

UH Environmental Health and Safety Office Fact Sheet

Safe Use of Hydrofluoric Acid

Hydrofluoric acid (HF), a solution of hydrogen fluoride gas in water, has a number of chemical, physiological and toxicological properties that make handling this material especially difficult. Concentrated HF is used in the fabrication of electronic components, as a solvent for minerals and to dissolve silica and metals in the laboratory. Dilute HF solutions are used in some biological staining procedures. Improper use of HF may cause serious injury, illness or even death. Faculty, staff and students are required to receive training prior to using hydrofluoric acid. At a minimum, instruction should include the information below and: identification of HF hazards, proper protective measures, acute and chronic effects of HF exposure and procedures for treatment in the event of exposure. Principal investigators and supervisors should develop a written Standard Operating Procedure (SOP) outlining laboratory specific information for using HF.

Chemical Properties

Hydrofluoric acid solutions are clear, colorless, fuming corrosive liquids with a density similar to that of water. The most widely known property of HF is its ability to dissolve glass. Hydrofluoric acid also attacks glazes, enamels, pottery, concrete, rubber, leather, and many metals and organic compounds. Upon reaction with metals, explosive hydrogen gas may be formed. Use and store HF in polyethylene, teflon, wax, or passivated steel vessels. While HF gas is one of the most acidic gases known, aqueous HF is technically a weak acid, with a pH of 3.2. This chemical definition of "weak" has no relation to hydrofluoric acid's ability to damage living tissue, which is considerable.

Physiological Properties

HF has poor warning properties. The odor threshold for humans is 3 ppm and irritation of mucous membranes begins at 5 ppm. If you can smell it, chances are the concentration is too high and immediate steps must be taken to lower it. Fluoride ions migrate through the body destroying tissue until lodging in the bones. If you are exposed to hydrofluoric acid seek prompt medical attention, even if you do not feel pain.

Toxicological Properties/Health Effects

Hydrofluoric acid is both acutely and chronically toxic. Acute effects of exposure to concentrated (>20%) HF include respiratory irritation, severe eye damage and pulmonary edema. Skin, eye or lung exposure will cause immediate, severe, penetrating burns. Exposure to less concentrated solutions may have equally serious effects, but the appearance of symptoms can be delayed for up to 24 hours. Chronic exposure to fluoride, including fluoride-containing compounds other than HF, can cause tooth mottling and increased bone density.

First Aid

Because of the fluoride ion's toxicity and its ability to move through the body, prompt first aid for HF exposures is essential. All personnel in the lab, not only those working with HF, should know and understand proper first aid procedures.

Skin Exposure

Remove the victim from the contaminated area and immediately wash the burned area with plenty of water for a minimum of 15 minutes. Limit washing to 5 minutes if treatment specific for HF exposure is available. Remove all contaminated clothing while washing continuously. Medical attention should be sought immediately, even if the injury appears slight. Contact campus security at x66911 to arrange for emergency response. After thorough washing for at least 5 minutes, the burned area should be immersed in a solution of .13% iced aqueous benzalkonium chloride until pain is relieved. As an alternative first aid treatment, 2.5% calcium gluconate gel may be continuously massaged into the burn area until pain subsides and medical attention is received.

Eye Exposure

Immediately flush eyes for at least 15 minutes with flowing water. Seek medical attention as soon as possible. If possible, apply ice water compresses during transport.

Inhalation

If HF gas is inhaled: Immediately move the victim to fresh air. Call x66911. Inhalation of HF fumes may cause swelling in the respiratory tract up to 24 hours after exposure. Persons who have inhaled HF fumes may need prophylactic oxygen treatment and should be seen by a physician as soon as possible.

Ingestion

Anyone who has ingested HF should drink a large quantity of water as quickly as possible. Do not induce vomiting. Again, medical help should be obtained promptly. Several glasses of milk or milk of magnesia may be given to soothe the burning effect.

Using Hydrofluoric Acid Safely

Laboratories that use HF should develop and implement a Standard Operating Procedure (SOP) for HF use in the laboratory. A typical SOP contains the following laboratory specific information: process description, potential hazards, personal protective equipment, engineering/ventilation controls, special handling procedures, storage requirements, accident/emergency procedures and waste disposal information.

The following practices should be incorporated into the SOP:

- 1) Laboratories that keep or use HF gas or solutions should have a first aid kit containing either .13% benzalkonium chloride solution or 2.5% calcium gluconate gel for use in emergencies.
 - a) Benzalkonium chloride solution can be prepared in the laboratory or may be special ordered via the University Health Services pharmacy under Zephiran chloride.
 - b) Calcium gluconate gel has a 1-2 year expiration period and should be periodically restocked. Contact Life Safety Association (lifesafety.com) for ordering information.
- 2) Keep a properly supplied spill kit to respond to small spills.
- 3) Before beginning any procedure involving HF, make sure the nearest safety shower and eyewash is accessible and in proper working condition.
- 4) Use and store HF only in non-glass containers.
- 5) Work in a fume hood with the sash closed as much as possible.
- 6) Wear goggles and a face shield, a lab coat, pants or a long skirt and closed-toe shoes.
- 7) Wear PVC or neoprene gloves.
- 8) For processes where HF vapor may be produced, ensure that the chemical hood does not have a glass sash.
- 9) If a small quantity (100 ml or less) of dilute HF solution is spilled, clean it up by applying powdered calcium carbonate or calcium hydroxide, or use a commercial HF spill kit. Call EHSO to dispose of the residue. If a larger amount is spilled, or the acid is concentrated, contain the spill as best you can, evacuate the area, and call X66911. Avoid exposure to the vapors.
- 10) A hardcopy Hydrofluoric acid material data safety sheet should be on hand to readily assist medical responders and physicians with medical aid.
- 11) This list is not inclusive. Additional procedures may be necessary depending on the concentration/use of HF and the facility location and capabilities. Refer to the manufacturer MSDS or contact EHSO for more information or assistance.

CAMPUS SECURITY: x66911
EHSO: x68660
POISON CONTROL CENTER: 1-800-222-1222

Information contained in this fact sheet includes excerpts from "Safety Net #70: Safe Use of Hydrofluoric Acid" by the Office of Environmental Health and Safety, University of California, Davis; "Academic Laboratory Chemical Hazards Guidebook," by William J. Mahn; "Hazardous Chemicals Desk Reference" edited by Richard Lewis; and Fisher Scientific and Honeywell Material Safety Data Sheets.