UCSF Safety Note

August 2025

University Chemical Safety Forum

Safety and the lifecycle of chemicals

Summary

- Always consider the risks associated with chemicals at the planning stage before a purchase is made. In accordance with the hierarchy of control always choose the safest substance that can be used to achieve the desired result.
- Consider implementing a responsible purchasing policy where researchers are encouraged to share common chemicals between groups and avoid ordering chemicals in large quantities unnecessarily.
- Remember to consider the safety of non-scientists (e.g. stores personnel) when planning how chemicals will be received and distributed and stored in your workspace.
- Ensuring that incompatible chemicals are not stored in the same area is extremely important. Improper storage can lead to an increased risk of fire or release of toxic gases in the event of leaks.

Introduction

Thousands of chemicals are used every day in research and teaching laboratories and the vast majority of these have the potential to cause harm if they are not managed safely. By considering safety throughout the lifecycle of a chemical, the risk of accident, injury and ill-health can be significantly reduced. For simplicity we will consider six stages from planning purchases to finally disposing of substances when they are no longer needed.

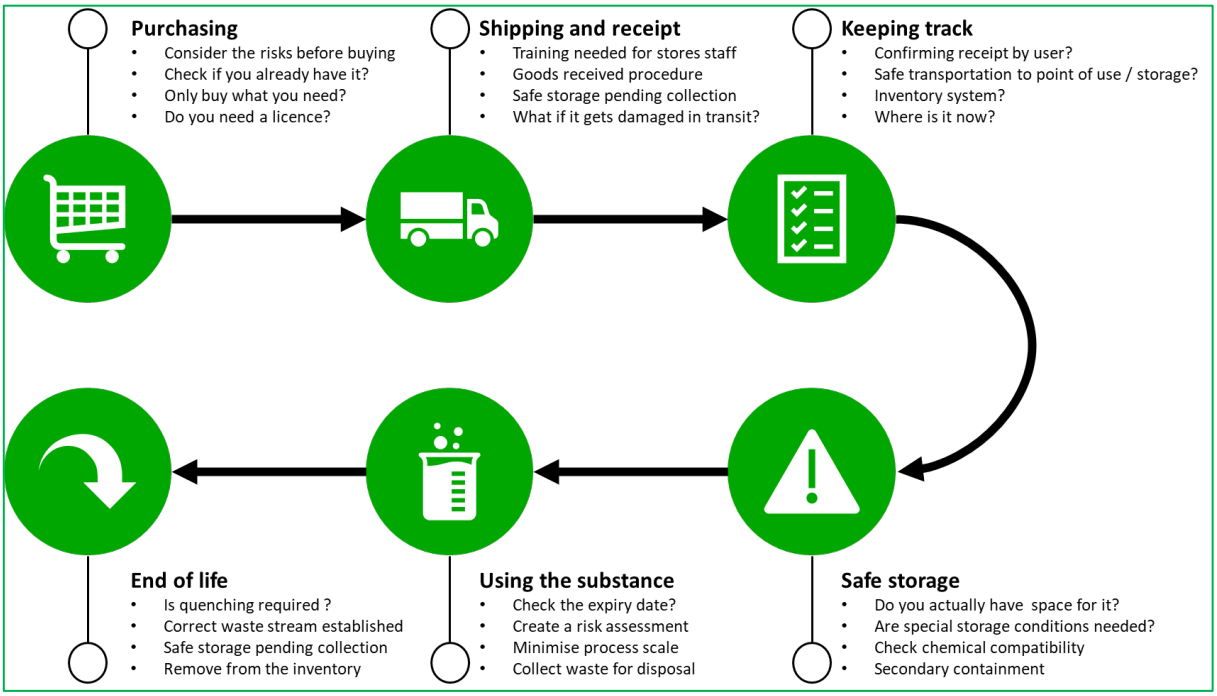

Figure 1: The lifecycle of a typical chemical highlighting key safety considerations.

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Stage 1: Purchasing

Safe chemical management should be considered even at the purchasing stage. Before buying chemicals consider the following points which can offer benefits from both the safety and sustainability point of view. Always consider the risks associated with a chemical before you make a purchase and where practical choose the safest substance that will achieve the desired result.

- Duplication of chemical stocks is a common problem, before buying a new chemical take a few minutes to check your inventory and consider whether you could borrow the chemical from another user or share some substances between research groups where practical.
- If you are planning to replace an old chemical that is no longer useful with a new one due to age, degradation or contamination, always take the opportunity to arrange for disposal of the obsolete substance before re-ordering.
- Don't buy more than you need for the process(es) being undertaken, it can be tempting to over-order to take advantage of a price break but this should only be considered for stock chemicals you use frequently and you should always aim to buy the minimum amount required.
- Before you order a chemical make sure you have suitable, safe storage available and check whether a licence, specialist storage (e.g. refrigeration, ventilated storage cabinet) or specialist first aid requirements are necessary and make sure all of these are in place before placing the order.

You may also wish to consider the twelve principles of green chemistry when planning purchases (link to the 12 Principles of Green Chemistry).

Stage 2: Shipping and receipt

Once a chemical has been purchased you will need to make sure it is delivered safely and can be stored appropriately in the short term before it is moved to the laboratory or to longer term storage. Staff working in receiving stores should be given sufficient information, instruction and training to ensure they can work safely with hazardous chemicals while they are in their possession.

- Staff with responsibility for receiving chemicals from suppliers should be given training to understand the risks associated with hazardous substances and what to do in the event of a leak or spillage.
- Stores should always be equipped with a suitable spill kit and some basic PPE so competent staff can safely manage leaking or damaged chemical containers.
- It's important to have a robust goods received procedure so that newly received chemicals can be properly accounted for and are not left unattended just because no-one was around to sign for them.
- Newly received chemicals should immediately be stored safely. Remember that they may need secondary containment, storage at a specific temperature or to be locked away until they can be collected.

Stage 3: Keeping track

When a new chemical is received it is important to be able to keep track of it in the store of workplace to help avoid duplication and/or storing substances beyond their normal lifespan. Keeping accurate records will also help with statutory reporting and managing use of storage cabinets and other finite resources.

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- When a substance is received it should be logged by stores and the end-user notified. It's important to make sure there is a system in place to do this and to record when it is collected by the owner.
- One thing that's often overlooked is the need to ensure substances are transported safely from the receiving stores to their place of long-term storage and/or use.
- The best way of keeping track of chemicals is to use an appropriate inventory system. For small users a spreadsheet may be enough but for large users an electronic inventory system may be needed.
- Inventory systems often allow chemicals to be given barcodes making them easier to track assigning them to a lab, cabinet or even shelf. Remember to log changes of ownership / location and delete chemicals from the system when they are used up or disposed of.

Stage 4: Safe storage

Once a chemical has been delivered it will need to be safely stored until it is needed, this may be in the laboratory or in a dedicated storage facility (e.g. a flammable solvent store). Some chemicals are incompatible and will need to be stored separately to eliminate the risk of an adverse chemical reaction which could occur if they were to mix following a leak or spillage, see the HSE publication HSG71 "The Storage of Packaged Dangerous Substances" for more information (link to HSG71).

- It's important to make sure that you actually have enough space in the workplace (or store) to store chemicals safely. Avoid double-stacking, placing bottles on their side or overfilling shelves.
- Make sure that any special storage conditions can be met, for example some substances may need to be kept away from light or oxygen or stored at reduced temperature in a fridge or freezer.
- Even when stored in closed containers accidents can happen, bottles may leak or be broken releasing their contents. It is essential that incompatible chemicals are stored separately to prevent adverse chemical reactions, fires etc. (see Appendix 1).
- It is generally a good idea to store hazardous substances in some form of secondary containment. This may be an overpack, bund or a simple tray to help contain drips, leaks and spills.

Stage 5: Chemical use

When considering the lifecycle of a chemical we of course have to think about how, where and by whom the substance will be used. Like any potentially hazardous process, the use of chemicals should be subject to a suitable and sufficient risk assessment. For more information on conducting a risk assessment for hazardous substances refer to HSE ACoP L5 Control of Substances Hazardous to Health (link to L5).

- Remember that chemicals will degrade over time and they make absorb water, change in composition or even damage their own container. Always check the expiry date before use and dispose of any chemicals which are no longer needed.
- The use of chemicals is subject to the requirements of the CoSHH Regulations (and in many cases the DSEAR Regulations). Ensure you have completed all of the necessary risk assessments for the work before you begin.

- In support of purchasing the smallest amount of material needed to undertake the work remember that in many cases working on the smallest practical scale is the safest option as there is less material involved in the process.
- Chemical processes usually generate some form of chemical waste which may pose a risk to staff and students. Collect waste for proper disposal and ensure it is properly labelled.

Stage 6: End of life

When a chemical comes to the end of its useful life then we have a duty to ensure it is disposed of safely and that care is taken to minimise the impact of the disposal on the environment. The days of disposing of unwanted substances down the sink have come to an end and it is common practice to collect all but the most innocuous waste chemicals for disposal via a specialist hazardous waste contractor.

- Some chemicals (e.g. thiols) must be properly and safely denatured prior to disposal, this process should also be covered by the CoSHH risk assessment and must be fully completed prior to disposal.
- When collecting waste it is important to have clear, unambiguous waste streams for the chemicals used (and generated) in the workplace (e.g. flammable solvents, halogenated solvents, flammable solids).
- All chemical waste should be considered hazardous and should be stored in appropriate, labelled containers within a chemical waste store / cabinet and must be segregated from incompatible chemicals.
- Once a substance has been disposed of in accordance with local procedures don't forget to delete it from your inventory system to avoid confusion.
- If a chemical hasn't been used for a long time (five years or more) consider if it is still needed and whether it can be disposed of. Over time chemicals (and their containers) can degrade due to moisture ingress, oxidation or photosensitivity which may affect the outcomes of research or teaching activities.
- If a chemical container (or lid) has visibly degraded or become damaged then the chemical should be carefully disposed of. Be aware that some plastic chemical containers can become brittle over time and may crack or shatter if handled.
- If a substance is not labelled with the current GHS hazard labels (red and white diamonds) and is marked with either the square, orange and black CHIP hazard labels (CHIPS was revoked in 2015) or indeed does not have any hazard labels at all then it should be disposed of (see figure 2 below for examples).

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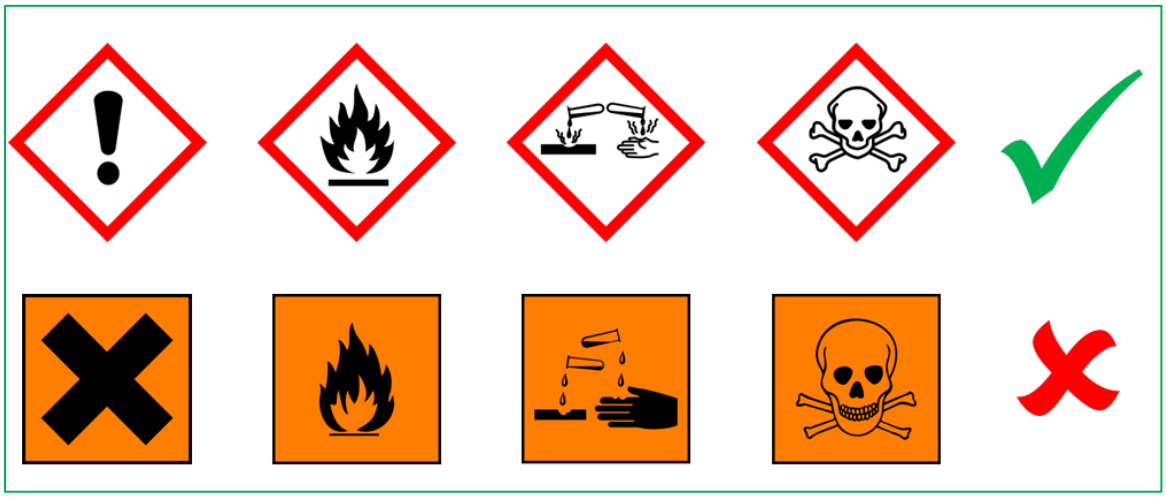

Figure 2: Chemical containers should be marked with the current GHS hazard pictograms, any containers marked with the obsolete square orange and black CHIP pictograms should be disposed of.

Appendix 1: Chemical Compatibility Chart

	Inorganic Acid (e.g. sulphuric acid)	Oxidising Acid (e.g. nitric acid)	Organic Acid (e.g. acetic acid)	Alkali (Caustic) (e.g. sodium hydroxide)	Oxidising Agent (e.g. hydrogen peroxide)	Toxic (Poison) (e.g. sodium cyanide)	Water Reactive Substance (e.g. n-butyl lithium)	Organic Solvent (e.g. xylene, ethanol)
Inorganic Acid (e.g. sulphuric acid)	✓	✓	X	X	X	X	X	X
Oxidising Acid (e.g. nitric acid)	✓	✓	X	X	X	X	X	X
Organic Acid (e.g. acetic acid)	X	X	✓	X	X	X	X	✓
Alkali (Caustic) (e.g. sodium hydroxide)	X	X	X	✓	✓	✓	X	X
Oxidising Agent (e.g. hydrogen peroxide)	X	X	X	✓	✓	✓	X	X
Toxic (Poison) (e.g. sodium cyanide)	X	X	X	✓	✓	✓	X	X
Water Reactive Substance (e.g. n-butyl lithium)	X	X	X	X	X	X	✓	✓
Organic Solvent (e.g. xylene, ethanol)	X	X	✓	X	X	X	✓	✓

Key / Notes

Corrosive*

Toxic (Poison)

Oxidising Agent**

Flammable (Solvent)*

Water Reactive***

*Due to high flammability, glacial acetic acid should be treated as a flammable chemical rather than as an acid for the purposes of segregation.

**Bleach and other hypochlorite compounds are strong oxidisers and may react with acids (including Virkon) to release highly toxic chlorine gas

***Some water reactive substances may also be air reactive and may be supplied as a solution in a flammable solvent.

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