

Hydrofluoric Acid Safety Procedures

Introduction:

Hydrofluoric acid (HF) has a number of chemical, physical and toxicological properties, which make handling this material especially hazardous. Anhydrous HF is a clear, colorless, fuming, corrosive liquid. HF is also available in the gaseous state. All forms including the solution or the vapor can cause severe burns to tissue.

Uses:

Concentrated hydrofluoric acid is used in the fabrication of electronic components, to etch glass and in the manufacture of semiconductors. Dilute hydrofluoric acid solutions are used in some biological staining procedures.

Chemical Properties:

Hydrofluoric acid solutions are clear and colorless with a density similar to that of water. The most widely known property of HF is its ability to dissolve glass. It will also attack glazes, enamels, pottery, concrete, rubber, leather, many metals (especially cast iron) and organic compounds. Upon reaction with metals, explosive hydrogen gas may be formed. Use and store HF in polyethylene, polypropylene, Teflon, wax, lead or platinum containers.

Toxicological Properties:

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. Due to low dissociation constant, HF can penetrate tissues quickly. Hydrofluoric acid which comes into direct contact with the fingers can severely damage or destroy the tissue underneath the nail without causing any damage to the nail itself. It is this ability to cause little harm to outer tissues but considerable harm to inner tissues which can produce dangerous delays in treatment of hydrofluoric acid exposure. Once the pain starts, it is out of proportion to the burns produced. Patients often describe the feeling as if they have struck their fingers with a hammer. HF that penetrates under the skin causes later development of painful ulcers, which heal slowly. Exposure to less concentrated solutions may have equally serious effects, but the appearance of symptoms can be delayed for up to 24 hours. If you are exposed to hydrofluoric acid seek medical attention immediately, even if you do not feel pain.

PPE:

Eye protection in the form of chemical splash goggles and a face shield should be used. Neoprene or Nitrile (22mil) gloves or other HF resistant gloves should be worn. It is also recommended that an acid resistant suit or apron be used (Some clothing is able to absorb the toxic material and maintain it close to the skin).

In order to warn and protect others from the hazard of HF, a warning sign indicating the use of HF should be posted. A Material Safety Data Sheet (MSDS) on HF should also always be kept in the immediate work area where HF is used.

Using Hydrofluoric Acid Safely

1. Never use Hydrofluoric Acid when working alone or after hours. Hydrofluoric Acid may be used when working alone during normal working hours provided knowledgeable laboratory personnel have been alerted and at least one is in the general vicinity.
2. When working with Hydrofluoric Acid or concentrated HF solutions (> 1%): Work in a fume hood with the sash as low as possible. Wear goggles and a face shield. Wear a long-sleeved, buttoned lab coat, pants or long skirt, and closed-toe shoes. Wear Neoprene or Nitrile (22mil) gloves or other Hydrofluoric Acid resistant gloves (Hydrofluoric Acid burns around the fingernails are extremely painful, difficult to treat, and may require surgical removal of the nail). A chemically resistant apron is also recommended.
3. All lab personnel, not just those who will be using Hydrofluoric Acid, should be informed of the dangers of this chemical and the emergency procedures necessary in case of an accident. A sign must be posted to alert people that work with Hydrofluoric Acid is in progress.
4. All persons who will be using Hydrofluoric Acid must be made aware of its properties and trained in proper procedures for use and disposal.
5. Laboratories which keep or use Hydrofluoric Acid gas or concentrated solutions (>1% Hydrofluoric Acid) must have these emergency procedures on hand as well as an MSDS.
6. Laboratories which keep or use Hydrofluoric Acid gas or concentrated solutions (>1% Hydrofluoric Acid) must have an operational safety shower and eye wash in their laboratory. Before beginning any procedure involving Hydrofluoric Acid, make sure the access to the emergency shower and eyewash is unobstructed.
7. Undergraduate students should never be given the task of mixing Hydrofluoric Acid solutions. Only experienced persons familiar with its properties should handle the concentrated acid.
8. A supply of calcium carbonate or calcium hydroxide for spills must be available near the fume hood where the work will be conducted.
9. A HF exposure Kit with Calcium gluconate gel (not expired) must be available in any lab that contains HF. Calcium gluconate gel is a topical antidote for HF skin exposure. Calcium gluconate works by combining with HF to form insoluble calcium fluoride, thus preventing the extraction of calcium from tissues and bones.
10. Dispose of unwanted hydrofluoric acid by requesting a Hazardous waste pick-up (<http://ehs.sc.edu/hazwaste/hw2.htm>).
11. Any exposure to Hydrofluoric Acid must be medically evaluated.

Storage

Store all HF and HF waste in labeled chemically compatible containers (e.g., polyethylene or Teflon). Glass, metal, and ceramic containers are not compatible with HF. HF should never be stored with incompatible chemicals such as ammonia or other alkaline materials. Always place HF on a low protected shelf or other location where it will not be accidentally spilled or knocked over.

Waste

HF waste should be placed in a chemically compatible container with a sealed lid and clearly labeled. Complete a Hazardous Chemical Label and submit a pickup request

Emergency Procedures:

HF Exposure Kit:

Before beginning work involving HF an exposure kit must be available and located in the laboratory area. The exposure kit must contain the following items:

1. Container of calcium gluconate gel.
 - a. This gel must be inspected before each use of HF or at least monthly to ensure the gel has not been removed or has not reached the expiration date. If a tube of the gel has been opened, a new container must be purchased and the old container discarded. No work with HF can be done with an expired tube of calcium gluconate gel.
2. 2 pairs of Neoprene or Nitrile (22mil) gloves.
3. Copy of these procedures and MSDS to take to the emergency room.
4. Emergency Response Procedures:

Skin Exposure:

1. Move the victim immediately under an emergency shower or other water source and flush the affected area with large amounts of cool running water for at least 5 minute. While the victim is flushing with water, they should also take off all clothing, shoes and jewelry, removing goggles last. Close your eyes, face water flow and pull goggles over head. **BE EXTREMELY CAREFUL NOT TO CONTAMINATE YOURSELF (USE Neoprene or Nitrile (22mil) gloves LOCATED IN THE HF EXPOSURE KIT TO ASSIST).**
2. Remove all contaminated clothing while flushing with water. Some clothing is able to absorb the toxic material and maintain it close to the skin.
3. While the victim is being rinsed with water, someone should call to arrange treatment by medical personnel. Call USC Emergency number at 7-9111 and tell the dispatcher the following:
 - a. There is a person that has been in exposed to Hydrofluoric Acid and the victim is in this location.
 - b. Please send an officer and ambulance.
4. Immediately washing off the acid is of primary importance!
5. After the affected area is flushed with copious amounts of water for at least five minute, calcium gluconate gel is to be applied using these guidelines. A 2.5% calcium gluconate gel will be located inside the HF exposure kit within the laboratory. In order to prevent cross contamination, the victim should self apply the calcium gluconate gel. If the victim is unable to self apply, anyone present can apply the gel after putting on the **NEOPRENE OR NITRILE (22MIL) GLOVES** in the HF exposure kit. Do not use latex gloves; they are not effective against HF. Note the time when the calcium gluconate gel was first applied to the

- contaminated site. Reapplying every 15 minutes Provide this information to the EMS team.
6. The victim must be escorted to the hospital by the responding person or assisting lab personnel.
 7. A copy of the MSDS and these emergency procedures must be also taken to the hospital.

Eye Exposure:

1. Immediately flush eyes for at least 5 minutes with copious cool flowing water. The victim should then be transported to a medical facility. If a sterile 1% calcium gluconate solution is available and MEDICAL PERSONNEL are available then following the 5 minutes wash time, 1% calcium gluconate irrigation should be started.
2. Inform Public Safety of Hydrofluoric Acid exposure and instruct them to notify hospital of person in transport.
3. Inhalation:
4. If a large volume of Hydrofluoric Acid gas is inhaled:
5. Immediately remove the victim to clean air. Call 7-9111.
6. Inform USC Police of Hydrofluoric Acid exposure and instruct them to notify hospital of person in transport
7. Inhalation of Hydrofluoric Acid fumes may cause swelling in the respiratory tract up to 24 hours after exposure. Persons who have inhaled Hydrofluoric Acid vapors may need prophylactic oxygen treatment and must be seen by a physician as soon as possible

HF Spills:

If HF is spilled outside a chemical hood, evacuate the area, close the doors, post the area with a sign to prevent others from entering, and call Campus Safety Office at 7-9111 Small spills of HF inside a chemical fume hood can be cleaned up by laboratory staff if they have received spill clean up training, have the correct equipment, understand the hazards, and are confident in their ability to clean up the spill safely and dispose of the waste properly. If a small quantity (100 ml or less) of dilute Hydrofluoric Acid solution is spilled, clean it up by applying powdered calcium carbonate or calcium hydroxide, or use a commercial Hydrofluoric Acid spill kit. If a larger amount is spilled, or the acid is concentrated, contain the spill as best you can, evacuate the area, and call 7-9111. Avoid exposure to the vapors. (Organic spill kits that contain Floor-Dri, kitty litter, or sand should not be used because HF reacts with silica to produce silicon tetrafluoride, a toxic gas.)