

STANDARD OPERATING PROCEDURE FOR CORROSIVES



NATURE OF HAZARD

Corrosive substances produce injury through contact with any internal or external part of the body, including skin, eyes, mucous membranes, mouth, throat, lungs, and digestive tract. Corrosive injury manifests at the site of contact. Some corrosives additionally possess toxic properties which can manifest remote from the point of absorption, and which may cause serious illness or death.

Corrosive injury may arise from two mechanisms, direct-acting and acting via toxicity, described below. Depending on the corrosive, one mechanism may be dominant, or both mechanisms may occur together.

NOTE: This SOP does NOT cover hydrofluoric acid (HF) or phenol.

DIRECT-ACTING CORROSIVES

Direct chemical attack causing corrosion and destruction of tissue. This is often the principal mechanism of highly chemically reactive corrosives. These substances literally eat away at human tissues.

Examples:

Medium-strength and strong acids, e.g. sulfuric acid, nitric acid, formic acid, concentrated acetic acid.

Strong bases, e.g. sodium hydroxide, aqueous ammonia, amines (Note: Bases can be even more dangerous to eyes than acids.)

Powerful oxidants, e.g. bromine, 30% hydrogen peroxide

Highly water-reactive substances, particularly if they hydrolyze to strong acids or bases, e.g. aluminum chloride, titanium tetrachloride, phosphorus pentoxide, lithium aluminum hydride, sodium hydride, alkali metals.

DIRECT ACTING + THERMAL BURN

Some highly water-reactive chemicals create heat on reaction with skin. The temperature rise may be sufficient to produce thermal burn damage as well as chemical damage. However, immediate drenching with water (e.g. using a safety shower/eyewash) is still recommended for removing water reactive corrosives as sufficient water will overwhelm thermal effects. Any delay caused by trying to remove contamination using non-aqueous methods will likely result in more severe injury.

CORROSIVES ACTING VIA TOXICITY

Penetration followed by a toxic effect which damages or kills cells. This is the principal mechanism of a number of exceptionally dangerous corrosive substances. These substances may not initially produce any visible effect on skin, as they do not cause external burning and corrosion. These substances penetrate the skin (or other part of the body), then cause cellular death and damage in the underlying tissues, which can result in an extremely serious burn appearing, often after a misleading symptomless delay. Burns by these substances may be accompanied by systemic (i.e. non-localized) poisoning, which may be fatal if sufficient material is absorbed.

DPS emergency number 213-740-4321

Examples:

Hydrogen fluoride (hydrofluoric acid), phenol, (di)alkylarsenic halides

Strong electrophiles, including: Simple alkylating agents, e.g. dimethyl sulfate, iodomethane; electrophiles which react by ring-opening, e.g. aziridines, epoxides, ethylene sulfide; mustards, i.e. compounds containing 2-chloroethylamine or 2-chloroethyl sulfide moieties; strong Michael acceptors, e.g. divinyl sulfone, ethyl vinyl ketone; reactive aldehydes, including formaldehyde, glutaraldehyde, phthalaldehyde, glyoxal.

Tetramethylammonium hydroxide (**TMAH** or TMAOH) is an example of corrosives that are also highly toxic

Many of these examples can main or kill by systemic toxicity following skin contact. Acutely toxic corrosives also need to be covered by an SOP for acute toxicants.

TOXIC AND REACTIVE CORROSIVES

A number of dangerously corrosive non-metal halides and oxyhalides likely act more-or-less equally through both the above mechanisms, e.g. thionyl chloride, disulfur dichloride, selenium oxychloride (seleninyl chloride), arsenic halides.

HAZARD IDENTIFICATION

Classification and identification of corrosives is covered in detail in Section 6 of the CHP. Further details of the OSHA/GHS classification, with examples, may also be found in Appendix G of the CHP. All personnel who agree to abide by this SOP are required to familiarize themselves with the contents of Section 6 of the CHP.

For purchased chemicals, identification as a corrosive should be made by assessing the hazard information given in the safety data sheet (SDS).

For synthesized chemicals, assume that all the following are corrosive: Acids, bases, substances which hydrolyse to acids/bases, highly reactive substances, and substances which have chemical analogies to known corrosive materials (e.g. assume all strong alkylating agents are corrosive).

WORK PRACTICES

A number of concentrated acids generate significant heat when diluted with water. If water is added to the acid, the mixture can locally exceed 100 °C, causing undissolved water drops to boil and throw acid out of the container. Therefore, **when diluting acids, always slowly and carefully pour the concentrated acid into water with continual stirring. Do NOT pour water into the acid.** Note that a number of bases also produce large temperature rises on dissolving in water (sodium hydroxide, potassium hydroxide) or reacting with water (CaO, SrO, BaO). Add base to water with stirring and caution.

PREPARATION

- Do not handle Corrosives while working alone in the cleanroom area.

- Remove hand and wrist jewelry. Do not wear contact lens (Contact lens are not permitted in the cleanroom).
- Identify the locations of safety equipment (Eyewash and Shower station, Hazardous Waste Container, Emergency buttons and Phones).
- Save DPS emergency line 213-740-4321 into personal phone.
- Read the Safety Guideline and Material Safety Data Sheet for specific Corrosives.
- Wear all appropriate PPE (Safety Goggles, Two layers of nitrile gloves, Long Butyl gloves over nitrile gloves).
- For operations with Tetramethylammonium hydroxide (**TMAH** or TMAOH), wear a Face Shield, Acid Apron, Acid Shoe Covers, and Neoprene gloves over long Butyl Gloves.
- Ensure an adequate supply of clean-up material is within reach in case of spills.
- Ensure an appropriate waste container is accessible to dispose contaminated clean-up material.
- For more hazardous work involving corrosives, restrict access to work area with sign labelled "Warning – Corrosive – Acid or Base".
- Use only the minimal amounts of Corrosives. Corrosives must be handled under a fume hood.
- Clearly label all containers with any liquids, including containers with water. Place containers with Corrosives into secondary polypropylene container while not in use.
- Labels must include User Name, Group (PI) Name, Contact Email or Phone Number, Chemical Name, and Chemical Formula.

STORAGE REQUIREMENT

Corrosive materials should be stored in cool, dry well-ventilated areas below eye level, away from sunlight in an upright and tightly closed manner. Concentrated acids and bases should be stored in dedicated cabinets in appropriate secondary containment (e.g. polypropylene trays). Separate cabinets should be used to segregate acids from bases, segregate organic from inorganic acids, segregate oxidizing acids from reducing/flammable/combustible acids, and segregate organic from inorganic bases. If there is lack of space, separate secondary containment within the same cabinet may separate incompatible materials provided excessive hazard is not thereby created; EH&S can advise on a case-by-case basis.

Avoid storing volatile acidic corrosives (e.g. hydrochloric acid) in metal cabinets as this may lead to corrosion. If this must be done, placing a container of activated carbon or calcium hydroxide in the cabinet will absorb vapor and reduce corrosion.

Do NOT store oxidizing acids (e.g. perchloric acid, nitric acid) with flammable/combustible organic acids (e.g. acetic acid); use separate cabinets. Oxidizing and reducing inorganic acids should NOT be stored in the same secondary containment (reducing acids include hydroiodic acid and hypophosphorus acid).

Please refer to the CHP (Section 7) for detailed requirements and recommendations for appropriate acid and base storage.

WASTE DISPOSAL

- Wash all beakers and cylinders used in handling.
- Wipe down and dry all surfaces.
- Ensure stock bottles after cleaned on the outside before storing.
- Store waste in containers labelled "CHEMICAL/HAZARDOUS WASTE FOR DISPOSAL."

SKIN AND EYE EXPOSURE

- For skin exposure, immediately flush with cool water for a minimum of 15 minutes. Remove contaminated clothing and footwear while rinsing.
- For eye exposure, forcibly hold eyes open and flush for at least 15 minutes. Continue flushing area with water if pain continues.
- Do not use neutralizing chemicals, creams, abrasives, or lotions.
- Contact DPS and alert cleanroom staff.

INHALATION EXPOSURE

- Move to location with fresh air.
- Obtain medical attention immediately if symptoms develop (coughing, shortness of breath, wheezing, burning in mouth or throat, or chest pain).
- Alert cleanroom staff and call DPS for medical assistance.

INGESTION

- Alert cleanroom staff and call DPS for medical assistance.
- If possible, determine what material was ingested by victim.
- If victim begins to vomit, turn head or entire body to one side to avoid choking.
- Do not induce the victim to vomit or drink any beverage unless instructed to by qualified medical personnel.

ACCIDENTAL SPILLS

Chemical spill clean-up shall not be attempted if lab personnel do not have proper training and experience, necessary spill kit supplies, and/or appropriate personal protective equipment. Before starting work, review the Spill Response and Clean-Up web page and Section 10 of the CHP. All personnel operating under this SOP shall familiarize themselves with this information and shall re-review these references at least annually.

Please refer to the EH&S Chemical Spill Kit Guide Sheet for guidance on appropriate spill kit materials.

Call DPS for all spills, even if they get cleaned up by lab personnel. DPS will pass information to the EH&S and Hazmat on-call system. If needed, trained staff will be sent to the lab to clean and decontaminate the spill. If lab personnel clean the spill themselves, notification should still be made as lab safety specialists may wish to follow up with a routine safety investigation.

Spills posing a respiratory hazard SHALL NOT be cleaned by lab personnel. Evacuate the area, restrict access, call DPS.

UNATTENDED EXPERIMENTS

- Chemicals may not be left unattended for more than 15 minutes.
- For unattended experiments longer than 15 minutes, notify cleanroom staff to get permission.
- The maximum time for unattended chemicals is one hour.
- Unattended chemicals require displayed signage at fume hood.

- The sign must contain the hazards of the experiment, the experimenter's name and contact information, responsible PI's name and contact information, expected date and time of disposal.
- For more information on unattended hazardous experiments, please refer to the [Unattended Hazardous Operations Fact Sheet](#).

EMERGENCY NOTIFICATION

- Notify the Department of Public Safety (DPS) at (213) 740-4321 or (323) 442-1000. For a non-emergency, dial (213) 740-6000.
- State the nature of the emergency (e.g., injury, hazardous materials or biohazards spill, fire) and provide details.
 - a) Location of injury/incident
 - b) Name(s) of injured and name(s) of witness(es)
 - c) Contact information (your name and call-back number)
 - d) Injury/incident summary
- Notify EH&S immediately at (323) 442-2200 or injuryprevention@usc.edu to report the injury/incident.
- Notify the cleanroom staff and your supervisor.

EXAMPLES OF CORROSIVES

Strong Acids: Nitric, perchloric, hydrochloric, and hydrofluoric acid.

Strong Bases: Hydroxides of sodium, potassium, and barium.

Strong Dehydrating Agents: Sulfuric acid, phosphorus pentoxide and calcium oxide.

Strong Oxidizing Agents: Concentrated hydrogen peroxide, sodium hypochlorite.

References

- [SOP – CORROSIVES | USC Environmental Health & Safety](#)
- [Chemical Hygiene Plan](#)

Contributors	Revised Date
Shiva Bhaskaran, Joey Vo	08/04/2021