Information for employees and students working at the Faculty of Science (W&N)
This AMD information sheet describes the general risks, regulations, and precautions involved when handling chemicals.

1 Introduction

Hazardous substances are substances that, due to their intrinsic properties, pose a safety or health risk for human beings or the environment. These substances may be single compounds as well as mixtures.
However, at the Faculty of Science (W&N) we prefer the term chemicals (and gasses) over hazardous substances, which is a term based in laws and regulations. Not every chemical substance is a hazardous substance in the legal sense (consider, for example, granulated sugar).

Chemicals may occur in several states and present themselves as: gasses (See AMD information sheet VOM 021), vapours, fumes, smoke, dust clouds, liquids, or solids.

To be able to work safely with chemicals, you must be aware of their specific hazards. Material safety data must be provided by the supplier. However, when it comes to reaction products or intermediary products that are (sometimes accidentally) produced in the course of the work, it is up to the user to make a risk assessment based on his or her own expertise. Please bear in mind that substances that are not classified as hazardous, may still have adverse effects, and, therefore, pose risks. For example, when someone gets a - relatively harmless - buffer in his or her eye, washing the eye will have little or no effect when it comes to lowering the pH!

Carcinogenic, mutagenic, and reprotoxic substances (CMR) are subject to such a specific set of rules and regulations that they will be discussed separately in AMD information sheet VOM012 *Working safely with Carcinogenic, Mutagenic, and Reprotoxic substances*.

2 Regulations for hazardous substances

As of 1 June 2015 the labelling of all substances and mixtures must satisfy the European CLP directive (Classification and Labelling of Packaging). This directive uses the symbols of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), which is used worldwide as of 2008. In addition, as of 1 June 2007 the REACH regulations apply in Europe. REACH is the acronym for: Registration, Evaluation, and Authorization of Chemicals. The aim of the REACH system is to contain the risks of chemical substances, such as the risks of toxic/pollution disasters, fires, and explosions; health risks to employees and consumers; and damage to the environment.

The intrinsic properties of a substance may be found by checking the 'hazard classification' of a substance or preparation according to the European hazardous substance regulations. The hazard classification consists of the hazard symbol (GHS hazard pictogram), a signal word ("Hazard" or, at a lower level, "Warning") and the H and P sentences of the substance or preparation. In this, H stands for Hazard, and P for Precaution. H and P are followed by one or more numbers. Please refer for the specific meaning to a list of H&P sentences. The H sentences provide hazard indications for material, health, and environmental risks, and the P sentences provide information on precautionary measures regarding prevention, reactions, and storage. This information may be found on the label or in the Material Safety Data Sheet (MSDS) (See Chapter 3).

Hazard symbols according to CLP directive/GHS:


GHS01: Explosive


GHS02: Flammable


GHS03: Oxidising


GHS04: gasses under pressure


GHS05: Corrosive


GHS06: Toxicity


GHS07: Irritation
Sensitizing
Harmful


GHS08: long-term health hazard


GHS09: Hazardous to the aquatic environment

Signal words:
Warning
Hazard

H Hazard

P Precaution

The symbol “Long-term health hazard” is an indication for, for example, a CMR substance, a substance to which one may develop an allergy, or refers to possible organ damage. The symbol for gasses under pressure is new, and the Saint Andrew's cross is replaced by an exclamation mark.

3 Material Safety Data Sheet (MSDS, Dutch: “VeiligheidsInformatieBladen”, VIB)

3.1 How to find an MSDS

Suppliers in the Netherlands are obligated to supply a Material Safety Data Sheet (“Veiligheidsinformatieblad”, VIB, in Dutch). At the Faculty of Science (W&N) we usually use the English acronym: MSDS, which stands for 'Material Safety Data Sheet'. The MSDS is a means of communication between the supplier of a (hazardous) substance or (hazardous) preparation and his or her customer about the hazards and the precautions to be taken to protect human beings and the environment. The MSDS needs to satisfy certain legal requirements and, among others, contains information regarding the possible harmfulness of the substance, required first-aid measures, recommended personal protection equipment, safe limits, and possibly required measures for containment. Because chemicals may be known under several synonyms or trademarks depending on the supplier, it is best to look them up using the CAS number. The CAS number is an unique identification number for a substance. In the chemicals registration system GROS, you will also find an internal hazardous substances database (BIG) containing validated MSDS data. See AMD information sheet RhL100 *Working with GROS*.

GROS contains an internal hazardous substances database (BIG) with validated MSDS data!

Up-to-date supplier MSDSs can often be found on the internet.

Please use the MSDS data for your risk assessment.

3.2 How to read an MSDS

According to REACH the producer is responsible for:

- providing risk scenarios for the intended use
- establishing whether the exposure remains beneath certain values in the scenarios
- providing measures regarding the scenarios

upon which the user may only work with the substance under those conditions.

In the MSDS, section 1 contains: “Identified uses of the substance or mixture”, and, if applicable: “Uses advised against”. To use the substance for research purposes this product use clause must state: “Laboratory chemicals”, “Analysis”, “Product preparation”, or something similar. If this is not the case, you, as a user, are not allowed to use the substance for this purpose until the producer provides an additional exposure assessment for it. As a user, you are, therefore, obliged to inform the supplier that your intended use is not mentioned. Newer MSDSs, drawn up according to REACH, the so-called extended Safety Data Sheets (e-SDS), also contain the assessed scenarios (Exposure scenarios and Contributing scenarios).

An MSDS contains 16 sections. Important sections for the user are:

- Section 1: Identification of the substance/mixture and of the company/undertaking
- Section 2: Hazards identification
- Section 4: First-aid measures
- Section 5: Fire fighting measures

- Section 6: Accidental release measures
- Section 7: Handling and storage
- Section 8: Exposure controls/personal protection
- Section 10: Stability and reactivity
- Section 11: Toxicological information

In addition to exposure data, these sections also contain, among others, important information regarding precautions, such as working in a fume hood or with ventilation hoods, recommended personal protection equipment, indications regarding which measures to use in firefighting and which not to use, and how to clean up a spill. In some cases there is also information on antidotes or neutralizing means that should be at hand.
Please keep in mind that MSDSs are drawn up with all kinds of work in mind, in industrial settings as well as in laboratories. Therefore, please translate the recommendations to a laboratory setting (a hazmat suit and self-contained breathing apparatus equipment will not often apply in a 'normal' laboratory setting, if you wear the proper personal protection equipment and work in a fumehood or an enclosed set-up.)

4 Effects on health

4.1 Exposure routes

Exposure is defined as contact between a human being and a chemical substance. This may occur through various routes:

- through the skin
- through the eyes (by spattering or rubbing)
- by inhalation of vapour, aerosols or solid particles
- by ingestion (often unnoticed by way of dirty fingers, hand-mouth behaviour, etc.)

As a general measure to prevent exposure through skin or eyes, a lab coat and safety glasses must be worn in the laboratories in which chemicals are used.
To prevent unintentional ingestion, the hands must be washed on a regular basis, at least before eating, drinking, or smoking. Furthermore, according to the Dutch Occupational Health and Safety Law (ARBO-wet), the presence of food, drinks, plates, mugs/cups and cutlery is not allowed in a laboratory.

To limit exposure by inhalation as much as possible, at least work with large amounts of chemicals, as well as work with the following substance categories must always be done in a fumehood:

- Toxic substances

- Carcinogenic, mutagenic, or teratogenic or reprotoxic (CMR) substances
- Volatile and/or explosive substances, such as volatile organic solvents
- Strong acids and bases, due to the risk of aerosol formation and risk of splattering

Please refer to AMD information sheet RhL023 *The fumehood* to learn how a fumehood works, and how to use it properly.

4.2 Effects

The effect of a substance depends on the exposure route. Inhalation of acetone may make you dizzy, but if you spill it on your skin, your skin becomes degreased/irritated and permeable for other substances. Splattering in the eyes causes severe eye irritation.
In case of an acid the biggest risk is the corrosive/caustic effect on the skin, although one must be wary of the formation of aerosols, for example, during pouring. Here too, the severity of the effect depends on the concentration as well as the amount to which a person is exposed. The amount determines the size of the affected part of the body.

The effects of chemicals may also be presented as a function of time:
Acute effects occur immediately or shortly after contact, such as feeling a burning pain in the case of contact of the skin with an acid (corrosive).
Delayed effects occur later or after repeated exposure. The best known example of a delayed effect is the occurrence of cancer decades later, for example due to frequent unprotected work with asbestos.

Yet another classification deals with the duration of the effect.
Effects may be ***temporary***, such as a red irritated spot, or ***chronic/permanent***, such as liver damage by excessive alcohol consumption or the development of an allergy to latex due to recurring use of latex gloves.

Furthermore, effects may occur in a single or several places.
Such as ***local*** damage: Contact occurred in a certain place and this place is where the effect occurs as well. For example, chemicals that have gotten into the eye, usually lead to irritation/damage to the eye only.
However, if the effects occur throughout the entire body, such as unconsciousness as a result of inhalation, we refer to them as ***systemic*** effects.

Substances may also increase each other's effect (**synergy**). For example, when your hands are first degreased by a solvent, other substances may penetrate your skin more easily.

4.3 Exposure limits

An **exposure limit** is the highest concentration of a gas, vapour, aerosol, fibre, or dust in the air at the workplace to which an employee may be exposed for 8 hours a day, 5 days a week in the course of 40 years of employment, and still be expected to suffer no ill effects on his/her health. The ***legal*** **exposure limit** is established by the Dutch government, based on an advice of the Health Council (Dutch: "Gezondheidsraad"). This limit is given for a limited number of substances only. Sometimes only indicative exposure limits are given; these are exposure limits that were established in other Western countries.

The exposure limit may be presented in several forms:

- TGG-8u. Time-weighted average over 8 hours, this is the "normal" exposure limit.
- TGG-15 min. Time-weighted average over 15 minutes. May occur occasionally, if the daily average stays below the TTG-8u.
- Exposure limit with C indication. C stands for ceiling limit. This is the absolute exposure limit that may not be exceeded, because above it acute effects occur.
- Exposure limit with H indication. The H (which stands for the Dutch word for skin: "huid") indicates that the substance may easily enter the body through the skin.

Under REACH producers are obligated to provide exposure limits as well, based on toxicological data. The exposure limit that is derived from these limits, is referred to as the **Derived No-Effect Level** or **DNEL**. The DNEL is the exposure level for the substance above which human exposure should not occur. This limit may vary with the exposure route.

When a DNEL is established for a substance, which is higher than the exposure limit, the (legal) exposure limit should be used. If the DNEL is lower, it is highly recommended to observe this lower limit, unless you have a very good reason not to.

5 Handling chemicals at the workplace

5.1 General guidelines

Please make sure you know what you are working with and to what you may get exposed to: Are there safe exposure limits, what are the precautions you need to take, and what to do (or not do!) when, despite preparations, something goes wrong? Are your colleagues aware of the hazards of the substances you are working with, or your activities?

5.2 General safety rules in the laboratory

- You are responsible for yourself, others at the lab, and the environment. If you detect unsafe behaviour, please confront those responsible.
- In a chemistry laboratory you must wear closed shoes, long trousers, and a lab coat.
- Work cleanly, organized, and responsibly. Chaos increases the chances of an incident.
- Provide flasks, retorts, jars and bottles with your self-made preparations with the correct labelling: the substance name and hazard symbol. This way, it will always be clear to anyone (and, thus, also for emergency professionals) what chemicals any type of container contains as well as what the possible hazards may be.
- Please always aim for the smallest amount of flasks/jars of chemicals on the lab bench, workbench, or in the fumehood. Only the "stock of the day", that is, that which you will actually be using that day, may be stocked outside the fire resistant storage facilities, with a maximum of 25 kg or litres per room. At the end of the day, all chemicals should be put back in the chemical storage facilities. The fumehood is not a storage facility. Please refer to AMD information sheet VOM014 *Storage of hazardous substances*.
- Please be sure to clean lab inventory, such as retorts and spatula, immediately after use. This way, you still know with what substances it has come into contact with.
- Eating and drinking is not allowed in laboratories, store rooms, or workplaces. This is to prevent the ingestion of chemicals.
- Please wear the personal protection equipment (PBM) prescribed by the work instructions, as well as the equipment indicated on the access door to the laboratory.
- Do you know the location of emergency facilities, such as the emergency shower, eye wash bottle, fire extinguishing equipment, and first-aid kit?

5.3 Specific measures to be taken in the laboratory

Make a risk assessment (Please refer to AMD information sheet RhL010 *Research risk assessment*) and pose yourself the following questions:

- What are the properties of the chemicals? Consult the MSDS of the substance and the label on the packaging.
- Check the MSDS or e-SDS for approved use in the laboratory as well as the use conditions and precautions.
- What is the method of operation and in what kind of places the work is allowed? Lab bench, fumehood or ventilation hood, or a closed system?
- What safety measures/personal protection equipment are required? And, if you need special absorbing or neutralizing materials in case of accidental spills, make sure these are at hand! Please refer to AMD information sheet RhL020 *Safety equipment* (also for the choice of personal protection equipment, such as gloves) as well as RhL022 *Ventilation and Exhaustion.*
- How to treat the waste? Please refer to AMD information sheet RhL090 *Waste collection.*
- Are there specific procedures for working with this chemical substance, or do these have to be drawn up? Take, for example, HF, KCN, Phenol, Chlorine gas, etc. If necessary, first make a 'dry run' of your activities. Please refer to the AMD for any advice and also read the AMD information sheet VOM015 *HF and other fluorides*.

- Some substances require a permit/exemption to work with, such as drug precursors, explosive precursors, and substances that may lead to ozone depletion. For these, the supplier will demand an end user statement. Please visit the AMD for advice on completing it (for, among other things, the permit number). In all cases, the use must be stated very specifically (so, not “lab work”, “research”, “reagent”, or something like that).
- When reactions need to continue overnight or in the weekend, a properly completed *Overnight|Weekend form* must be attached visibly on the fumehood, for emergencies. The form may also contain notes on which equipment must keep running.