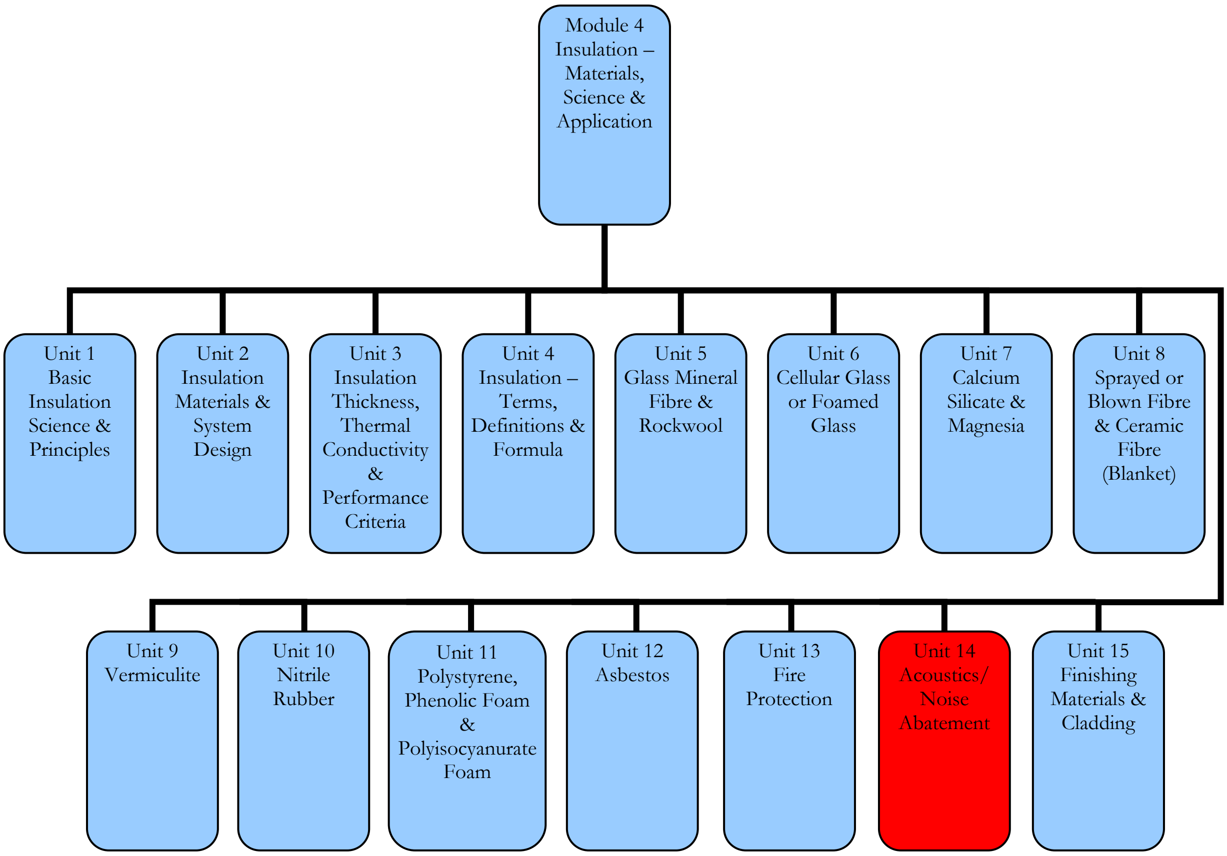
Introduction

Noise control or noise abatement is an active or passive means of reducing sound emissions, often incentivised by personal comfort, environmental considerations or legal compliance. Practical and efficient noise control is wholly reliant on an accurate diagnosis of what is causing the noise, which first involves finding the source of noise. Once the source of noise has been found, the focus is reducing the noise at source by engineering means.

The most common noise sources can be divided into aerodynamic (fans, pneumatics, combustion, etc) and mechanical (impacts, friction, etc). Effective noise control focuses on reducing the noise from these sources as close to the source as possible. Noise control for aerodynamic sources include quiet air nozzles, pneumatic silencers and quiet fan technology.



Unit Objective

By the end of this unit ***each apprentice*** will be able to:

- State and describe the benefits of acoustic insulation.
- List the insulating materials and finishing products most widely used in noise abatement.
- Fabricate a small acoustic panel.

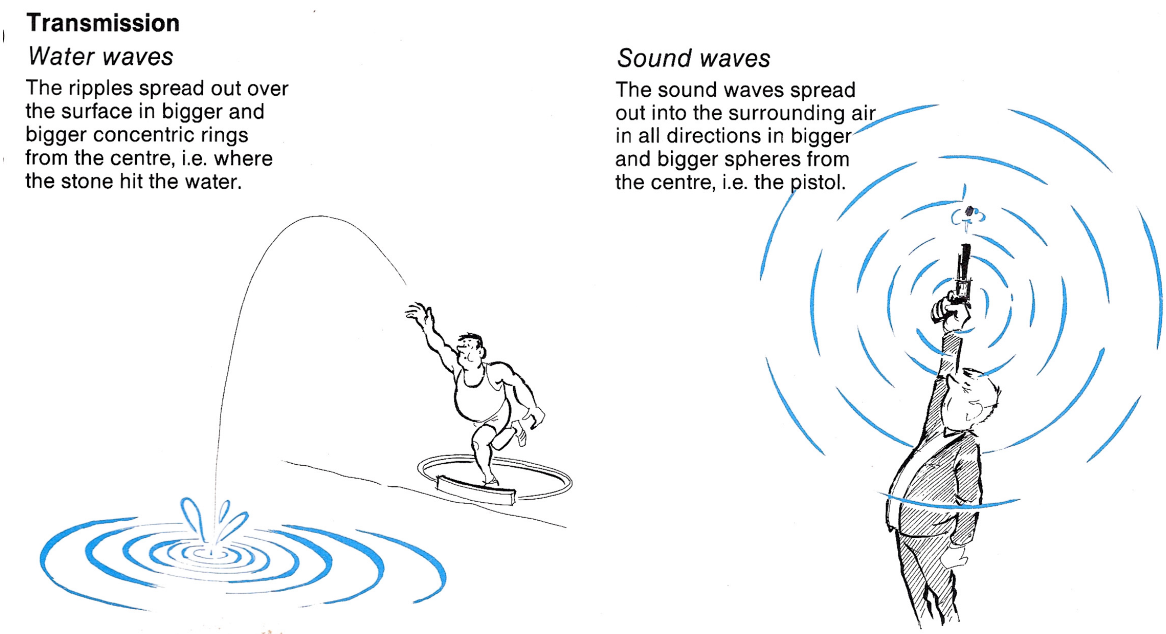
1.0 Acoustic/Noise Abatement

Key Learning Points

- Definition of sound.
- Definition of the units of sound: dB.
- Measurement of sound.
- Acceptable sound/noise levels in work environments.
- Hazards associated with working in environments with excessive sound levels.
- Reasons for noise abatement: ergonomics, health and safety legislation.

1.1 Definition of Sound

Sound is a type of energy made by vibration when any object vibrates, it causes movement in the air particles. It can be recognised as a succession of travelling pressure waves or vibrations moving away from the source of the noise or sound. These sound waves are measured according to their frequency and intensity. Lets pursue the analogy so that we can understand more clearly how sound waves spread and can be deadened. The transmission of sound is wave movement which occurs in a medium e.g. Air and which is invisible to us. This transmission has however great similarities to another wave movement – that



of water – which we can see and whose origins we understand.

Absorbing Sound

When the sound waves meet a soft porous wall e.g. of mineral wool the oscillating air molecules will penetrate the outer layer to some extent and there be brought to a halt by friction against the material fibres.

That part of the sound energy which is absorbed in this way is converted to heat within the material and the remainder is the part that is reflected back out into the room. This kind of damping, in which the sound is impeded by the outer layer of a soft material, is called porous absorption.

Different materials are of different efficiency when it comes to sound absorption. In the case of hard materials e.g. concrete or marble surfaces, almost all the sound energy will be reflected rather then absorbed. In a room with hard surfaces, sound reverberates for a long time before dying out. The room has a long resonance time and there is a strong and troublesome echo. The sound level from ordinary noise sources will be high.

In the case of soft materials, e.g. thick layers of mineral wool, the opposite happens. The sounds is mainly absorbed and deadened, thus reducing noise levels.

1.2 Definition of the Units of Sound - dB

The intensity of loudness of sound is measured in a unit called the decibel (dB)

Decibel Scale

You have to think about the decibel scale very carefully, because it's a logarithmic scale and it works in a different way to the scale on a ruler, which is a linear scale. On a ruler, a distance of 20cm is twice as long as a distance of 10cm and 30cm is three times as long. But the logarithmic decibel scale goes up in powers of ten: every increase of 10dB on the scale is equivalent to a 10-fold increase is sound intensity (which broadly corresponds with loudness). That means a sound of 20dB is 10 times louder than a sound of 10dB and 1 30 dB sound is 100 times louder. That's why sounds high up to the decibel scale (from about 85-200dB) are a major cause for concern: the sounds waves carry so much energy that they will damage your hearing, sooner or later.

dB levels	Typical everyday example	x 10 dB
10dB	Rustling or falling leaves	1
20dB	Watch ticking	10
30dB	Birds flying by	100
40dB	Quiet conversation	1,000
50dB	Louder conversation	10,000
60dB	Quiet traffic noise	100,000
70dB+	Louder traffic	1,000,000
80dB+	Motorway traffic at close range	10,000,000
85dB	Hearing damage after approximately 8 hours	

100dB	Pneumatic drill at close range	1,000,000,000
100dB	Hearing damage after about 15 mins	
110dB	Jet engine at about 100m	10,000,000,000
120dB	Threshold of pain. Hearing damage after very brief exposure.	

1.3 Measurement of Sound

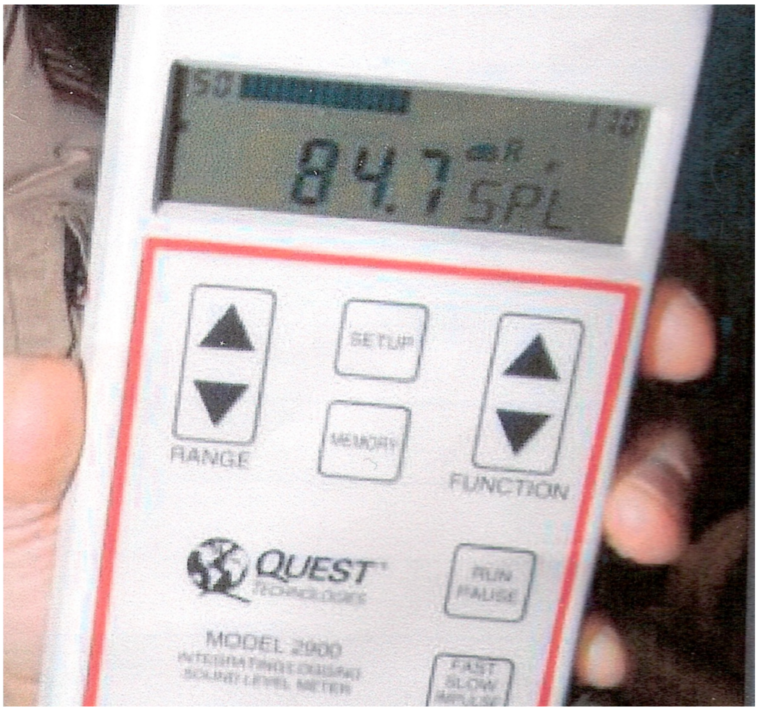
Noise levels in the work environment and elsewhere are measured using a sound level meter.

Sound level Meter

A sound level meter is an instrument designed to respond to sound in approximately the same way as the human ear and to give objective, reproducible measurements of sound pressure level. There are many different sound measuring systems available. Although different in detail, each system consists of a microphone, a processing section and a read-out unit.

How Sound Level Meters Work

Sound level meters look quite simple. They have a pointy stick at the top, which is the microphone that samples and measures the sound. The stick keeps the microphone away from the body of the instrument, cutting out reflections, and giving a more accurate measurement. Inside the square box at the bottom of the meter, electronic circuits measure the sound detected by the microphone and amplify and filter it in various ways before showing a readout on the digital LCD display.



1.4 Acceptable Sound/Noise Levels in the Work Environment

Noise Exposure Limits

Noise is measured in decibels (dB). An 'A-weighting' sometimes written to measure average noise levels, and a 'C-weighting' or 'dB(C), to measure peak, impact or explosive noise.

The Noise Regulations require you to take specific action at certain action values. These relate to (1) the levels of exposure to noise of your employees averaged over a working day or week and (2) the maximum noise (peak sound pressure) to which employ working day. The values are:

Lower Exposure Action Values

Daily or weekly exposure of 80dB

Peak sound pressure of 135dB

Upper Exposure Action Values

Daily or weekly exposure of 85dB

Peak sound pressure of 137dB

There are also levels of noise exposure which must not be exceeded:

Exposure Limit Values

Daily or weekly exposure of 87dB

Peak sound pressure of 140dB

These exposure limit values take account of any reduction in exposure protection.

1.5 Hazards Associated with Working in Environments with Excessive Sound Levels

Some of the hazards of excessive sound levels are:

- It can contribute to both physical and mental ill-health
- It causes accidents as well as symptoms such as headache, irritability and tiredness
- Prolonged exposure to noise inflicts irreparable damage to hearing
- Stress and lost work time/absenteeism

1.6 Reasons for Noise Abatement: Ergonomics, Health and Safety Legislation

Proper work space planning is very important so as to place noisy equipment as far as possible from noise sensitive areas. As mentioned earlier in **section 1.5** a noisy work area can lead to all sorts of problems for workers such as hearing loss, tiredness, ill health and lost work time/absenteeism. For example, HVAC (Heating, Ventilation, Air-Conditioning) equipment such as chiller rooms, fan/air handling rooms, cooling towers and roof top package units should be well isolated from noise sensitive areas by proper design and layout of the building at the earliest stage of the design process.

When mechanical services equipment has been properly located it should be correctly installed using proper vibration isolators, sound traps, acoustic duct liners, flexible connections etc. So as to eliminate or reduce noise levels to acceptable standards to satisfy current health and safety legislation.

2.0 Materials and Methods of Construction

Key Learning Points

- Range of insulating products for noise abatement in industry.
- Methods of construction of noise abatement panels used in industry.
- Manufacturer's data sheets and product information.
- Selection criteria for acoustic materials.
- Fabrication of an acoustic panel.
- Communication skills in decision-making regarding selection of materials.

2.1 *Range of Insulating Products for Noise Abatement in Industry*

Sound proofing and acoustic materials are used to attenuate, deaden or control sound and noise levels from machinery and other sources for environmental improvement and regulatory compliance. Sound proofing and acoustic materials can be used either for noise reduction or noise absorption. Noise reduction reduces the energy of sound ways as they pass through an area, whereby noise absorption suppresses echoes, reverberation, resonance and reflection.

Many different types of sound proofing and acoustic materials are available such as:

- Sound proofing mat or pads
- Acoustic flooring
- Noise absorber foam
- Acoustic soundproofing ceiling tiles
- Acoustic mineral wool mats or slabs
- Acoustic panels and curtains
- Acoustic flexible connections for ducting, air-handling units and fans

2.2 *Selection Criteria for Acoustic Panels*

Acoustic panels are designed to control excessive reverberation and echo in busy locations. This reverberation results when sound waves reflect off rigid, non-absorbent and reflective surfaces multiple times. In certain cases, reverberation is treated by adding sound absorption.

Acoustic panels are selected to provide an acceptable background noise level and/or respects sound criteria with a required reverberation level.

Acoustic panels are used in:

- Gymnasiums and pools
- Libraries and halls
- Machine shops, workshops
- Computer rooms
- Offices
- Shopping centres
- Mechanical plant rooms.

2.3 Composition of Acoustic Panels

Standard acoustic panels are made entirely (including edges) from 0.8mm perforated galvanized steel sheets. Acoustic panels can also be manufactured from aluminium stainless steel or other metals. Other thicknesses such as 0.6mm and 1.0mm are also used. The standard size is 600mm in height by 1200mm in length. Panels are available in two thicknesses: 50mm and 100mm. The internal cavities of the panels are filled with dense rock fibre wool and the backing is covered by a protective Mylar film. An internal spacing grill is inserted between the rock fibre wool and the perforated sheet to favour sound absorption. The manufacturer's data sheets will provide all the necessary information regarding the composition of the sound absorbing material, the safe handling of the material and its range of uses.

2.4 Design and Fabrication Methods to Manufacture an Acoustic Panel

General steps on making an acoustic panel. These steps may vary depending on the design of the panel.

1. Design acoustic panel.
2. Mark out panel on perforated sheet using standard tools.
3. Cut sheet on guillotine and notch corners using corner notcher or snips.
4. Fold panel using press brake or box and pan folding machine
5. Check corners of panel for proper fit-up and de-burr.
6. Fit absorption grille and high density rock wool to inside of panel
7. Cover rock wool with Mylar protective film and finish
8. Support at back of panel can be metal strips riveted to panel frame.

Note: Perforated sheets can also be used on both sides of the panel for utilization as an acoustic baffle and to favour sound absorption on both sides.

Summary

The intensity of loudness of sound is measured in a unit called the decibel (dB). Noise levels in the work environment and elsewhere are measured using a sound level meter. Exposure to high levels of noise, either continuously or as a loud sudden 'bang' from equipment such as cartridge-operated tools or guns, can have a number of physiological and psychological effects on workers including stress, tinnitus and if exposed to high noise levels over long periods of time, permanent loss of hearing can occur. High noise levels can also interfere with communications in the workplace, leading to an increased risk of accidents.

In accordance with the current regulations every employer shall reduce the risks resulting from exposure to noise to the lowest level reasonably practicable, taking account of technical progress and the availability of measures to control the noise in particular, at source. However the potential risk to an employee's hearing can be related to the length of time a person is exposed to certain levels of noise, both daily and the cumulative amounts over a number of years.

Noise abatement techniques such as acoustic panels are used to dampen down high noise levels from mechanical equipment thus reducing the exposure to the employees.

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