

Guidelines for the Safe Use of Hydrofluoric Acid (HF)

Introduction

Hydrofluoric Acid (HF), has a number of physical, chemical, and toxicological properties that make it especially hazardous to handle. Both anhydrous hydrofluoric acid (hydrogen fluoride) and aqueous solutions are clear, colorless, and highly corrosive liquids. All forms including the solution or the vapor can cause severe burns to tissue which are very painful and very slow to heal.

Prevention of exposure or injury must be the primary goal when working with HF. However, any HF user must be intimately familiar with the appropriate first aid in case of an exposure.

Toxicology

The unique toxicological properties of HF are due to the action of the fluoride ion. Fluoride ions are both acutely and chronically toxic. Acute effects of HF exposure include extreme respiratory irritation, immediate and severe eye damage and pulmonary edema. Skin, eye, or lung exposure to concentrated (>50%) HF solutions will cause immediate, severe, penetrating burns. Exposure to less concentrated solutions may have equally serious effects, but the appearance of symptoms can be delayed up to 24 hours. If you are exposed to hydrofluoric acid seek medical attention immediately, even if you do not feel pain.

HF burns require immediate and specialized first aid and medical treatment. Delays in first aid care or medical treatment or improper medical treatment will likely result in greater damage or may, in some cases, result in a fatal outcome.

Exposure Control

The ACGIH ceiling limit and OSHA PEL (permissible exposure limit) for HF is 3 PPM. Work with HF should always take place inside a chemical fumehood.

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Training

Prior to conducting any work with HF the Principal Investigator must provide training to all laboratory personnel in his/her laboratory specific to the hazards involved with this substance, work area decontamination, and first aid and emergency procedures.

At a minimum, the training program shall consist of the following topics:

- A description of the hazards associated with HF
- A description of the initial first aid measures
- A description of the delayed onset of symptoms associated with HF
- A description of the personal protective equipment available and a description of its use and limitations
- The location of Material Safety Data Sheets and other safety, health & environmental information
- The location of first aid equipment on site
- The correct response to involvement in an HF incident
- Emergency procedures, including how to contact the Security command Center
- How/where to get further medical attention
- The importance of cleaning up and decontaminating surfaces and equipment when work is complete
- Decontamination procedures including the most effective way to decontaminate tools, equipment, and personal protective equipment
- The importance of labeling samples or contaminated equipment
- The importance of reporting all incidents or near misses so that recurrences are prevented
- A practical demonstration showing how to put the personal protective equipment on
- A practical demonstration of the decontamination procedures
- A practical demonstration of the use of calcium gluconate gel
- Validation of the understanding of each part of the procedure
- A check that each attendee has a tube of calcium gluconate gel available at home (if applicable)
- The importance of reporting any exposure, either while at work or home

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Antidote

The Principal Investigator must ensure that an adequate supply of 2.5% calcium gluconate gel (within expiration date) is available and all staff is aware of its location. It is suggested that anyone using HF, or who could possibly come in to accidental contact with it (e.g. people working in the same laboratory or regular visitors), keep a fresh tube of gel at home at all times.

Storage

HF should be stored in a location that is secure to unauthorized access. Examples are a locked cabinet, or within a laboratory that is locked when authorized personnel are not present. A cabinet containing HF must be labeled with a caution sign noting the presence of HF and its hazards (extremely corrosive). Store HF in appropriate, sealed containers within unbreakable, compatible secondary containment (i.e., a polyethylene tub or tray).

Work Practices

- HF should always be handled in a **designed area** such as inside a chemical fumehood which is identified with a sign stating “Danger, Hydrofluoric Acid Used in this Area”
- Copies of MSDS and these guidelines or SOP should be posted or readily available near the designated area
- An HF spill kit should be nearby
- A HF Exposure Kit should be available and contain the following items:
 - a tube of 2.5 calcium gluconate gel. This gel can be purchased from a number of different sources (see references). The gel must be inspected at least monthly to ensure that it is available and has not reached the expiration date. If the gel has exceeded its shelf life or has been opened a new tube must be purchased and the old tube discarded.
 - 2 pairs of Neoprene or Nitrile (minimum 22 mil) gloves
 - 1 heavy-duty polyethylene bag to be used for items contaminated by HF
 - Copy of these guidelines and MSDS to take to the emergency room
 - Calcium Carbonate (antacid tablets)

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Handling and Solution Preparation

- HF should be purchased in the smallest practical amount, and in no instance should bottle size exceed 500mL.
- It should not be heated. When heated, highly corrosive HF vapor is emitted.
- Prior to beginning work with HF, review the checklist attached to these guidelines. Ensure that all items are immediately available and in good working order.
- A minimum of two individuals trained in the hazards of HF must be present whenever HF is used. Each individual must be familiar with the applicable first aid procedures, maintain visual contact with the other, and be ready to assist in the event of an accident.
- HF must be opened and handled only in a chemical hood that has been certified within the last 12 months. Bench top use of HF is prohibited. During use, the sash must be lowered to operating height or below. Containers of HF must not be left open since vapors can etch the glass of the hood sash.
- Do not use glass lab ware for work with HF. Use lab ware with a wide base (such as Erlenmeyer flask) to increase stability. Rinse lab ware thoroughly after use and then dip them into a saturated solution of sodium bicarbonate.
- Work with HF will take place over polyethylene secondary containers or spill trays.
- Wash hands thoroughly immediately after working with any concentration of HF.

Personal Protective Equipment

The following must be available and worn during operations involving HF:

- Splash-proof chemical goggles with plastic face shield. Contact lenses should not be worn.
- Long, gauntlet-type Best Ultraflex Neoprene 32 gloves over Best N-Dex 8005 nitrile gloves. Double-gloving is required when working with HF. Inspect gloves frequently. Change gloves frequently and immediately whenever contaminated, punctured or torn. If gloves are to be reused, rinse thoroughly after use and then dip them into a saturated solution of sodium bicarbonate.
- Wash hands immediately after removing gloves
- A standard or disposable laboratory coat or disposable coveralls. A standard laboratory coat may be reused before laundering if it has not been contaminated with HF.

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- A chemical-resistant apron with attached sleeves should be worn over the laboratory coat
- Closed-toed, leather shoes (not fabric or mesh). Alternatively, boots made of Polyvinyl alcohol (PVA) may be worn.

First Aid Treatment for HF Exposure

HF exposure requires **immediate** and specialized first aid and medical treatment. **Prompt first aid is essential**, even if the victim does not exhibit any signs or symptoms, or feel any pain. First aid procedures must be initiated if any contact is suspected because burns from weak HF solutions may not be noticed immediately. **First aid must be followed by treatment by a physician as soon as possible.**

Arrangements with local medical resources should be made ahead of time to ensure that medical personnel are familiar with the toxicity and treatment of HF exposure. Medical treatment for HF exposure is specialized and differs from treatment of other inorganic acid exposures.

Inhalation

If HF vapor has been inhaled, move the victim to fresh air immediately. If breathing has stopped, start artificial respiration. Oxygen should be administered as soon as possible.

Skin Contact

If HF has been spilled on skin or clothing, immediately rinse the affected area with water using a safety shower for a minimum of 15 minutes until medical treatment is provided (or limit rinsing to 5 minutes if 2.5% calcium gluconate gel is available). **While the victim is rinsing, someone should call the Security Response Center at 811 and report that an exposure to HF has occurred and emergency medical attention is needed.** During washing, remove all contaminated clothing while wearing protective gloves. Remove goggles last. A disposable laboratory coat or jumpsuit should be available for the exposed individual to wear after using a safety shower. Colleagues must be careful not to become contaminated while assisting the victim.

After rinsing for 5 minutes, victim should self-apply 2.5% calcium gluconate gel and massage into the contact site and adjacent area, while wearing protective gloves. (If victim is unable to self-apply the gel, a trained colleague wearing protective gloves should apply the gel.) Apply gel frequently (every 15 minutes) and continuously massage into skin. Continue until at least 15 minutes after pain is relieved or until medical treatment is provided. Continue applying and massaging calcium gluconate gel during

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transport to a medical facility. [Note: Iced 0.13% benzalkonium chloride (Zephiran) solution is also effective for skin exposure to HF. If gel is not available, a calcium solution (20 g calcium in 2 liters of water) can also be used for soaking the contact site.]

Eye Contact

If HF liquid or vapor has contacted the eyes, immediately flush for at least 15-20 minutes. Hold upper and lower eyelids open and away from the eye during irrigation. Remove contact lenses if possible. Continue flushing with a personal eyewash or apply ice water compresses during transport to medical facility or eye specialist. Avoid rubbing of the eyes.

Ingestion

If HF is ingested drink large amounts of water as quickly as possible to dilute the acid (if conscious). Do not induce vomiting, use emetics or baking soda. Drink several glasses of milk or several ounces of Mylanta, Maalox or milk of magnesia.

Accident Reporting

Notify the victim's supervisor, if immediately available. The supervisor, a co-worker, or the victim must call the Accident Reporting Information Hotline 215-955-SAFE (7233) to report the accident. In addition the supervisor will complete an "Employee Accident Report" form #0155-10 and submit a copy to the Department of Environmental Health and Safety.

Never use hydrofluoric acid working alone or after hours.

Spills

A small supply of calcium carbonate or calcium hydroxide for spills should be kept near where the work will be conducted. If a spill should occur phone the Security Response Center by dialing 811. Report that there has been a spill of Hydrofluoric Acid (HF) and to contact the Department of Environmental Health and Safety. DO NOT attempt to clean up a spill.

- Isolate the area to prevent the spread of contamination (e.g., close doors to affected area and post a warning sign).
- Alert personnel in the immediate area to evacuate.
- Attend to any injured personnel.

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- Stay nearby to direct the TJU Emergency Response Team to the location of the spill and HF spill cleanup materials.

HYDROFLUORIC ACID CHECKLIST

Note: Prior to ordering hydrofluoric acid or bringing it into the laboratory, the Principal Investigator is responsible for reviewing this checklist and ensuring that all required items mentioned below are immediately available in the laboratory and in good working order.

Each day **before** beginning any work involving HF, ensure that the following items are in place:

- Arrangements with local medical resources have been made to ensure that medical personnel are familiar with the toxicity and treatment of HF exposure.
- A colleague with training of the HF SOP is available and aware that work with HF will be conducted.
- First aid, spill procedures and HF MSDS are immediately available in HF work area.
- Proper functioning of chemical hood has been verified.
- Eyewash and emergency shower are functioning and access is unobstructed.
- An adequate supply of calcium gluconate gel is available and within its expiration date.
- Neoprene or nitrile gloves are stored with the gel.
- Necessary personal protective equipment items are available.
- Maalox, Mylanta and/or milk of magnesia are available.
- Powdered calcium carbonate or calcium hydroxide, plastic scoop and polyethylene container (or commercial HF spill kit) are available in case of spill.

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References

Mallinckrodt Baker Inc. MSDS #H3994, Hydrofluoric Acid 48-52%, 7/7/2004.

Recommended Medical Treatment for Hydrofluoric Acid Exposure, Honeywell, Morristown, NJ.

<http://www.honeywell.com/sites/docs/D47O8KSXCHVRH7M7737TW4JJXG2I3YSV0803114421015.pdf>

Prudent Practices in the Laboratory: Handling and Disposal of Chemicals. 1995, National Academy of Sciences, National Academy Press, Washington, D.C. Laboratory Chemical Safety Summary (LCSS), Hydrogen Fluoride and Hydrofluoric Acid.

Calcium Gluconate Gel Distributor

Calgonate: www.calgonate.com/enUS/product_line.php

HF Spill Kits Suppliers

Lab Safety: www.labsafety.com/search/hf+acid+eater/31141/

Fisher Scientific:

www.fishersci.com/wps/portal/SEARCHRESULTS?ru=http%3A%2F%2Fprodwcsserver%3A9060%2Fwebapp%2Fwcs%2Fstores%2Fservlet%2FSearch&searchPref=no&position=search&preferProd=unchecked&searchType=Rapid&catalogCode=SA_SC&keyWord=hf+acid+eater&catCode=ALL