UC | Center for Laboratory Safety

Standard Operating Procedure

Hydrofluoric Acid

This SOP is not complete until it has been signed and dated by the PI and relevant lab personnel.

Print a copy and insert into your
Laboratory Safety Manual and *Chemical Hygiene Plan*.
Refer to instructions for assistance.

Department:	Chemistry & Biochemistry – Chemical Engineering
Date SOP was written:	December 14, 2012
Date SOP was approved by PI/lab supervisor:	January 18, 2013
Principal Investigator:	Prof. Susannah Scott
Internal Lab Safety Coordinator/Lab Manager:	Stephanie Goubert-Renaudin
Lab Phone:	805-893-8941
Office Phone:	805-893-7403
Emergency Contact:	EH&S24 hour line: 805-893-3194 *(Name and Phone Number)*
Location(s) covered by this SOP:	ESB 3324 and 3328 *(Building/Room Number)*

Type of SOP: ☐ Process ☒Hazardous Chemical ☐ Hazardous Class

Purpose

Hydrofluoric acid (HF) is a highly corrosive liquid and is a contact poison. It should be handled with extreme care (i.e., beyond what is generally required to handle other mineral acids). Owing to its low dissociation constant, HF as a neutral lipid-soluble molecule penetrates tissue more rapidly than typical mineral acids. Because of the ability of hydrofluoric acid to penetrate tissue, poisoning can occur readily through exposure of skin or eyes, or when inhaled or swallowed. Symptoms of exposure to hydrofluoric acid may not be immediately evident. HF interferes with nerve function, meaning that burns may not initially be painful. Accidental exposures can go unnoticed, delaying treatment and increasing the extent and seriousness of the injury.

HF is a calcium seeker. A person can't sense when it comes in contact with the skin. But, it dissolves the calcium in the bone. HF burns are not evident until a day later. If not stored, handled and disposed of properly, HF can pose a serious threat to the health and safety of laboratory personnel, emergency responders and waste handlers. Hence, it is important to thoroughly understand the properties of HF and follow all safety protocols to properly store and handle HF.

Uses: HF is used to etch glass. Because of its ability to dissolve oxides, hydrofluoric acid is useful for dissolving rock samples (usually powdered) prior to analysis. The ability of hydrofluoric acid to dissolve metal oxides is the basis of several applications. It removes oxide impurities from stainless steel, a process called 'pickling', and silicon wafers in the semiconductor industry.

Physical & Chemical Properties/Definition of Chemical Group

CAS#: 7664-39-3

Class: **Very toxic & Corrosive**

Molecular Formula: HF

Form (physical state): Liquid

Color: Colorless

Boiling point: 108° C (226.4° F) (48% wt)

Potential Hazards/Toxicity

HF removes calcium from body in the affected area (Targets the bone).

Target Organs - Liver, Kidney, lungs, mucous membranes, skin, eyes, bones, teeth.

Potential Health Effects

Inhalation Toxic if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.

Skin May be fatal if absorbed through skin. Causes skin burns.

Eyes Causes eye burns.

Ingestion May be fatal if swallowed.

Personal Protective Equipment (PPE)

Respiratory Protection
Respirators should be used only under any of the following circumstances:

- As a last line of defense (i.e., after engineering and administrative controls have been exhausted).
- When Permissible Exposure Limit (PEL) has exceeded or when there is a possibility that PEL will be exceeded.
- Regulations require the use of a respirator.
- An employer requires the use of a respirator.
- There is potential for harmful exposure due to an atmospheric contaminant (in the absence of PEL)

- As PPE in the event of a chemical spill clean-up process

Lab personnel intending to use/wear a respirator mask must be trained and fit-tested by EH&S. This is a regulatory requirement.

Hand Protection
Natural Rubber arm length or Heavy duty Nitrile arm length gloves are highly recommended. **Note:** This type of gloves must be put on over the inner Butyl Viton gloves/disposable nitrile gloves. Gloves must be inspected prior to each use. Use proper glove removal technique (without touching outer surface of the gloves) to avoid skin contact with HF on the contaminated gloves. *Dispose of inner nitrile gloves* after use as hazardous waste. Wash hands thoroughly with warm water and soap.

NOTE: Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with Hydrofluoric acid.

Refer to glove selection chart from the links below:
http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf
OR
http://www.allsafetyproducts.biz/page/74172
OR
http://www.showabestglove.com/site/default.aspx
OR
http://www.mapaglove.com/

Eye Protection
Tightly fitting safety goggles & face shield (ANSI approved).

Skin and Body Protection
- Lab coat
- Full-length pants
- Closed-toe rubber or leather shoes

Hygiene Measures
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Engineering Controls

To be used within a chemical fume hood.

First Aid Procedures

If inhaled
Move to fresh air. If the person is not breathing, give artificial respiration. Avoid mouth to mouth contact. Call **9-911** from a campus phone **or 805-893-3446** from a cell phone. Call EH&S at **805-893-3194**.

In case of skin contact
Immediately (within seconds) flush affected area for at least 15 minutes. Remove all contaminated clothing. Call **9-911** from a campus phone or **805-893-3446** from a cell phone. Call EH&S at **805-893-3194**. Wearing compatible gloves, massage calcium gluconate gel into the affected area. Re-apply every 15 minutes until medical help arrives. Note: Hydrofluoric acid exposure is often treated with calcium gluconate, a source of Ca^{2+} that sequesters the fluoride ions. HF chemical burns can be treated with a water wash and 2.5% calcium gluconate gel, or special rinsing solutions. However, because it is absorbed, medical treatment is necessary; rinsing off is not enough. Intra-arterial infusions of calcium

chloride have also shown great effectiveness in treating burns. In some cases, amputation may be required.

In case of eye contact
Use Calgonate Emergency Eyewash immediately. Call **9-911** from a campus phone or **805-893-3446** from a cell phone. Call EH&S at **805-893-3194**. NOTE: Do not open the Calgonate Emergency Eyewash Solution container seal, unless needs to be used. Use the entire 120 ml content during an emergency (eye exposure). Calgonate Emergency Eyewash Solution is for single use only.

If swallowed
DO NOT INDUCE VOMITING. Give large quantities of milk (preferable) or water. Never give anything by mouth to an unconscious person. Call 9-911 from a campus phone or **805-893-3446** from a cell phone. Call EH&S at **805-893-3194**.

Special Storage & Handling Requirements

- Ensure that you have all the PPE required for handling HF.
- HF must always be stored in plastic (nalgene / polypropylene) containers. DO NOT store HF in glass bottles/containers.
- Store in corrosive/acid storage cabinet within a secondary containment (nalgene/ polypropylene tray or tub).
- Do not store in the top most shelf of the storage cabinet. Note: In general, do not store chemicals at or above eye level.
- Ensure the container is tightly closed at all times.
- Do not store with oxides, organic chemicals, bases or metals.
- Carefully carry the stock bottle in a rubber maid bottle carrier/nalgene secondary container to the wet bench/chemical fume hood and pour out desired amount into a smaller container.
- Place stock bottle back in corrosive chemical storage cabinet with cap tightly closed.
- Lab buddy system is highly recommended when handling HF. Lab emergency contact information must be readily available. The lab personnel must have easy access to a telephone (landline or cell phone).

Spill and Accident Procedure

General Guidelines:

Personal precautions

Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Methods and materials for containment and cleaning up

Soak up with inert absorbent material (such pads or powder available in the spill kit) and dispose of as hazardous waste in a bag labeled “HF waste”. Keep in suitable, closed containers for disposal. Personal Protective equipment must be worn – natural rubber gloves (arm length), goggles, face shield, natural rubber apron/suit, long pants, closed-toe rubber/leather shoes, respirator approved for HF handling.

- Immediately assess amount spilled. Contact Environment Health & Safety (EH&S) at x3194 and dial 9-911 from a campus phone.
- Use neutralizing agent (sodium carbonate) and liquid binding material (vermiculite, sand, kitty litter).
- Pick up contaminated material with a disposable scoop and place in a double transparent plastic bag.
- Label and tag as hazardous waste and bring to hazardous waste pick up.

Chemical Spill Dial 9-911 and EH&S (805-893-3194)

Spill – Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Small – If you have training, you may assist in the clean-up effort. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up.

Large – Dial **9-911 from campus phones (and 805-893-3446 from a cell phone)** and EH&S (805-893-3194) for assistance.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. *Notify supervisor and EH&S immediately.*

Medical Emergency Dial 9-911

Life Threatening Emergency, After Hours, Weekends and Holidays – Dial **9-911** (or 805-893-3446 from a cell phone) or go to the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411) *Note: All Serious injuries must be reported to EH&S within 8 hours.*

Non-Life Threatening Emergency – Go to the Student Health Building, Building 588 (phone number: 893-5361, hours: M, T, R, F 8am-4.30pm, W 9am - 4.30pm, R 5pm to 7pm by appointment). After hours go to the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411) *Note: All serious injuries must be reported to EH&S within 8 hours.*

Needle stick/puncture exposure (as applicable to chemical handling procedure) – Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure, flush the affected area for 15 minutes using an eyewash station. Page the needle stick nurse \ and then enter your extension. After hours go to the nearest emergency room: the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411). *Note: All needle stick/puncture exposures must be reported to EH&S within 8 hours.*

Decontamination/Waste Disposal Procedure

HF is listed as Extremely Hazardous (EH) Substance by the State. Even the containers (irrespective of the size) which once held HF must be disposed of as hazardous waste with an on-line hazardous waste tag affixed on the container.

Even the safety gloves that come in contact with HF (i.e., HF contaminated gloves) must be disposed of as dry hazardous waste. All dry hazardous waste must be double bagged (*use only transparent bags*) and affixed with an on-line waste tag.

General hazardous waste disposal guidelines:

Label Waste

- Affix an on-line hazardous waste tag on all waste containers using UCSB EH&S website as soon as the first drop of waste is added to the container

Store Waste

- Store hazardous waste in closed containers, in secondary containment and in a designated location
- Waste must be under the control of the person generating & disposing of it

Dispose of Waste

- Dispose of regularly generated chemical waste within 90 days
- Call EH&S
- Empty Containers
    - Dispose as hazardous waste if it once held extremely hazardous waste (irrespective of the container size
    - Consult waste pick-up schedule

  Prepare for transport to pick-up location
        - Check on-line waste tag
        - Write date of pick-up on the waste tag
        - Use secondary containment

Safety Data Sheet (SDS) Location

Online SDS can be accessed at http://ehs.ucsb.edu/units/labsfty/labrsc/chemistry/lschemmsdsacc.htm

Protocol/Procedure

Work with hydrofluoric acid HF is not allowed when alone in the Lab. Prior to starting reaction, locate the calcium gluconate gel (located next to First aid Kit), eyewash and safety shower.

Hydrofluoric acid is obtained as a 48% diluted solution and is stored in the ventilated “Acid” cabinet, in a secondary plastic container.

In our Group, HF is employed in small quantity (few mL) after dilution (roughly 10 times) with abundant water to clean pyrex reactors from metals and as 48% solution (few μL) to dissolve silicates completely for elemental analysis.

As HF is corrosive and readily destroys tissues, it has to be handled wearing a lab coat, safety goggles and Viton or nitrile gloves, under a ventilated fume hood. Gloves have to be discarded as soon as contaminated, or torn. When working with HF, make sure a sign is posted in the fume hood informing your co-workers that work with HF is being done. Label all containers containing HF.

HF should never be stored in containers made of glass, metal or ceramic but only in plastic containers.

Diluted hydrofluoric acid should be disposed as hazardous waste in the plastic waste container, clearly labeled and kept closed at all times.

NOTE: Any deviation from this SOP requires approval from PI.

Documentation of Training (signature of all users is required)

- Prior to conducting any work with Hydrofluoric Acid (HF)., designated personnel, i.e. approved users listed below, must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training as required by EH&S.

I have read and understand the content of this SOP:

Name	Signature	Trainer	Date
Prof. Susannah Scott			
Stephanie Goubert-Renaudin			
Gary Kwanyi Ng			
Alessandro Gallo			
Anthony Crisci			
Haibo Yu			
Taeho Hwang			
Bethany Wigington			
Daniel Coller			
Zachary Jones			
Youhong Wang			
Jinghong Zhou			

Jason Fendi			