

Handling of Hazardous Chemicals: Hydrofluoric Acid

MSU Department of Chemistry

Use of hydrofluoric acid (HF) is to be limited to applications for which no suitable substitute is available. Any purchase or use of this material must be authorized through the office of the department's Laboratory/Safety/Waste Coordinator.

I. Identification of Primary Hazards

Hydrofluoric acid is highly corrosive, and produces deep-seated burns that may be slow to heal. The acid readily penetrates the skin, damaging the underlying tissue and bone. Depending on concentration, these actions may be evident immediately upon exposure, or may be delayed by as much as 24 hours. **Any exposure should be treated as a life-threatening medical emergency.**

The individual(s) responsible for dispensing or using hydrofluoric acid should read this entire document and the reference documents in Appendix 1. If this material is used in an instructional laboratory, each student should read the material safety data sheet or the Lab Chemical Safety Summary (Appendix 2).

II. Storage and Handling

A. Storage

All containers of hydrofluoric acid are to be stored in secure acid cabinets. These containers shall be accessible to only those persons familiar with proper handling precautions. It is preferable that these compounds be stored only in the designated locked acid storage cabinet in the chemistry stockroom. Storage at satellite locations should be discouraged, and the quantity stored should be kept to a minimum. All containers should be clearly labeled with the chemical name, and marked as corrosive and toxic.

A copy of this document and all attachments shall be kept at each storage site. A calcium gluconate gel kit shall be available at each location where HF is stored or used. A current inventory of hydrofluoric acid shall be maintained.

B. Handling

1. Posting of Laboratory

Before beginning work with hydrofluoric acid, the doorway(s) should be posted as follows: "Danger. Hydrofluoric acid in use. Authorized entry only. In case of emergency, *do not enter*. Call 911". See Appendix 3. Near the laboratory phone, post the emergency notification fact sheet shown in Appendix 4. Provide specific information for the

location and experimental conditions in use.

2. Designation of Work Area

Hydrofluoric acid shall be dispensed and handled only in an operational fume hood. Before commencing work, the average face velocity of the fume hood should be checked. This must be 80-120 fpm at the working sash height. If a minimum face velocity of 80 fpm is not attained with sash fully opened, clearly mark the maximum sash position where this velocity is achieved. A fume hood that will not maintain a face velocity of at least 80 fpm at a reasonable working sash position should *not* be used. If the fume hood is equipped with a flow alarm, confirm that it is working properly by blocking airflow to the sensor (use a piece of paper to cover the opening). The monitor alarm should sound. If the fume hood is not equipped with an operational audible alarm, affix a tissue paper streamer to the sash at each end to serve as an indicator of air flow into the hood. The fume hood should be posted as shown in Appendix 5.

Mark a work area on the floor outside the fume hood extending three feet in front of the hood, and two feet on each side of the hood. When hydrofluoric acid is used only on a temporary basis, this area may be marked using masking tape or a similar material. Only the person(s) assigned to use/dispense HF should enter this work area. No more than two individuals should be in this area at any time.

Mark a work area inside the fume hood beginning six inches back from the plane of the hood sash. All operations using HF (opening containers, dispensing, etc.) should be performed behind this line.

3. Preparation of Work Area

To contain possible spills, place a plastic tray or pan in the working area of the fume hood. You may also wish to have a plastic bottle (with a wide mouth *or* with a funnel) for waste generated. All materials necessary for completion of the laboratory task should be placed in the fume hood. Prepare for possible spills by having a spill response kit available in the hood.

This entire documentation packet should be immediately available to the individuals in the HF work area, but just outside the designated work zone. A calcium gluconate gel prep kit should be placed in the same location.

4. Personal Protective Equipment

All personnel entering the designated work area must wear chemical splash goggles and protective gloves. The following glove configuration is recommended: lightweight PVC or nitrile gloves underneath (next to skin) topped by SilverShield gloves topped by neoprene/latex gloves. For HF concentrations >30%, minimum hand protection is provided by

lightweight PVC or nitrile gloves topped by neoprene/latex gloves. For HF concentrations <10%, lightweight nitrile gloves provide adequate protection against incidental exposure. Unless SilverShield gloves are used, immediate decontamination and complete glove change is recommended in any suspected contact with solutions of HF. A lab coat or other protective clothing is advised. Arms must be covered at all times. A heavy lab apron is recommended. Shorts and sandals are prohibited, as are other types of clothing leaving large expanses of skin exposed.

5. Notification

The supervising professor and lab/safety/waste coordinator should be contacted prior to commencing work with hydrofluoric acid.

6. Use

The hydrofluoric acid may be removed from the acid cabinet *only* after previous steps have been completed. HF should *never* be used by an individual working alone in a laboratory. The container of acid should be placed directly into the working area of the designated fume hood. Plastic labware must be used when handling HF. Hydrofluoric acid attacks glass and metal, so these materials should not be used for HF. All labware, utensils, and PPE with possible HF contact must remain in the fume hood until decontaminated.

7. Decontamination of Work Area

Utensils, labware, and other surfaces contaminated with HF must be decontaminated at the end of the laboratory work session. This should be completed in the fume hood before removing any of the items. Use water to wash all contaminated surfaces into the HF waste bottle.

8. Waste

Hydrofluoric acid waste should be collected in a *plastic* bottle in the HF work area hood. This container should *not* be used for other waste. Label as follows: "Hazardous Waste. Contains Hydrofluoric Acid. Toxic. Corrosive. Contents: (list all compounds present, with approximate concentration of each). pH: (list pH of contents). Volume: (list total waste volume)." See Appendix 6.

Empty containers of HF should be treated according to the decontamination procedure above. Once decontaminated, the bottle may be discarded as non-hazardous waste.

9. Completion of Work

Confirm that all experimental work with hydrofluoric acid has been completed, and that all waste has been discharged or placed into a hazardous waste container. Replace HF in acid cabinet. Remove warning signs and store information packet with the HF.

III. Emergency Response

Depending on the type and severity of emergency, internal response by the office of Environmental Safety and Health or Laboratory/Safety/Waste Coordinator may be suggested. In the event of an emergency at a time when neither of these offices can be reached, the emergency call should go directly to 911.

It is assumed that all persons making a response to an emergency involving hydrofluoric acid will use protective equipment already identified in this procedure (II.B.4).

A. Spill

If a spill is contained in the designated fume hood, and involves less than 5 mL of material, it may be neutralized using calcium sulfate/calcium carbonate. This spill response mixture should be available in each location where HF is stored/used. (See Appendix 9). Surround the spill with the spill response mixture. Use a plastic scraper to push the material inward until all the material is contained in a small heap at the center of the spill site.

A spill contained in the designated fume hood involving greater than 5 mL of material should be treated as a major spill. Call for backup response from the department's Laboratory/Safety/Waste coordinator at 6390 *or* the office of Environmental Safety and Health at 3480. Meanwhile, close the sash to the fume hood, and clear all laboratory personnel from the HF work area.

Any spill not contained in the designated fume hood should be treated as a major spill. Evacuate the laboratory immediately and call for backup response from the department's Laboratory/Safety/Waste Coordinator at 6390 *or* the office of Environmental Safety and Health at 3480. An exposure is very likely in a non-contained spill. Follow guidelines in section C, below.

Any release of hydrofluoric acid to a sink or drain presents a very serious exposure risk. Evacuate the laboratory immediately and call for backup response from the Laboratory/Safety/Waste Coordinator at 6390 *or* the office of Environmental Safety and Health at 3480. If they recommend immediate evacuation of the building, pull the nearest fire alarm as you exit. Follow exposure guidelines in section C, below.

B. Hood Failure

Failure of the fume hood to provide adequate airflow will be indicated by an audible alarm and/or indication by tissue paper strips. All work in the hood should be ceased

immediately, and the hood sash should be closed completely. Call for backup response from the Laboratory/Safety/Waste Coordinator at 6390 *or* the office of Environmental Safety and Health at 3480. If they recommend immediate evacuation of the building, pull the nearest fire alarm as you exit. No personnel should be permitted inside the HF work area until the fume hood has been repaired. Proper operation should be confirmed as outlined in section II.B.2 prior to resumption of experimental activities in the HF work area. If there is any possibility of inhalation exposure, follow guidelines in section C, below.

C. Exposure

In *any* exposure to hydrofluoric acid, immediate emergency response is crucial. Call 911 to report the emergency. Use the emergency call sheet in Appendix 4 as an aid in providing complete information. Since it may be easy for a dispatcher to confuse *hydrofluoric* acid with the familiar *hydrochloric* acid, it is helpful to refer to “hydrofluoric acid - *HF*”. The MSDS and related information in Appendix 1 should be given to emergency response personnel upon arrival.

Because of the danger of collateral exposure, no first aid response should be made by any individual not properly trained and protected from exposure. Laboratory evacuation will normally be required, and building evacuation may be necessary. Contact the department’s Laboratory/Safety/Waste coordinator at 6390 for assistance. Designate an individual to direct emergency response personnel to the right location on arrival. This person should wait at the west entrance to the building.

Keep a written log of any emergency assistance administered on site by MSU personnel. Provide this log and the MSDS to emergency response personnel upon arrival. See Appendix 8.

1. Inhalation

In case of an inhalation exposure, move the victim to fresh air. Keep a conscious victim warm, and in a restful position. Monitor condition closely until medical help arrives. If the victim becomes unconscious, but is breathing, administer oxygen if it is available. *Do not* give mouth-to-mouth resuscitation, as the risk of collateral exposure is significant. Emergency room personnel should be prepared to administer calcium gluconate via a nebulizer.

2. Eye Contact

Immediately flush the eyes with plenty of water for at least 15 minutes. Consider the possibility of subsequent inhalation exposure, and follow the inhalation guidelines above. *If* it is possible to prepare a 1% solution of calcium gluconate in a buffered eyewash solution, this may be applied to the eyes after an initial 5-minute flush with water.

3. Skin Contact

Immediately flush the skin with plenty of water for at least 5 minutes while removing contaminated clothing and shoes. Prepare a calcium gluconate gel (see Appendix 9) to apply to affected area. If treating exposure to a hand, place the gel into a glove, then put the injured hand into the glove to provide continuous contact. Consider the possibility of subsequent inhalation exposure, and follow the inhalation guidelines above.

4. Ingestion

Have the victim drink large amounts of water as quickly as possible. Do not induce vomiting. *Never* give anything by mouth to an unconscious person. If available, give several glasses of milk, several ounces of milk of magnesia, Mylanta, or a similar product. The calcium or magnesium in these products may tend to act as an antidote. Consider the possibility of subsequent inhalation exposure, and follow the inhalation guidelines above.

Appendix 1

Material Safety Data Sheet (MSDS)
Hydrofluoric Acid

First Aid for a Unique Acid: HF

Eileen Segal

Chemical Health and Safety

September/October 1998

Treatment of Hydrofluoric Acid Exposure

Allied Signal

Appendix 2

Lab Chemical Safety Summary (LCSS)
Hydrofluoric Acid
National Academy of Sciences, 1995



Hydrofluoric Acid in use.

Authorized entry only.

In case of emergency,
do not enter. Call 911.



HYDROFLUORIC ACID IN USE.
GOGGLES AND GLOVES REQUIRED

This work area restricted to two people.
Authorized entry only.

In case of emergency, *evacuate*.
Call 911.

Appendix 6
Labeling of Hazardous Waste

Label waste bottles as shown below.

HAZARDOUS WASTE CONTAINS HYDROFLUORIC ACID <i>TOXIC</i> <i>CORROSIVE</i>	
Contents:	<i>List each compound present, with approximate concentration of each.</i>
pH	<i>List pH of contents.</i>
Volume	<i>List total waste volume.</i>

Appendix 7

Spill Response Kit

For neutralization of up to 5 mL of 50% HF, a mixture of calcium hydroxide (10 grams) and calcium sulfate (50 grams) may be used. This will provide an excess of base for neutralization of the acid, and will provide sufficient calcium to bind the fluoride ions present. These compounds should be premixed in the proportions above, and stored in a wide-mouth plastic bottle with the hydrofluoric acid.

Appendix 8
Log of On-Site Treatment, Hydrofluoric Acid (HF) Exposure

Record below any treatment given on-site, or other details that may be important to medical personnel.

Name of victim		Approximate age	
MedicAlert or other medical information available			
Date of Exposure		Time of exposure	
Specific chemicals involved		Estimated quantity	Concentration
hydrofluoric acid (HF)			
other:			
Probable route of exposure (inhalation, skin contact, eye contact, ingestion, injection)			
Time emergency reported (911):			
Victim conscious?		Time victim became unconscious:	
Victim breathing?		Time victim stopped breathing.	
Air/oxygen administered?		Time initiated, how?	
Victim has pulse?		Time pulse stopped	
CPR administered?		Time started	
Skin/eyes flushed?		Start time: Stop time:	
Calcium gluconate administered?		Amount: Start time:	
What other materials were administered?		Amount:	

Appendix 9

Preparation of Calcium Gluconate Gel

A calcium gluconate gel preparation kit must be stored in each location where hydrofluoric acid is stored or used. It should contain:

- 1 tube (4 oz., 113.4 grams) K-Y Jelly
- 1 popsicle stick, for stirring
- 2 pairs PVC gloves, large
- 1 zip-seal bag containing 2.8 grams calcium gluconate

If skin contact with hydrofluoric acid occurs, empty the contents of the tube of K-Y Jelly into the bag containing calcium gluconate. Mix using the enclosed stick. Use directly from the bag or seal bag and cut off a corner to dispense. Wear gloves when applying to affected skin. The gel may be dispensed into gloves for best contact in case of exposure to hands.

This gel should *not* be used for exposures to the eyes.