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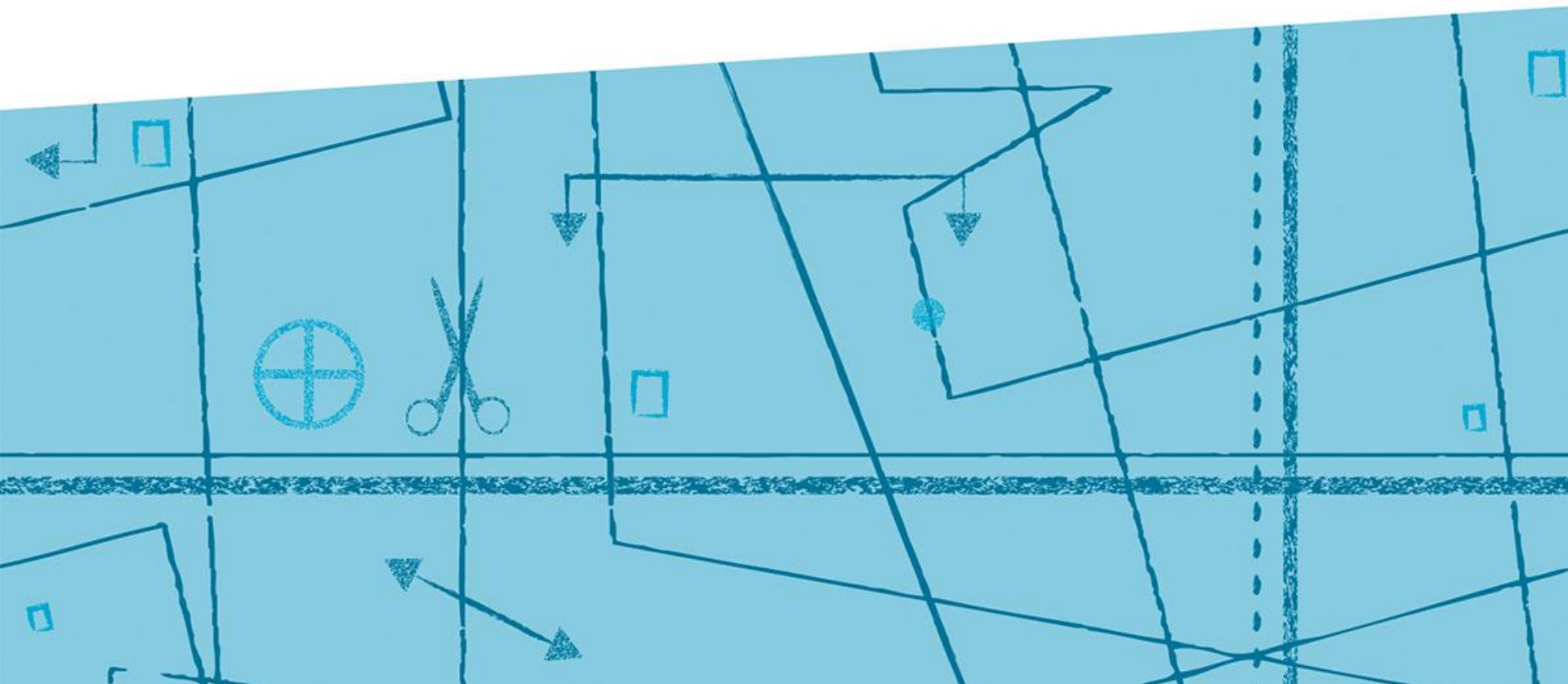
Module 5

Health Protection and Occupational Safety



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Overview and Content

Module 1: Chemicals in Textiles

Module 2: Chemical Management

Module 3: Good Housekeeping

Module 4: Wastewater and Sludge Treatment

Module 5: Health Protection and Occupational Safety

- Target of the Module
- Control Exposure and Releases
- Personal Protective Equipment
- Plan and Prepare for Emergencies
- Fire Emergencies
- Corrective Actions
- Example and Exercise

Module 6: Risk Analysis and Action Planning

Module 7: Evaluation and Possible Next Steps

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Target of the Module „ Health Protection and occupational safety “

This module deals with good chemical management practices concerning health and safety aspects:

- Control exposure and releases
- Select and use personal protective equipment
- Provide training, procedures and instructions
- Improve chemical handling
- Safe chemical storage
- Safe chemical transport
- Plan and prepare for chemical emergencies
- Manage and dispose chemical waste

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Control Exposure and Releases

ELIMINATE HAZARDS THROUGH CHEMICAL AND PROCESS SUBSTITUTION –TEXTILE SECTOR (EXAMPLES)

Process	Approach
Desizing	Recovery and reuse of water-soluble synthetic sizing agents through ultrafiltration
Bleaching	Use of hydrogen peroxide instead of chlorine-based bleaches
Mercerising	Recovery and reuse of caustic soda solution from the mercerising process
Printing	- Use of optimized printing paste - Low-emission thickeners - APEO-free pigments with a high degree of bio eliminability, reduced ammonia content
Finishing	Replacement of halogen organic solvents (e.g. in stain removal and subsequent cleaning).

Source: Environmental Standards in the Textile and Shoe Sector, UBA, 2011

Control Exposure and Releases

Isolate hazardous chemicals and processes

For example:

- Placing your spraying operations in a separate work area which is structurally enclosed and fitted with exhaust extraction systems to remove contaminants
- Mixing of chemicals in a segregated well ventilated area
- Segregating incompatible chemicals during storage
- Segregating waste water flows with incompatible chemicals
- Keeping sources of ignition away from flammable chemicals

Source: GIZ PSES

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Control Exposure and Releases

Engineering control measures

For example:

- Enclosing and/or encapsulating of processes with hazard chemicals and chance of releases
- Removing chemical emissions using special drainage arrangement and local exhaust ventilation (LEV) on process machinery or at point of work
- Using drainage systems and general ventilation in work areas
- Installing secondary containments in storage areas to limit contamination in case of spills and leaks
- Using waste water treatment systems before discharging waste water

Control Exposure and Releases

Improvement of working conditions with LEV

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Control Exposure and Releases

Fume hood for resin spraying in a denim laundry

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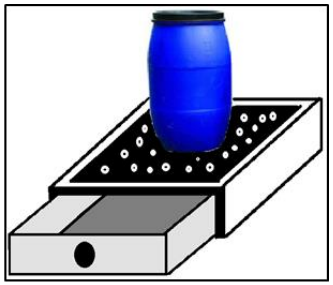
Control Exposure and Releases

Secondary Containment of hazardous chemicals



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Control Exposure and Releases

Special consideration for ventilation systems

- Exhaust and ventilation systems can maintain a safe atmosphere by introducing uncontaminated air or removing contaminated air
- Avoid recirculation of contaminated air
- Contaminated air removed through locally exhausted ventilation systems should be cleaned by means of scrubbing or other cleaning devices before being released into the ambient air.

Check in your company:

- ✓ Are the stack heights maintained as per local regulation?
- ✓ Are local exhaust systems connected to operational cleaning devices?
- ✓ Are there provisions to release exhaust air (luvers, vents) at the ceiling?
- ✓ Is there a chance of cross-contamination to/from other work areas, generator sets (or neighbouring factories?)

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Control Exposure and Releases

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Dust collector in dyestuff weighing area

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Personal Protective Equipment

Select and use personal protective equipment

The main purpose of personal protective equipment (PPE) is to protect employees/workers should an accident or incident occur despite appropriate management systems and operational procedures.

PPE must be provided **free of charge** to the employees who are facing hazards in their work.

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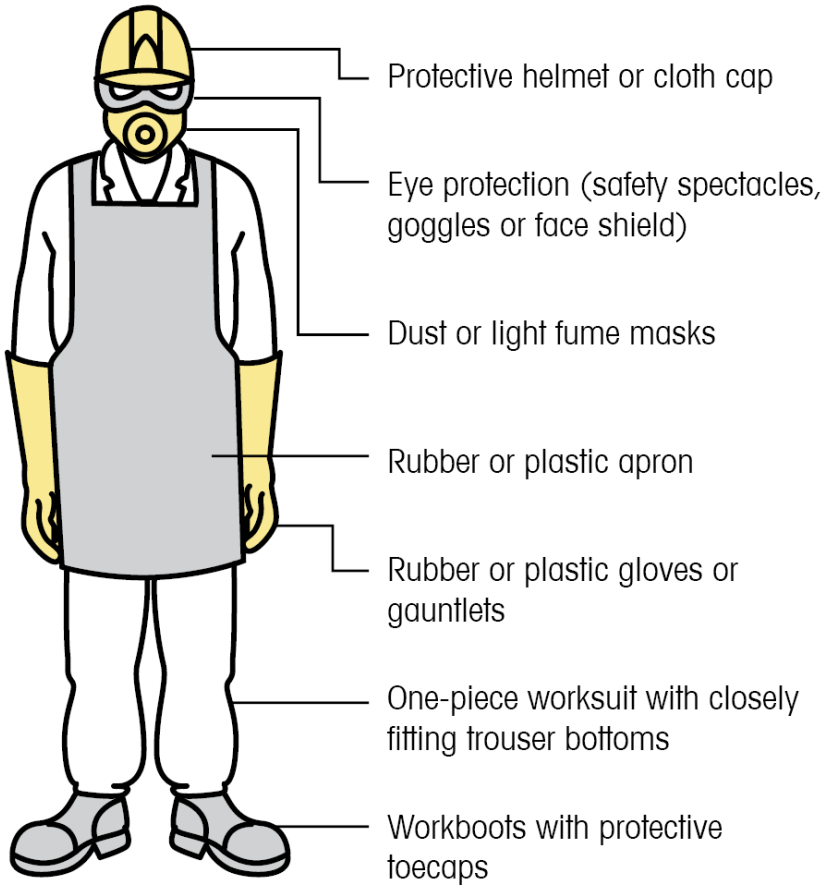
Personal Protective Equipment

Commonly, PPE includes protective clothing (e.g. overalls, aprons, footwear, gloves, chemical resistant glasses, face shields) and respirators.

Engineering controls protect everyone in the workplace; a respirator can only help the person wearing it.



PPE is the last barrier between the contaminant and you!

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Personal Protective Equipment

Find information sources and guidance on PPE

To make sure that the PPEs can effectively provide the desired protection, employees/workers need guidance on the selection and proper use of the PPEs. Such guidelines may cover the following areas:

- How to select the correct type of personal protection equipment, taking into consideration the exposure and work situation
- Clear instruction to workers on the proper use of the PPE (when, where, how)
- Guidance on storage, cleaning and maintenance of PPE
- Guidance on replacement of PPE

Video Chemical Safety & Handling Training:
http://chemicals.cita.org.hk/mod/mediagallery/cita_video_item.php?g=2 & video_id=10046

The main source of information for the selection of appropriate PPEs are the safety data sheets. ►Check section 8 in the (GHS conform) safety data sheet

Personal Protective Equipment

Ensure adequate respiratory protection

Respiratory protection equipment protect you against exposure from airborne contaminants in form of

- solid or liquid particles (dust, mist, aerosols)
- vapors
- gases by inhalation and partly eye absorption (depending on type of mask

Disposable APR for solid and liquid particulates only!

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Personal Protection Equipment

Ensure adequate respiratory protection

- Contaminants may either directly affect the respiratory tract, or get absorbed into the body`s circulatory system, resulting in systemic effects.
- Respiratory protection equipment (e.g. dust masks) purify the air you breath.
- Special case: Respiratory protection devices for use in situations with immediate danger to life and health such as in areas with oxygen-deficiency (for example in confined spaces such as tanks or vessels),

  → providing breathable air from a tank or through a supply line.

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Personal Protective Equipment

Overview of basic types of respiratory protective devices

Air purifying respirators (APR) use filters (for solid and liquid particulates e.g. dust, aerosols), cartridges (for gases and vapours) or canisters (used with „gas mask“). These can only be used, if the atmospheric oxygen level remains higher than 19.5%.

If the atmospheric oxygen level drop below this level, atmosphere-supplying respirators or supplied-air respirators (SAR) need to be provided. These may be air supply units or self-contained breathing apparatus (SCBA).

Example: Assigned Protection factors (APF) of common air purifying respirators

Paper Disposable APF - 5

Half-Mask APF - 10

Full-Face (FF) APF - 50

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Personal Protective Equipment

Ensure adequate respiratory protection

- Be aware of the lifetime of cartridges and filters → plan for replacement!
- The lifetime of the cartridges and filters depend on intensity and conditions of use (e.g. humidity, temperature). Check also the recommended service life indicators for cartridges and canisters.
- Make users aware of how they can verify filter or cartridge break-throughs (e.g. odor, smell, irritation).
- Make sure, that replacement of PPE (Personal Protective Equipment) at recommended intervals is planned and budgeted for.

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Personal Protective Equipment

Selecting respiratory protective equipment:

- Is the PPE meant for routine use or non-routine use (e.g. for escape in an emergency situation)?
- What are workplace hazards the wearer of the PPE may encounter as a consequence of wearing the PPE?
- What are the physical characteristics of the wearer?
- What is the physical demand of the work (e.g. complexity of tasks, work place temperatures and humidity)?
- What are the respirator capabilities and limitations?

Type of contaminant	Characteristics
Particulate	Fine liquid or solid particles such as dust, smoke, mist or fumes found in air or emissions
Mist	Small droplets suspended in air
Dust	Minute solid particles with diameters less than 500 micrometers
Aerosol	Collection of very small particles suspended in air. The particles can be liquid (mist) or solid (dust or fume)
Fume	Vapor carrying suspended solid particles or liquid droplets
Vapor	Vapor The gaseous form of materials that are normally liquids or solids at room temperature and pressure (e.g. steam)
Gas	Gas is one of the four major states of matter, consisting of freely moving atoms or molecules without a definite shape and without a definite volume

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Personal Protective Equipment

Train uses on respiratory protection

- Everyone who is involved in the use of respiratory protective equipment (RPE) needs to be trained. Training may be available from the supplier or manufacturer of your RPE.

  →Awareness why the respirator is being worn, which respirator should be used and how it should be worn properly.

- Training for supervisors should also cover other issues such as health hazards, work practices, use of other equipment on site and medical surveillance requirements (especially for emergency and rescue teams).
- All workers need to be trained prior to the use of a respirator.
- This training should be repeated at least once a year.

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Personal Protective Equipment

Train uses on respiratory protection

Minimum content of respiratory protection training :

- What are the hazards and effects of contact with chemical?
- What are the limitations of personal protective equipment?
- When and how to use the personal protective equipment?
- When and how to clean or dispose of personal protective equipment?

Do the managers and supervisors act as role models for good personal protective practices in your company by following the same requirements?

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Personal Protective Equipment

Ensure adequate protection of skin and eyes

The safety data sheet (see section 8) will provide guidance on what type of personal protective equipment for skins and eyes may be required when handling the specific chemical.

A good safety data sheet will not only indicate the type of personal protective equipment, but also the recommended material.

The exposure to chemicals may directly affect the skin or eye, for example in case of chemicals with corrosive or irritant hazards, or result in systemic effects when absorbed through skin and eyes.

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Personal Protective Equipment

Be aware of limitations of protective materials

- Permeation rate (rate at which chemical is moving through the material)
- Breakthrough time (duration of chemical to permeate completely through the material)
- Degradation (physical deterioration of material due to contact with a chemical e.g. getting stiffer or softer, brittle, weaker,…)

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Personal Protective Equipment

Ensure adequate protection of skin and eyes

Factors for selecting suitable skin protection:

- Check task and task requirements (flexibility, grip and touch sensitivity needed)
- Identify all hazards e.g. list of the chemicals, physical hazards (e.g. abrasion, tearing, puncture, fire/flames, temperature) as well as effects of skin exposure
- Determine type of contact (e.g., occasional contact or splash protection or continuous immersion of hands) and contact period
- Consider what hazards may be presented by the use of the protective clothing itself. For example, protective clothing can contribute to heat stress; reduced dexterity; rip or tactile functions; poor comfort; or may contribute to skin conditions.
- Consider decontamination and disposal procedures.

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Plan and Prepare for Chemical Emergencies

- Emergencies with chemicals can have catastrophic effects not only for workers but also for the community at large and the environment.
- Pre-emergency planning gives clear guidance to everyone in the enterprise as to what and what not to do. It also provides an excellent opportunity for discussion with fire, police, medical and other emergency services outside the plant.
- Management should establish emergency measures and facilities to deal with any eventuality. These facilities should be regularly inspected to ensure that they are in operation when needed.

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Plan and Prepare for Chemical Emergencies

Common emergency situations involving chemicals:

- Fire or explosion (e.g. warehouse, disposal yard, production area)
- Fire producing harmful gases or mixtures
- Medical emergency (e.g. poisoning, burns, asphyxiation e.g. in confined spaces)
- Spill, rupture and leak from chemical containers, dosing or conveyance systems
- Leaks from effluent treatment plant
- Flooding of chemical store
- Vehicular accidents during transport of chemicals and waste

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Plan and Prepare for Chemical Emergencies

Management has ***a responsibility*** to establish procedures to deal with emergencies and accidents that might arise from the use of hazardous chemicals at work. These procedures must be reviewed regularly and changed as appropriate when, for example:

- new chemicals are brought into the work-place
- new chemical processes are developed or existing processes are changed

To prepare for chemical emergencies, look into the requirements for the (1) prevention of and (2) response to emergency situations.

Preparation involves an assessment of where, what, and with which probability, chemical emergencies may happen.

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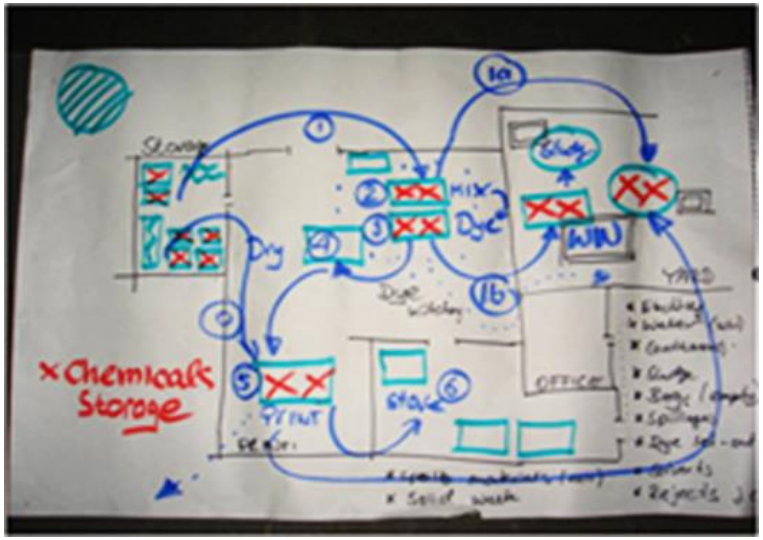
Plan and Prepare for Chemical Emergencies

Practical tips

As part of your emergency planning process, consider the use of or consult your eco-maps (see also module two, chemical management), in order to identify and document areas and types of possible chemical emergencies in your company.



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Chemical Fires and Explosions

The risk of a fire is based on the presence and combination of three basic factors:

(1) the availability of fuel (differentiated by the degree of flammability of a substance)

(2) the availability of source of ignition/heat and

(3) the ambient conditions such as the temperature and presence of oxygen.

The control of at least one of these three factors will significantly reduce the probability of a fire, for example:

- Substitution of highly flammable substances with non-flammable ones,
- Segregation of incompatible chemicals
- Segregation of flammable materials and potential sources of ignition (e.g. no smoking rule in chemical store, placement of electrical switches outside the store)

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Chemical Fires and Explosions

Classes of fire and how to prevent them

Class A	Class B	Class C	Class D
Ordinary combustibles (wood, paper, trash, cloth)	Flammable and combustible gases and liquids	Energized electrical equipment	Combustible metals (e.g. Magnesium, titanium, potassium, sodium
Routine housekeeping and cleaning	Good handling and storage practices	Good maintenance and prevention of misuse	Follow special advice
▪ Make sure storage and working areas kept free of trash	▪ Reduce ventilation to prevent build-up flammable vapor or gas concentrations ▪ Storage of substances in tightly sealed containers ▪ Storage away from spark producing sources ▪ Limit portable storage containers to 20 liters each ▪ Avoid storage of more than 100 liters of flammable liquids inside a building unless in approved storage containers	▪ Regularly check electrical equipment. Report any hazardous conditions to your supervisor ▪ Prevent electric motors from overheating by keeping them clean and in good working order ▪ Never install a fuse rated higher than specified for a circuit ▪ Never overload wall sockets. ▪ Investigate any appliance or equipment that smells strange. This is often the first sign of a fire ▪ Use utility lights that have some type of wire guard over them. Direct contact with an uncovered light bulb can ignite combustible materials.	

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Chemical Fires and Explosions

Prevent and responding to different types of fire

Understanding some basic terminologies

- ***Auto ignition temperature*** means the minimum temperature required to cause self-sustained combustion, independent of any other source of heat.
- ***Boiling point*** means the temperature at which a liquid boils at a fixed pressure, especially under standard atmospheric conditions (liquid and vapor phases are in equilibrium with each other at a specified pressure).
- ***Flashpoint*** means the lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture with air and burn when a source of ignition (sparks, open flames, cigarettes, etc.) is present.
- ***Lower flammable limit*** **(LFL)** means the lowest concentration of a material that will propagate a flame. The LFL is usually ex-pressed as a percent by volume of the material in air (or other oxidant).
- ***Explosive atmosphere*** is an accumulation of gas, mist, dust or vapor, mixed with air, which has the potential to catch fire or explode. An explosive atmosphere does not always result in an explosion, but if an explosive atmosphere exists, there is a real danger of an explosion

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Chemical Fires and Explosions

Prevent and responding to different types of fire

1. Ventilation

- Is there plenty of fresh air where flammable liquids or gases are stored and used? Good ventilation will mean that any vapors given off from a spill, leak or release from any process, will be rapidly dispersed.

2. Ignition

- Have all the obvious ignition sources removed from the storage and handling areas. Ignition sources can be very varied and they include sparks from electrical equipment or welding and cutting tools, hot surfaces, open flames from heating equipment, smoking materials, static electricity etc.

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Chemical Fires and Explosions

Prevent and respond to different types of fire

3. Hazardous areas (zoning)

- The extent of safety measures required to avoid ignition sources depends on the area in which the operation takes place. As far as the likely presence of ignitable gas/air or vapor/air mixtures is concerned, the following zones can be defined:

- **Zone 0:** Areas in which an explosive atmosphere is continually present or present for long periods of time.
- **Zone 1:** Areas in which an explosive atmosphere is likely to occur during normal operation. These conditions can prevail in the immediate vicinity of Zone 0.
- **Zone 2:** Areas in which an explosive atmosphere is unlikely to occur during normal operation and, if it occurs, will only exist for a short time. These conditions can, among others, pre-vail in areas surrounding Zones 0 and 1.

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Chemical Fires and Explosions

Prevent and responding to different types of fire

Using hazard zoning:

- According to the classified zones, the electrical equipment used has to be flame or explosion-proof standard.
- Electrical safety is to be maintained (i.e. adequate earthing, overload protection, equipment and wiring in good repair).
- Hot surfaces and mechanically generated sparks should be avoided in such hazardous areas.
- Auxiliary equipment (petrol or gas-driven fork-lift trucks, electrical dryers, shrink wrapping equipment with open ignition sources and battery charging stations) must not be used in hazardous areas defined as zone 0 to 2.
- Non-routine activities (maintenance work, plant clean-outs) which can produce ignition sources (e.g. welding, drilling, etc.), must be authorized be means of written work permits

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Chemical Fires and Explosions

Prevent and responding to different types of fire

4. Exchange (Substitution)

- Can you exchange a flammable substance for a less flammable one? Can you eliminate flammable substances from the process altogether? You may be able to think of other ways of carrying out the job more safely.

5.Containment

- Are your flammable substances kept in suitable containers? If you have a spill will it be contained and prevented from spreading to other parts of the working area? Use of lidded containers and spillage catchment trays, for example, can help to prevent spillages spreading. Keep absorbent material handy.

6. Segregation

- Are flammable substances stored and used well away from other processes and general storage areas? Can they be segregated by a physical barrier, wall or partition?

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Chemical Fires and Explosions

Prevent and responding to different types of fire

- Implement passive fire protection measures (selecting locations) as well as preparing structures, (e.g. evacuation routes, provision of evacuation plans, fire resistance materials and doors).
  - ➢ Check with the regulatory requirements in your location.
- Think about the flammable substances you have at the workplace and apply these principles wherever possible.
- Tell workers, and others who need to know, about the hazards and how they should control them

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Possible Useful Corrective Actions

- Initiate engineering control measures which prevent the chance of exposure (skin contact, inhalation) and limit the area of releases.
- Clear instruction to workers on the proper use of the PPE (when, where, how)
- PPE must be provided free of charge to the employees who are facing hazards in their work.
- Adequate training should be provided to ensure proper PPE use. This training should be repeated at least once a year.
- Prepare an emergency plan to give clear guidance to everyone in the enterprise as to what and what not to do in case of emergencies.

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Literature, sources and further Reading

- ZDHC Chemical Management System Guidance Manual: *https://www.roadmaptozero.com/fileadmin/layout/media/downloads/en/CMS_EN.pdf*
  - » ZDHC CMS 2.3 Procurement/Supplier Practices
  - » ZDHC CMS 3.5 Chemical Management Work Practices
  - » ZDHC CMS 3.6 Emergency Procedures
- GIZ: Resource Efficient Management of Chemicals in Textile and Leather Sector Companies, Company Handbook: https://www.sia-toolbox.net/solution/resource-efficient-management-chemicals-textile-and-leather-sector-companies
- Respiratory protective equipment at work, Guideline by HSE, UK HSG53: *http://www.hse.gov.uk/pubns/books/hsg53.htm*
- Training kit of the International Labour Organization (ILO): International Chemical Control Toolkit: *http://www.ilo.org/legacy/english/protection/safework/ctrl_banding/toolkit/icct/*

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Exercise and Example

Exercise:

“Selection of PPE”

Example:

“Checklist - Emergency Preparedness Work Floor”

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Questions?