



Good chemical management practices

SAFE STORAGE OF CHEMICALS AND WASTE

Good practices in storage of chemicals

Exercise

- In your group review the drawing shown in a moment.
- Identify and note down as many chemical related issues as you can on a flipchart.

Time 15 min



Exercise



Exercise



Common causes of incidents during storage of chemicals

- Lack of awareness of the properties of the dangerous substances;
- Operator error, due to lack of training and other human factors;
- Inappropriate storage conditions with respect to the hazards of the substances;
- Inadequate design, installation or maintenance of buildings and equipment;
- Exposure to heat from a nearby fire or other heat source;
- Poor control of ignition sources, including smoking and smoking materials, hotwork, electrical equipment etc; and
- Horseplay, vandalism and arson.



Chemical stores are equipped with...

- good ventilation
- flat and impermeable floor
- sufficient lighting
- emergency drains connected to an effluent treatment plant
- appropriate extinguishers (also outside the side)
- shelves, cabinets and storage containers



General storage practices



- Inventory system in place and kept up to date
- Upon receipt of new product, availability of MSDS ensured by store supervisor
- Operators in store informed about product hazards and given advice/training/
- Instructions on safe handling
- Leaking and damaged packaging immediately isolated (as per procedure)
- Staff regularly trained about the hazards of chemicals and safety aspects

General storage practices

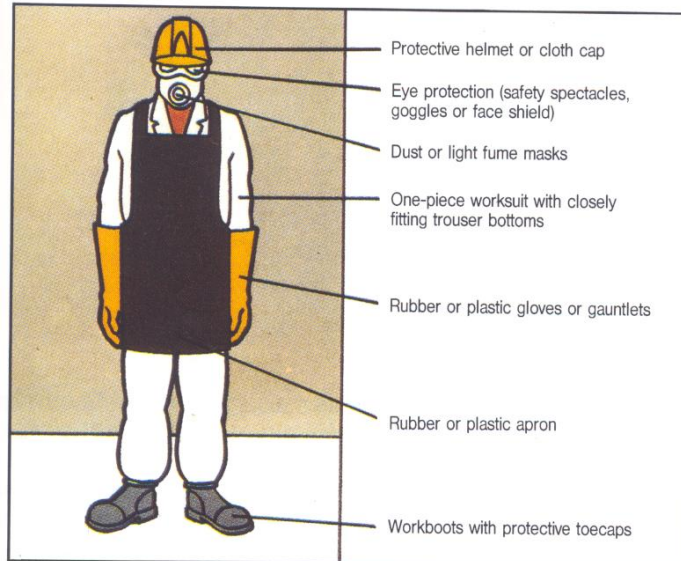
Apply good housekeeping practices
=> minimize damages, leakages and fire risks.

Common good practices:

- Stocks being frequently inspected for leakage and mechanical damage
- Floors clean and free of dust
- Whole storage area free of dirt, rubbish and redundant equipment
- Empty, combustible material kept out of the warehouse
- All gangways and forklift routes clear of obstructions



General storage practice



Provision and use of personal protective by all staff as per safety instructions and specific for each chemical substance:

- Chemical resistant overalls
- Eye protection (safety goggles)
- Dust or fume masks
- Chemical resistant rubber or plastic gloves according to each chemical
- Rubber or plastic apron
- Safety- or work boots with protective caps

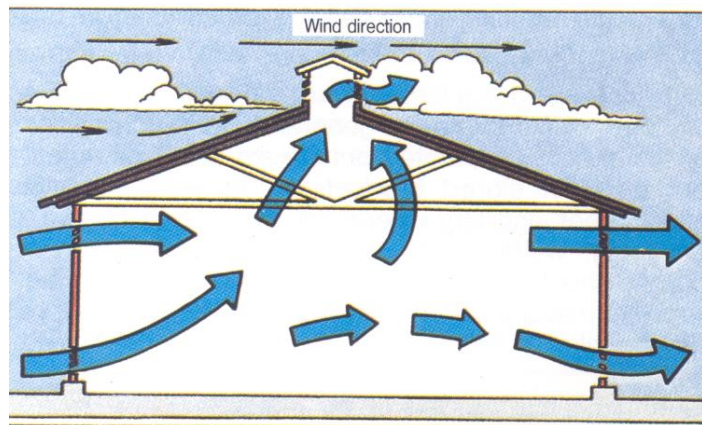
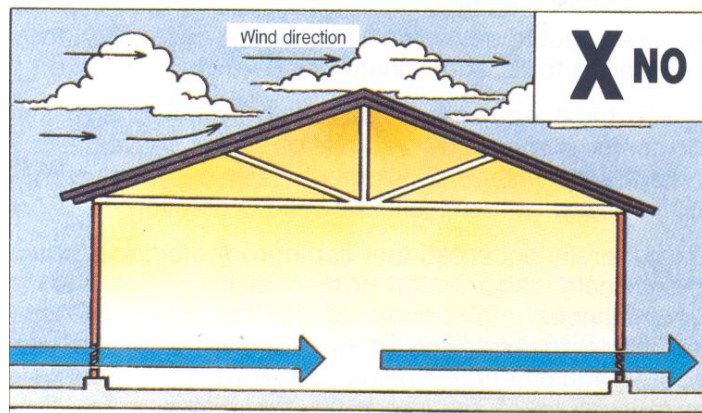
Storage conditions

Ensure well ventilated storage areas

- to reduce accumulation of dust or vapours
- to control temperature and humidity

Consult the SDS or chemical suppliers for recommended storage conditions!

Good natural cross-ventilation by combined roof and wall ventilation



Floor and layout

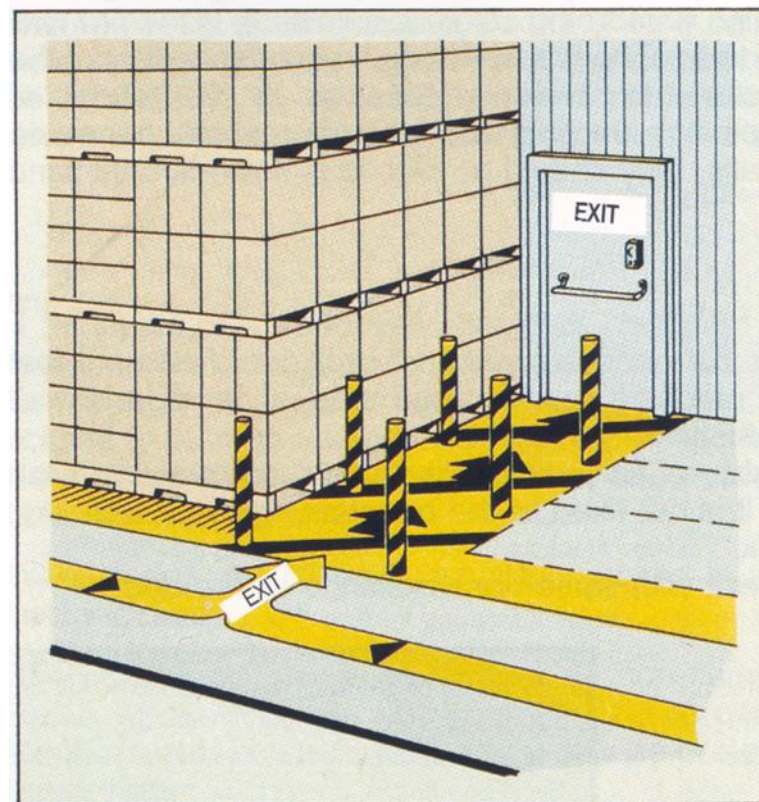


Floors

- impermeable to liquids.
- made from concrete and sealed with resin resistance against organic solvents.
- smooth surface, but not slippery; free from cracks to allow for easy cleaning.

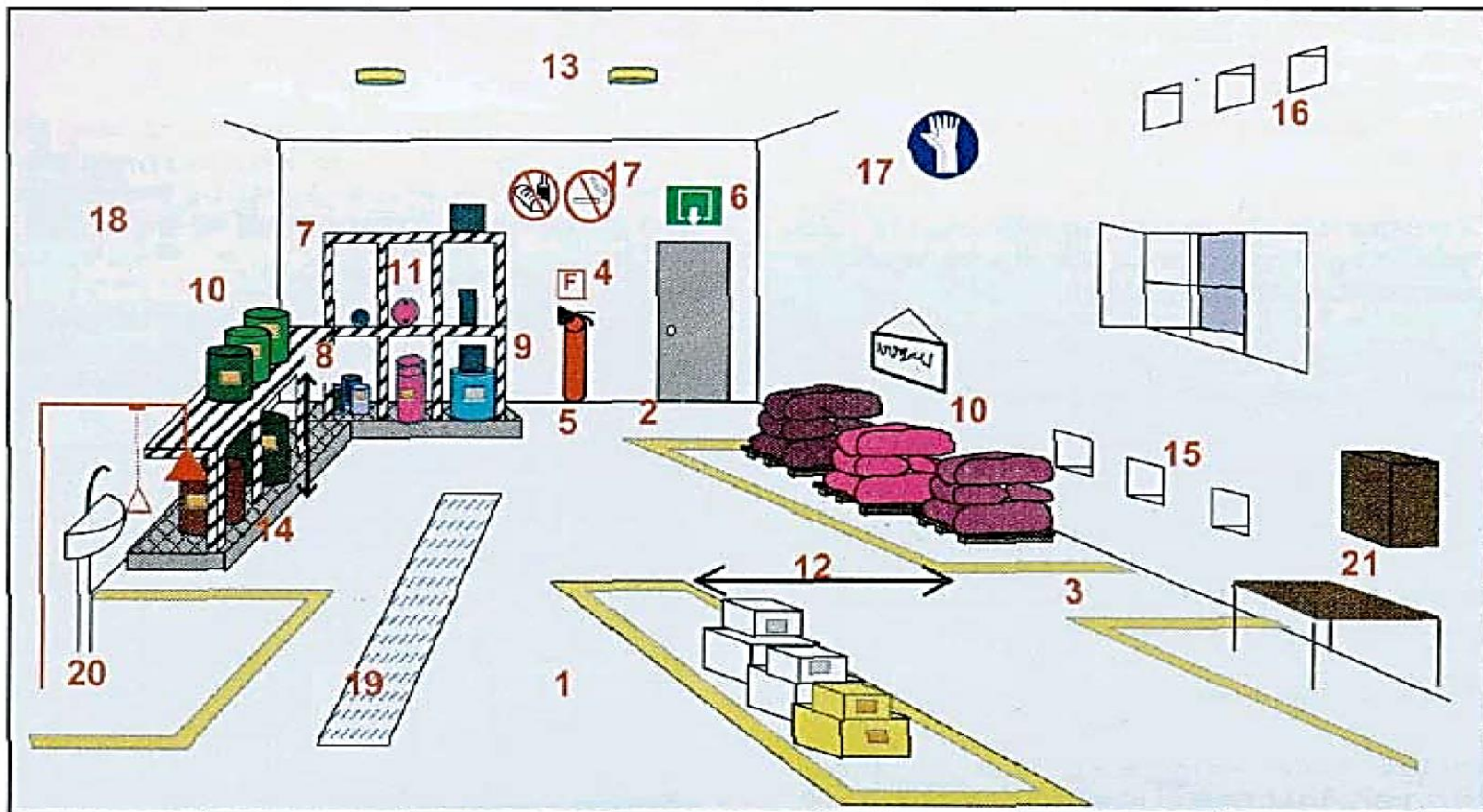
Layout

- Plan storage layout
- Assign areas for storage and movement
- Use colour markings
- Allow for storage on pallets for easier rearrangement



Floor markings for better storage organisation easier movement

Model layout of a chemical store



Dealing with unused chemicals



- Consult your chemical inventory
- Get rid of all unneeded chemicals
- When ordering chemicals, only order the amount currently needed – **don't order excess.**
- Use storage management such as “First in-First out”
 - Rearrange chemicals (e.g. place older chemicals at front, allow access to stack from two sides)

Note: Some chemicals can become more dangerous the longer they are stored (i.e. peroxide forming chemicals like ethyl ether and tetrahydrofuran).

Benefits

- Minimization of accidents, fires, or other events
- Increase of available storage space
- Lower expense (consider less inventory, storage facilities, spill response measures and equipment, etc.)

Chemical storage – Regular clean-Out



- Dispose of expired chemicals in timely manner
- Inventory all unwanted chemicals
- Remove spills immediately

Separate incompatible chemicals



- Materials should always be segregated and stored according to their chemical family or hazard classification.
- Do not store chemicals alphabetically unless they are compatible!
- **Companies establish separate storage areas for**
 - ✓ Flammable and combustible organic liquids and solvents
 - ✓ Acids and bases
 - ✓ Dry poisons, salts, and oxidizers

Storage of incompatible chemicals

Most common hazard classes include:

- flammables/ combustibles
- corrosive acids
- corrosive bases
- Toxics
- highly toxics
- oxidizers
- compressed gases
- cryogenes
- pyrophorics
- water reactives
- explosives



Storage of incompatible chemicals



CLASS		1	2	3	4	5	6	8
Chemical Segregation By Chemical Group								
Explosive	1.0 Explosive	Segregate From	Segregate From	Segregate From	Segregate From	Segregate From	Segregate From	Segregate From
Compressed gases	2.1 Flammable	Segregate From	Keep Apart	Segregate From or Keep Apart	Segregate From	Segregate From	Segregate From	ISOLATE
	2.2 Non Toxic Non flammable	Segregate From	Keep Apart	Keep Apart	Segregation may not be necessary	Segregate From	Segregation may not be necessary	Segregate From
	2.3 Toxic	Segregate From	Segregate From or Keep Apart	Keep Apart	Segregate From	Keep Apart	Segregate From	Segregation may not be necessary
Flammable liquids		Segregate From	Segregate From	Keep Apart	Segregate From	Keep Apart	Segregate From	ISOLATE
Flammable solids	4.1 Readily combustible	Segregate From	Segregate From	Segregation may not be necessary	Keep Apart	Keep Apart	Keep Apart	Segregate From
	4.2 Spontaneously combustible	Segregate From	Segregate From	Segregate From	Segregate From	Keep Apart	Keep Apart	ISOLATE
	4.3 Dangerous when wet	Segregate From	Segregate From	Segregation may not be necessary	Keep Apart	Segregate From	Keep Apart	Segregation may not be necessary
Oxidising substances	5.1 Oxidising substance	Segregate From	Segregate From	Segregation may not be necessary	Segregation may not be necessary	Segregate From	Segregate From	Keep Apart
	5.2 Organic peroxide	Segregate From	ISOLATE	Segregate From	Segregate From	ISOLATE	Segregate From	ISOLATE
Toxic		Segregate From	Keep Apart	Segregation may not be necessary	Segregation may not be necessary	Keep Apart	Keep Apart	Segregation may not be necessary
Corrosive		Segregate From	Keep Apart	Keep Apart	Keep Apart	Keep Apart	Segregation may not be necessary	Segregation may not be necessary

Chemical segregation chart (Example)

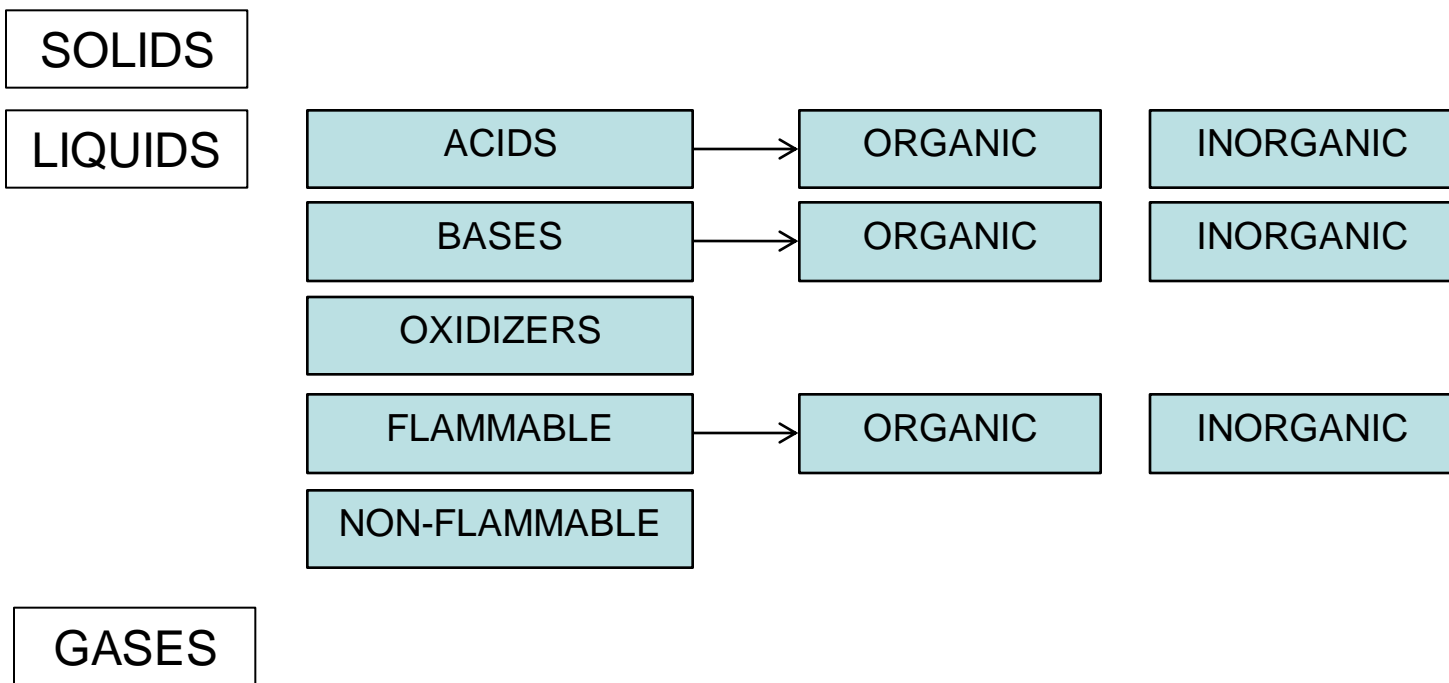
Storage of incompatible chemicals

Caution:

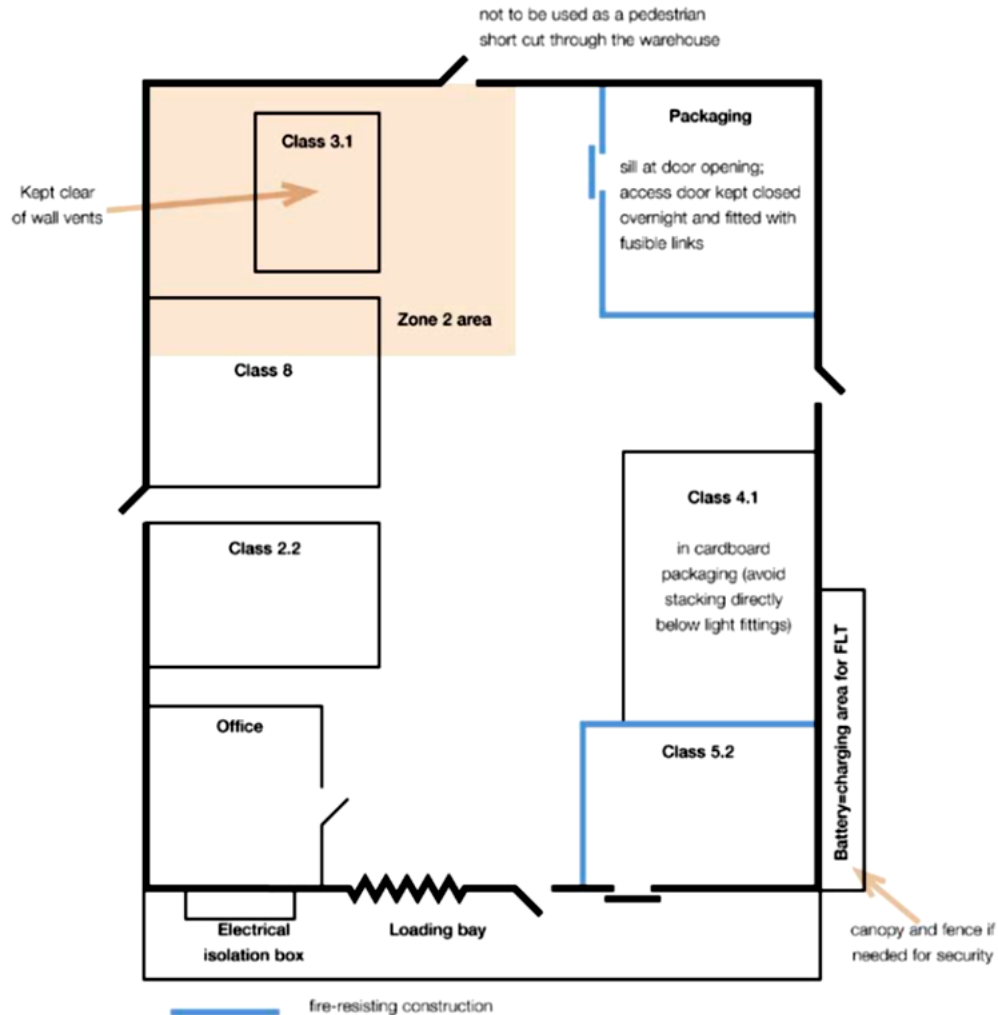
- Place groups of compatible chemicals together.
- Segregate chemicals that are in storage according to compatibility.
- Oxidizers (hydrogen peroxide, nitric acid, perchloric acid, etc.) need to be stored separately from organic chemicals (fuels).
- Particularly dangerous chemicals should be isolated in storage (e.g. hydrofluoric acid, pyrophoric materials, etc.)



STORE MATERIALS OUTLINES BY BOXES - Example



Assigning storage areas within the chemical warehouse



Source: HSE-HSG 71

Consider maximum storage limits for hazardous chemicals

Minimize quantity of flammables in workplaces



Use safety cans



Examples (HSE)

In cabinets and bins

- no more than 50 litres for extremely, highly flammable and those flammable liquids with a flashpoint below the maximum ambient temperature of the workroom/working area
- no more than 250 litres for other flammable liquids with a higher flashpoint of up to 55°C

Group exercise

Task

- In groups reorganize a chemical store by correctly placing the chemical containers
- Also consider efficiency, compatibility, ergonomic and legal aspects

Time 30 min



Chemical Storage – corrosive liquids

Acid and base bottles to be stored in separate plastic tubs or other compatible secondary container.



Acid storage cabinet



Plastic tub

Note: A layer of sand should be placed underneath secondary containers. Doing so will help prevent bottles from breaking (e.g. during an earthquake) and will help absorb any spilled chemicals.

Chemical Storage - Peroxide forming chemicals

- Example of most dangerous peroxide forming chemicals potassium metal, isopropyl ether, sodium amide, and potassium amide.
- Chemicals not to be stored for longer than three months.



Chemical Storage – Gas cylinders

- Gas cylinders to be stored upright in separate location
- Stored cylinders to be secured by chain



Chemical Storage – Gas cylinders

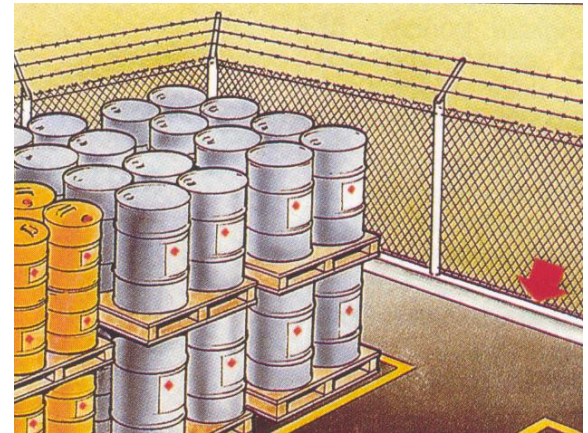
LPG gas cylinders

- Stored upright, preferably in open air on concrete or load-bearing surface
- Protected from direct sunshine
- Separated from flammable liquids, combustible, corrosive, oxidising materials, toxic materials or other compressed gas
- Maximum size of any stack not exceed 30,000 kg (outdoor storage).
- As per HSE (UK)
 - For storage indoors, no more than 5000 kg may be stored in each purpose designed building compartment
 - a maximum of five compartments may exist in a single building



Recommendations for outdoor storage

- Products stored outdoors protected from sun and rain
- Store upright on pallets
- Outdoor storage, especially in tropical areas, exposes product to high temperatures => fast degradation, shorter shelf life
- Avoid contamination of soil and water:
 - stored area surface of impervious, heat and water resistant material.
 - equipped with controlled drain system
- Storage area clearly marked and secured/fenced to prevent unauthorised access



Good practices – examples



Prevent spillages and leaking containers

- Check containers on delivery
- Use good quality containers
- Ensure good and careful handling practices
- *Bad handling and long storage under bad conditions => risk of spills and leaks*
- Inform yourself in advance on measures and provisions in case of spillages or leakages
 - Refer to material Safety Data Sheet and manufacturer's instructions for corrective action.



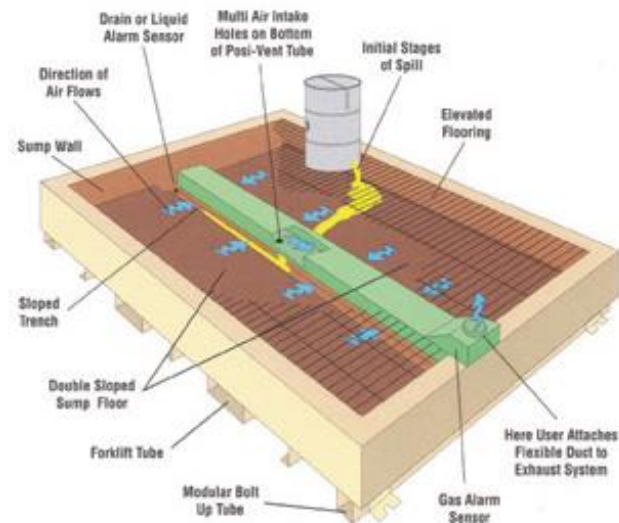
Provision of secondary containment

- Containing spill and leaks - Secondary containments
- Dealing with spill and leaks - Responding

Secondary containments

- Recommended capacity **110%** of the maximum capacity of the largest tank or drum
- Bunds or drip trays

Note: Check your local regulations for specific requirements.



Handling spillages and leaking containers

Keep spill control kits ready

- adequate with additional provisions needed to clean up materials that may spill
- to be ready for use in the store at all times.

Spill control kits are commonly available from chemicals or other specialized distributors.



Handling spillages and leaking containers

Recommended equipment:

- Personnel protective equipment
- Absorbent materials (Sand, clay, sawdust or special chemical absorbers)
- Empty open drums and oversized or open-top drums
- Labels for marking drums
- Detergent solution (lime)
- Brooms, shovel, metal funnel
- Electric solvent resistant and explosion proved drum pump

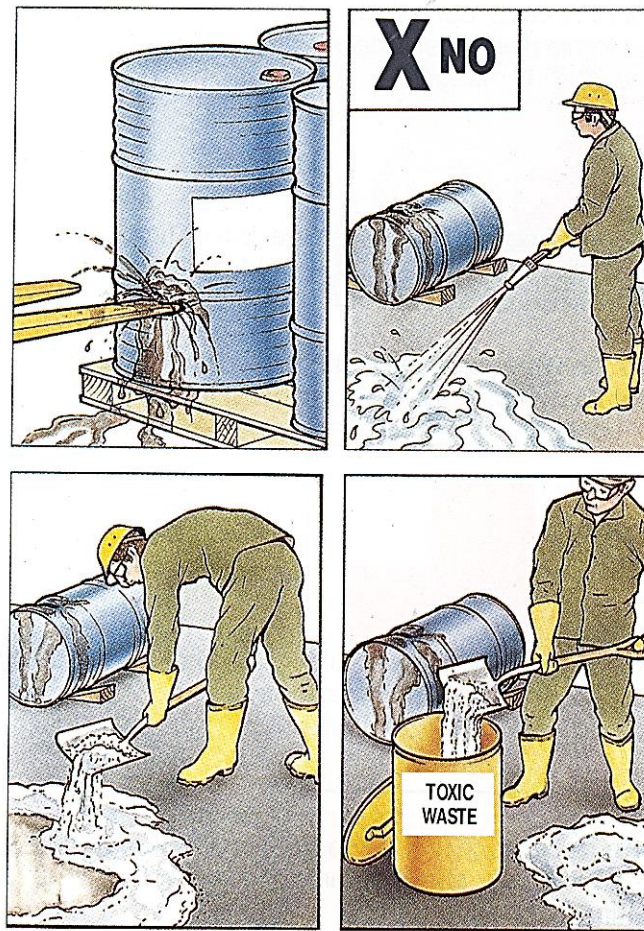


All safety and emergency related equipment must be frequently and regularly checked and maintained to ensure that its condition is satisfactory.

Responding to spillages and leaking containers

Liquid spillages be treated as soon as possible

- Collect with solid absorbent (in clay, sand, sawdust) - refer to recommendation in (M)SDS
- Decontaminate area according to information in (M)SDS
- Do not use water to wash away liquid spills!



Responding to spillages and leaking containers

Dealing with solid spills:

- Remove with industrial vacuum cleaners.
- Collect solid contaminated materials in “old-open Top drums” until final disposal
- Dispose waste according to manufacture’s instruction and/or legal requirements.



Responding to spillages and leaking containers

Check in advance:

- Some chemical releases can be cleaned up, whereas other releases create an emergency (evacuate).
- Determine what can and cannot be cleaned up should a release occur.
- Materials used to clean-up chemical spills must be treated as hazardous waste, placed in the proper container, labeled, and provided to the responsible department.
- Do not place paper towels or other materials used for clean-up in the trash.
- Oily rags must be placed in a metal safety can that has a self closing lid until provided to chemicals management in a proper waste container.



Did you know...

...cat litter is an excellent all purpose absorbent and should be kept in stores where high volumes of solvents are stored



Hazardous Waste Storage Area

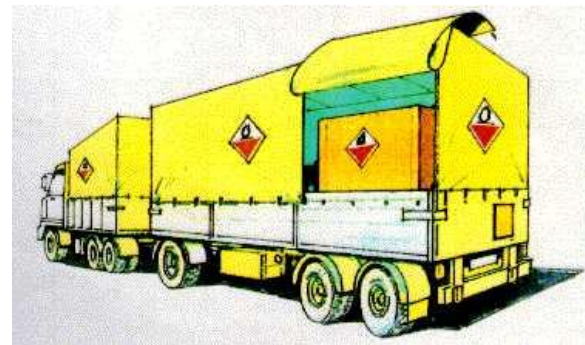


- large enough to hold quantities of hazardous waste generated between the usual pick-up dates or further scheduled times of disposal for the hazardous waste
- separately store different types of hazardous waste
- protected from sun and rain => Excessive heat might trigger a fire or explosion, while rain water might mix with residue of leaked chemical wastes and effuse/flow out, contaminating soil and groundwater
- provisions to contain any leakage or spillage => floor made of impermeable material or plastic sheets or lined with sheets as well as having provisions for containment / dyking

SAFE TRANSPORT OF CHEMICALS

Procedures and practices on the safe transport of chemicals (and waste):

- Transport of chemicals and chemical waste to/from your company
- Receiving and unloading of chemicals
- Internal transport and conveyance of chemicals and waste (e.g. transport to warehouse, from warehouse to production areas, within production areas,...)

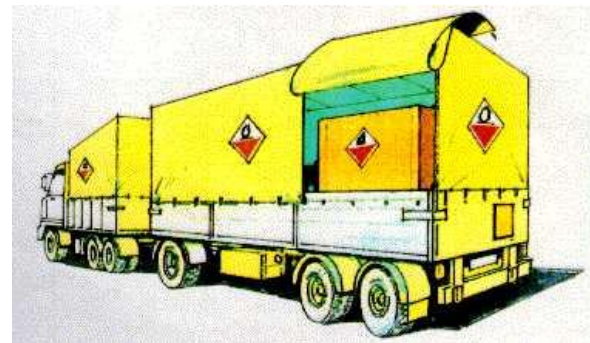


Source: ILO-CIS

SAFE TRANSPORT OF CHEMICALS - EXTERNAL

Procedures and practices on the safe external transport of chemicals (and waste):

- Who is responsible (refer to scope of your chemical management system)?
- Does your company provide instructions for the safe external transport of chemical?
- What are the national requirements for the safe transport of chemicals (and waste)?



Source: ILO-CIS

SAFE TRANSPORT OF CHEMICALS - EXTERNAL

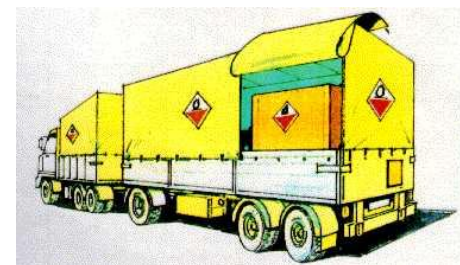
Aspects to consider

- making and labeling of packages (during transport)
- vehicle requirements (such transport documents, transport, emergency provisions)
- qualification of drivers (e.g. special license, training)
- loading requirements with regard to quantity, mixing with other loads (e.g. compatibility issue)



SAFE TRANSPORT OF CHEMICALS - EXTERNAL

For example: Labels and placard on vehicle transporting caustic soda flakes to your company:



80
1823

Substance identification code as assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods

ADR Kemler Code

First figure identifies primary hazard

- | | |
|--------------------|-----------------------|
| 2 Gas | 5 Oxidising substance |
| 3 Flammable liquid | 6 Toxic substance |
| 4 Flammable solid | 8 Corrosive |

The second and third figure indicate secondary hazards

- | | |
|---|----------------------------|
| 0 First digit adequately describes hazard | 6 Toxic risk |
| 2 Gas may be given off | 8 Corrosive risk |
| 3 Fire risk | 9 Risk of violent reaction |
| 5 Oxidising risk | |

X = Reacts dangerously with water

Where the first and second digit are the same, an intensification of the primary hazard is indicated. For example 33 indicates highly flammable.

Blank plates (without any numbers) are displayed when the vehicle is carrying dangerous load (drums, packages, etc.).

Check section 14 of your SDS for information on required numbering and labels.

SAFE TRANSPORT OF CHEMICALS - INTERNAL

Internal transport and distribution of chemical containers:

- Secure loading of containers and cylinders (protection of valves!)
- No overloading or avoidance of heavy manual loads
- Smooth and wide enough passage ways to avoid excessive shocks or local stress on containers
- Forklifts to be equipped with a fire extinguisher and an electrically conductive strip for earthing static electricity
- Special training and instructions to operators of transport vehicles
- (such as speed limits, maximum loads, routes)

Provide carts, trolleys, and other simple transport devices to move materials in order to avoid accidents and spillage that can easily occur during manual carrying.

- Insert photo on transport of chemicals -



SAFE TRANSPORT OF CHEMICALS - INTERNAL

Pipeline conveyance:

Establish a standard colour coding system for everybody in your factory to clearly identify what the respective pipe may contain.

- Failure to correctly identify the service of a pipe work system can and often has been shown to be the cause of plant upsets and safety incidents.

Check what specific colour coding system is in use in your country.

Example for colour coding of pipes

Pipe content	Color
Fire quenching fluids	Red
Potable, cooling, boiler feed and other water	Dark blue
Toxic & corrosive fluids	Yellow
Flammable fluids	Orange
Combustible fluids	Dark blue
Compressed air	Blue
Waste water	Black

For further information



- HSE (UK) HSG71 - Chemical warehousing guideline
<http://www.hse.gov.uk/pubns/priced/hsg71.pdf>
- ISSA Storage of Chemicals - Guidelines for good practices
[http://safety-work.org/fileadmin/safety-work/documents/BGRCl/storage_of_chemicals/BG Storage Chem A5 UK.pdf](http://safety-work.org/fileadmin/safety-work/documents/BGRCl/storage_of_chemicals/BG_Storage_Chem_A5_UK.pdf)