NEBOSH AWARD IN HEALTH, SAFETY AND ENVIRONMENT FOR THE PROCESS INDUSTRIES

UNIT PS1
PROCESS SAFETY

Element 3: Common Hazards, Risks and Controls in the Chemical Industry

SAMPLE MATERIAL

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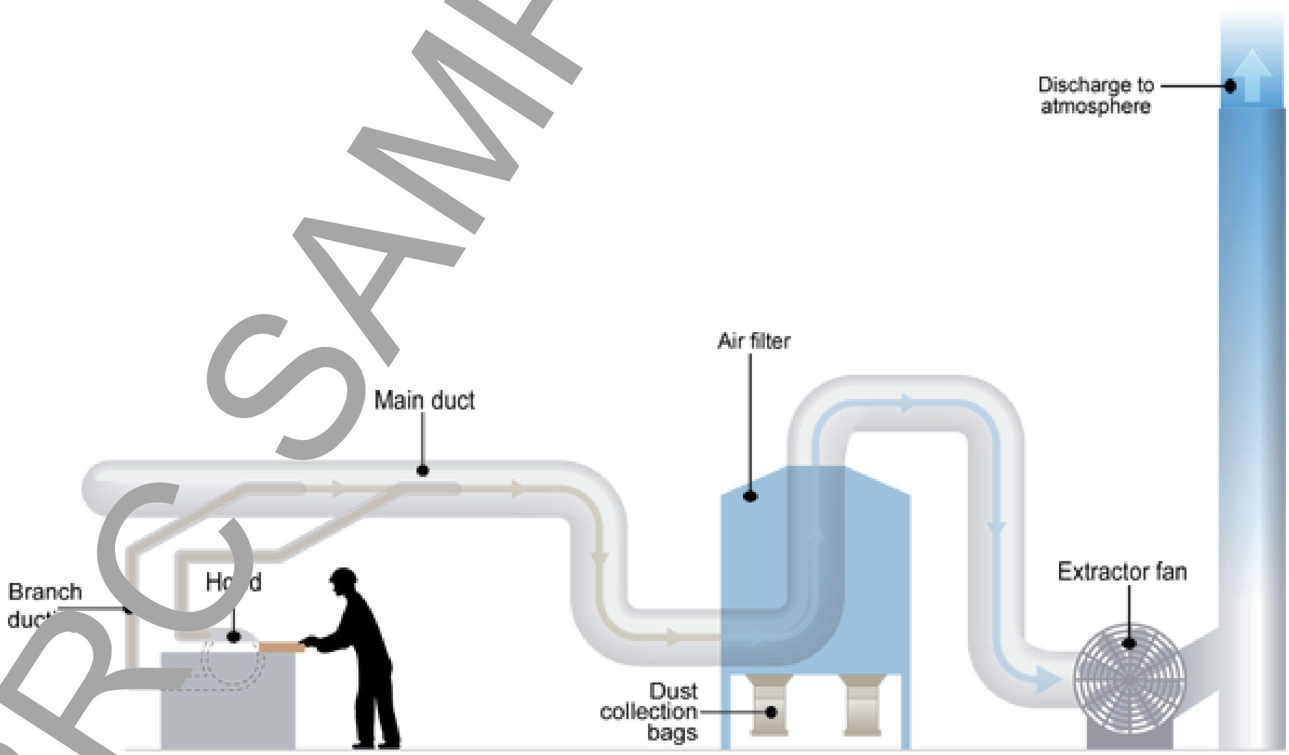
Local Exhaust Ventilation and Plant Preparation

Key Information

- The basic principle of a local exhaust ventilation (LEV) system is the extraction of contaminated air at the point of generation and then the filtering of the contaminant out of the air, allowing the clean air to exhaust to atmosphere.
- Effectiveness of an LEV system will be reduced by plant misuse, including poorly positioned intake hoods, damaged ducts and excessive amounts of contamination.
- In situations where systems contain hazardous substances, plant often needs to be prepared prior to handover to maintenance workers.

Use of a Local Exhaust Ventilation (LEV) System

One common control for substances that might become airborne is the use of local exhaust ventilation (LEV) systems. A wide variety of different types of LEV is available, but the basic principle of an LEV system is the extraction of contaminated air at the point of generation and then the filtering of the contaminant out of the air, allowing the clean air to exhaust to atmosphere. LEV is above the use of PPE in the risk control hierarchy. The effective use of an LEV system will therefore reduce or eliminate the need for operatives and others to wear PPE, as the hazardous substances will already have been extracted from the workplace air.



A typical LEV system extracting sawdust from a bench-mounted circular saw

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A variety of different intake hoods are used on LEV systems, but they can be categorised into two main types:

- **Captor hoods** – capture the contaminant by drawing it into the system, overcoming the contaminant's initial velocity (which may have been taking it away from the hood, such as during grinding).
- **Receptor hoods** – positioned in such a way that the contaminant is moving in that direction already so less air movement is required to achieve uptake (e.g. a large intake hood suspended above a bath of molten metal - the metal fume will be hot and rising up into the hood on convection currents).

Topic Focus

Effectiveness of an LEV system will be reduced by plant misuse, including:

- Poorly positioned intake hoods.
- Damaged ducts.
- Excessive amounts of contamination.
- Ineffective fan due to low speed or lack of maintenance.
- Blocked filters.
- Build-up of contaminant in the ducts.
- Sharp bends in ducts.
- Unauthorised additions to the system causing overextension.

LEV systems should be routinely inspected and maintained to ensure their on-going effectiveness:

- **Routine visual inspection** – to check the integrity of the system, signs of obvious damage and build-up of contaminant both outside and inside the ductwork.
  - Filters should be visually inspected to ensure they are not blocked.
  - The exhaust out-feed should be checked.
- **Planned preventative maintenance** – may include replacing filters, lubricating fan bearings and inspecting the fan motor.
- **Periodic testing** – to ensure that air velocities through the system are adequate. This can be done by:
  - Visual inspection of the intake hood using a smoke stick.
  - Measuring air velocities at the intake and in the ductwork using anemometers.
  - Measuring static pressures using manometers and pressure gauges.

Testing of LEV systems on a 14-month basis is a legal requirement under the **Control of Substances Hazardous to Health Regulations 2002 (COSHH)**.

Appropriate Plant Preparation

In situations where systems contain hazardous substances, plant often needs to be prepared prior to handover to maintenance workers. This will help to reduce the:

- Risk of exposure to maintenance workers.
- Reliance on PPE during maintenance operations.

Activities that might be required to prepare plant may include:

- Depressurise to atmospheric pressure.
- Cool (or heat for cryogenic systems).
- Drain.
- Water flush and/or fill.
- Nitrogen purge.
- Others such as air movement, high-pressure water jetting, back flushing, detergent wash.
- Demonstrating a non-explosive atmosphere immediately before the work starts.

Bleeds or vents are connections in pipework that enable liquids to be drained or depressurised from the system. They will enable safe depressurisation of plant parts and are necessary to monitor the integrity of plant isolation.

The amount of purging and flushing will depend on the substance concerned and the nature of the intrusive activity. For example, very stringent control is required where intrusive hot work is to be carried out on systems that have contained flammable substances.

Hazardous substances should always be removed without:

- overloading the drains and/or vent systems;
- inadvertent/uncontrolled entry of air into pipework and equipment;
- formation of ice/hydrates; or
- creating a vacuum in vessels not designed for the purpose.

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Revision Questions

6. Identify four factors as to why LEV can be misused.
7. What are the three ways in which LEV systems can be inspected and maintained?
8. Name three common methods of preparing plant.

(Suggested Answers are at the end of Unit PS1.)

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Personal Protective Equipment (PPE)

Key Information

- Personal Protective Equipment (PPE) is clothing or equipment which is worn or held by a worker that protects them from one or more risks to their safety or health.
- Many different types of PPE are available, such as ear defenders, gloves, respiratory protection and eye protection.
- The use of PPE should be seen as the last resort when it comes to risk control.
- Adequate storage of PPE is essential.
- All PPE will have a usable lifespan.

Jargon Buster

Personal Protective Equipment (PPE)

Clothing or equipment which is worn or held by a worker that protects them from one or more risks to their safety or health.

Many different types of PPE are available, such as:

- Ear defenders for noise.
- Gloves to prevent contact with substances hazardous to the skin.
- Respiratory protection against substances hazardous by inhalation (breathing in).
- Eye protection against splashes of chemicals and molten metals, mists, sprays and dust, projectiles and radiation including bright lights.

PPE as the Last Resort

The use of PPE should be seen as the last resort when it comes to risk control.

Topic Focus

PPE is the last resort because:

- It only protects one person – the wearer.
- It may not protect adequately if it is not fitted correctly.
- It may not be comfortable and may interfere with the wearer's ability to do the job.
- It may increase overall risk by impairing the senses (e.g. goggles that mist up).
- It may not be compatible with other items that have to be worn or used.
- People do not like wearing PPE.
- If it fails, it fails to danger (the worker is exposed to risk).

There are:

- Instances where no other control measures can be used.
- Times when some of them can, but residual risk still remains.

If this is the case then it may be necessary to use PPE.

The regulations covering PPE also require employees to:

- Use the PPE provided in accordance with their instruction and training.
- Report loss or defect to their employer.

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The Importance of Using the Appropriate PPE

Many factors have to be taken into account when choosing PPE. The main factors are:

- Type of protection required.
- Level of protection required.
- Compatibility issues.
- Personal issues relating to the individual user.
- Wearer acceptability.
- Fit.
- Training requirements.

More...

http://www.hse.gov.uk/pubns/priced/l25.pdf

We will now consider the different types of PPE, particularly those that are commonly used in the process industry.

Gloves

When safety gloves are being selected for use, it is very important to choose the material of construction which is designed to give protection against the particular hazard. Where chemicals are handled, suppliers will provide a good guide as to the type required. Glove resistance charts are often available (see the following example).

Glove Resistance Chart

Chemical	Latex	Neoprene	Nitrile	Normal PVC
Ethanoic acid	E	[illegible]	E	E
Nitric acid (up to 50%)	NR	NR	NR	G
Benzene	NR	F	G	F
Diesel fuel	NR	F	G	F
Wood preservatives	NR	[illegible]	G	F

Key to ratings: E - excellent
G - good
F - fair
NR - not recommended

You will note in the table the wide variation in suitability of differing materials for the chemical listed. Glove manufacturers use three technical terms to characterise the chemical resistance properties of gloves:

- **Breakthrough time** - the time a chemical takes to permeate through the glove material and reach the inside. Permeation is a process by which a chemical can pass through a material without going through pinholes or pores or other visible openings. This tells you how long you can use a glove for.
- **Permeation rate** - the amount that then permeates through. The higher the rate the more of the chemical will move through the glove. Choose a low rate.
- **Degradation rating** - some chemicals can destroy the glove material. It may get harder, softer or may swell. Degradation indicates the deterioration of the glove material on contact with a specific chemical. Choose gloves with an excellent or good degradation rating.

There are several European Standards for gloves, such as:

- BS EN 374-2, showing the gloves are waterproof.
- BS EN 374-3, for chemical resistance.
- BS EN 407, for thermal resistance.

Gloves must be CE marked to the relevant standard, depending on the nature of:

- the hazard they have been selected to protect against; and
- the work environment in which they are to be used.

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CE Mark

A mark that shows that a product conforms with all EU legislation relevant to it.

CE Mark

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Footwear

As with any PPE, protective footwear must be suitable for the job. Consider whether slip-proof or chemical-resistant soles are needed, or if the entire shoe or boot needs to be waterproof, or insulated to protect against electrical hazards, or steel-toed and fitted with a midsole to protect against injury.

- **Reinforced Toecaps**

  In some workplaces, employers must supply their workers with official standard safety work boots, but workers could choose to buy their own from the huge range of safety boots on the market. Reinforced toes help prevent crushing or severe cuts or severing of the toes and must conform to manufacturing standards as set out by law. Reinforcement either comes from a moulded steel plate or a composite plate that is made from plastics and/or rubber.

- **Reinforced Soles**

  As for steel toecaps, exactly the same can be done for the bottom of the work boots too, helping to prevent sharp objects piercing the boot and subsequently the foot.

- **Static Resistant**

  In some lines of work, the build-up of static electricity can be highly dangerous, especially if flammable materials are present in the workplace. Work boots that have antistatic soles are therefore required to prevent static build-up.

- **Oil and Chemical Resistant**

  In factories where oil and chemicals are in use, it is important to provide workers with protective clothing. The feet are the place where most likely spills will come into contact with the body, so work boots that are resistant to corrosive chemicals are also an important feature.

Work boots should:

- Be comfortable.
- Provide good insulation while allowing the foot to breathe, to ensure that workers don't suffer from extremes of temperature or bacterial infections caused by excess moisture.

Overalls/Chemical Suits

The body can be protected from hazardous substances by the use of a range of clothing such as:

- Overalls (prevent direct skin contact with agents such as grease).
- Aprons (prevent spills and splashes from getting onto normal work wear and soaking through to skin).
- Whole body protection (entire body is encased in a protective, chemical-resistant suit).

Handling small quantities of low risk chemicals may only require aprons protecting against accidental splashes. Larger quantities of chemicals or risks of contact with sprays or jets of chemical are likely to require protective coats/trousers or coveralls. Potential exposures to large quantities of chemicals or very hazardous materials will often require the use of gas- or liquid-tight suits and appropriate respiratory protective equipment (RPE).

Respiratory Protective Equipment (RPE)

RPE is any type of PPE specifically designed to protect the respiratory system, e.g. self-contained breathing apparatus. There are two main categories of RPE:

- **Respirators** – filter the air taken from the immediate environment around the wearer.
- **Breathing apparatus** – provides breathable air from a separate source.

Respirators

Respirators come in a variety of types:

- **Filtering Face-Piece Respirator**

  The simplest type, consisting of a filtering material held over the nose and mouth by an elastic headband.

A Worker Wearing a Filtering Face-Piece Respirator to Prevent Inhalation of Wood Dust

This type of respirator is useful to prevent inhalation of dust (and sometimes gas and vapour), but is not suitable for high concentrations of contaminant, for use against substances with high toxicity, or for long duration use.

Use and Benefits	Limitations
Cheap	Low level of protection
Easy to use	Does not seal against the face effectively
Disposable	Uncomfortable to wear

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