

GUIDELINES FOR USING HYDROFLUORIC ACID

A. INTRODUCTION

Hydrofluoric acid (HF) has a number of chemical, physical and toxicological properties, which make handling this material especially hazardous. Although chemists consider hydrofluoric acid (HF) to be a “weak” acid, its potential to produce serious health effects greatly exceeds that of “strong” acids commonly used in the laboratory. HF shares the corrosive properties common among mineral acids but is unique in its ability to cause deep tissue damage and hypocalcemia. 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 which are extremely painful and very slow to heal.

B. 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.

C. TOXICOLOGICAL PROPERTIES:

The unique toxicological properties of HF are due to the action of the fluoride ion. Fluoride ion causes soft tissue necrosis (similar to alkali damage) and bone damage by binding calcium. 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 contact with HF is probably the most common route of exposure for laboratory personnel (often under fingernails), however HF can cause damage through eye contact, inhalation, or ingestion. Exposures 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 for up to 8 hours for concentrations of 20-50% and up to 24 hours for concentrations less than 20% HF.

Concentrated HF burns can be fatal even if only 2 % (~ an 8-inch square) of the body is exposed. Working with anhydrous HF is extremely dangerous from the mist produced, which presents a severe inhalation hazard.

If you are exposed to hydrofluoric acid seek medical attention immediately, even if you do not feel pain.

D. EXPOSURE CONTROL, PPE AND WORK PRACTICES:

The ACGIH ceiling limit and OSHA TWA for HF is 3 PPM. Local ventilation should always be used when working with HF. Work in a laboratory hood whenever possible and always work in a hood when handling concentrated HF, anhydrous HF, or when heating HF solutions.

In order to warn and protect others from the hazard of HF, a warning sign indicating the use of HF should be posted.

Always wear gloves, a lab coat, and chemical safety goggles when working with any HF solution. Additionally, a face shield and rubber apron should be worn when handling solutions greater than 2% (1 molar), or if high splash potential exists. Not all gloves provide adequate protection against HF; high quality gloves made from butyl or neoprene rubber are recommended. Two pairs of gloves are recommended when working with concentrations exceeding 20% or when heavy exposure to gloves is expected. Always check gloves for leaks prior to use.

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The purpose for personal protective equipment (PPE) is to shield the individual in the event of a release of vapor, a spill or other incident. PPE is not a substitute for safe work practices. Although accidents involving HF may not be totally eliminated, pre-planning will minimize the effects of such incidents. All laboratories that store or use HF should develop standard operating procedures that outline how to safely use HF, as well as how to respond to personnel contamination and HF spills. See section F for general guidelines to use when developing a laboratory specific SOP.

E. HF EXPOSURES

Although HF exposures can result in injury, quick response will minimize the damage. All exposures should be treated immediately even though burns may not be felt for hours. Commercially available HF first aid and spill response kits shall be standard equipment in laboratories that use or store HF. Affected personnel must receive medical attention for all eye and inhalation exposures, and all but the most minor skin burns. Maintain a copy of these procedures and MSDS to take to the emergency room or doctor's office.

Skin Contact – Immediately wash all affected areas with water. Be sure to remove any clothing or jewelry that could trap HF (remove goggles last). Flush skin for fifteen minutes or until medical attention is available. Flushing can be reduced to five minutes if calcium gluconate gel (2.5%) is immediately available. Apply calcium gluconate gel to the affected area (use rubber gloves) every fifteen minutes and massage continuously. Get medical attention.

Calcium gluconate gel, manufactured by Anachemia Science, can be purchased from a number of different sources (see references). The price is approximately \$35 per tube. (Note: It is recommended that individuals who frequently work with HF keep a tube at home as the symptoms of HF exposure are often delayed.)

Eye Contact – Immediately flush eyes for at least fifteen minutes with water while holding eyelids open. Get medical attention. Flushing can be limited to five minutes if medical personnel are immediately available to administer sterile calcium gluconate (1%) solution (via continuous drip into eyes).

Inhalation – Move to fresh air as soon as possible. Get medical attention. Medical personnel can administer pure oxygen and calcium gluconate (via nebulizer) to patient. Laboratory personnel should only attempt to clean up small HF spills that do not involve personnel contamination and that are contained and under control. Be sure that good ventilation is available and that personal protective equipment is worn before attempting to clean up a HF spill.

F. 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. 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 should be posted to alert people that work with Hydrofluoric Acid is in progress.
3. All persons who will be using Hydrofluoric Acid must be made aware of its properties and trained in proper procedures for use and disposal.
4. Laboratories which keep or use Hydrofluoric Acid gas or concentrated solutions (>1% Hydrofluoric Acid) should have these emergency procedures on hand as well as an MSDS.

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5. Laboratories which keep or use Hydrofluoric Acid gas or concentrated solutions (>1% Hydrofluoric Acid) must have an operational safety shower and eyewash in their laboratory. Before beginning any procedure involving Hydrofluoric Acid, make sure the access to the emergency shower and eyewash is unobstructed.
6. Hourly employees should never be given the task of mixing Hydrofluoric Acid solutions. Only experienced persons familiar with its properties should handle the concentrated acid.
7. A small supply of calcium carbonate or calcium hydroxide for spills should also be kept near the hood where the work will be conducted. 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. Call EHS to dispose of the residue ext. 7329. If a larger amount is spilled, or the acid is concentrated, contain the spill as best you can, evacuate the area, and call 911. Avoid exposure to the vapors.
8. Dispose of unwanted hydrofluoric acid by completing a request for waste disposal and submitting it to EH&S.
9. Always use the appropriate PPE and engineering controls when working with hydrofluoric acid or >1% HF solutions. (See section D for additional information.)
10. Any exposure to Hydrofluoric Acid must be medically evaluated.

References:

http://www.pp.pdx.edu/FAC/Safety/Hydrofluoric_Acid_Safety.htm

Honeywell HF Information <http://www.hfacid.com/>

CHAS article on first aid unique to HF <http://www.adpub.com/ctimes/features3/Hydrofluoric.cfm>

Calcium gluconate gel distributors

Attard Minerals, <http://www.attminerals.com/>
Fisher Scientific, <https://www1.fishersci.com/>
Lab Safety Supply, <http://www.lifesafety.com/>

HF Spill Kits

Fisher Scientific, <https://www1.fishersci.com/>
Lab Safety Supply, <https://www.labsafety.com>
VWR, <http://www.vwrsp.com/>

HF First Aid Kits

Lab Safety Supply, <https://www.labsafety.com>