Hydrofluoric Acid Use Handling and Emergency Response

http://en.wikipedia.org/wiki/Hydrofluoric_acid

Common Names
Hydrogen fluoride, hydrofluoric acid, HF, fluoric acid, fluorine monohydride

CAS Number
7664-39-3

Common Uses
HF is used to etch glass, manufacture semiconductors and electrical components, dissolve sedimentary rock, remove rust, as well as in biological staining procedures.

Routes of Exposure
Ingestion, inhalation, dermal and eye exposure.

Exposure Limit
Ceiling exposure value: 3 ppm, as per Ont. Reg. 833

Physical Characteristics
HF is a clear colourless liquid often transported as a compressed gas. Concentrated solutions and anhydrous forms produce sharp and pungent fumes when exposed to air. Solutions of less than 40% HF do not produce significant vapours and have the appearance of water.
Toxicology/Toxicity

CONCENTRATED HF MAY CAUSE SEVERE BURNS, METABOLIC IMBALANCES, PULMONARY EDEMA AND POTENTIALLY FATAL CARDIAC ARRYTHMIAS.

 HF is an extremely corrosive acid which may result in serious burns to the eyes, skin and mucous membranes. The toxicity of HF is based both on the ready penetration of the fluoride ion into the skin as well as on its reaction with calcium stores in the body. Resultant hypocalcemia may be fatal. Reaction with the body’s magnesium stores is also expected to occur.

Exposure to HF may result in extreme respiratory irritation, immediate and severe eye damage and pulmonary edema. Exposure of the skin, eyes or lung to concentrated HF (greater than 50%) will cause immediate, severe and penetrating burns, however exposure to dilute solutions may also have serious effects with the appearance of symptoms not arising for up to 24 hours after the exposure.

Safe Handling and Use Procedures:

Personal Protective Equipment:
Required PPE includes:

- Safety goggles
- Gloves: Nitrile, neoprene or other HF resistant material
- Lab coat
- Apron: Nitrile, neoprene or other HF resistant material
- Long pants
- Closed-toed, closed-heeled shoes

Handling and Storage Requirements:
Lab supervisors are responsible for ensuring that all personnel working with or near HF are trained in its hazards and the corresponding emergency response procedures.

- Prepare a plan of the work to be performed.
- Ensure that no work with HF is performed when working alone.
- Ensure that emergency response procedures and the material safety data sheet are available at all times.
- Before beginning any work with HF ensure that the paths to the eyewash station and emergency shower are unobstructed and that these pieces of emergency equipment are operational.
- Ensure that calcium gluconate gel is readily accessible and that the gel has not reached its expiration date.
• Ensure that there is sufficient calcium carbonate for the clean-up of a spill of all of the HF in the lab.
• Ensure that all use and handling of HF is performed in a chemical fumehood.
• Ensure that all waste (including spill clean-up materials) is disposed of according to the University of Guelph’s hazardous waste disposal procedures.

Emergency Response Procedures

HF First Aid Supplies
The following items are to be maintained and readily accessible to applicable lab personnel for first response to HF exposure:

• Tube of 2.5% calcium gluconate gel
• Calcium carbonate tablets (i.e. Tums)
• Gloves: nitrile, neoprene or other HF resistant material
• Triangular bandages for wet compresses
• Gauze for compression dressings
• Copy of MSDS for reference and for emergency responders
• Copy of this standard

Treatment for Exposure

Skin Contact
Immediately upon exposure to the skin:

1. Flush exposed area with copious amounts of water while removing contaminated clothing. Note that flushing under the tap is acceptable if the exposed area is easily accessible, otherwise the emergency shower is to be used.
2. While flushing, emergency personnel are to be contacted at x2000.
3. Continue flushing area until 2.5 % calcium gluconate gel is available for application.
4. Apply 2.5% calcium gluconate gel every 15 minutes and massage continuously into the affected area.
5. Continue massaging in 2.5% calcium gluconate while transporting the injured person to the hospital emergency room. Ensure that the person applying the calcium gluconate gel wears neoprene or nitrile gloves.

_Treatment information for medical personnel:_ It may be necessary to infiltrate around the affected area with 5% aqueous calcium gluconate using a small-gauge needle ensuring that not more than 0.5 ml per cm² of burned skin is applied and that the appearance of the skin is not distorted. Pain is indicative of whether or not the treatment is being successful and hence local anaesthetics are not recommended. In
some cases it may be necessary to surgically remove damaged tissue and then apply 5% aqueous calcium gluconate. It is recommended that persons with HF burns covering more than 52 cm² (8 sq in) be admitted to intensive care and monitored for 24 to 48 hours. Serum calcium, magnesium and potassium levels should be monitored. The Q-T interval should be observed for signs of hypocalcemia (indicated by a prolonged Q-T interval). Large surface area burns may require massive intravenous calcium infusions.

Nail Burns
1. Irrigate with water.
2. Add calcium gluconate gel to the inside of the fingertips of a glove and have the injured party put the glove on the affected hand, immersing the fingertips in the calcium gluconate gel.

*Treatment information for medical personnel:* Treatment of nail burns may introduce unique problems in that the fluoride ion can penetrate the nail, but may prevent soaks in calcium gluconate from being effective. It may be necessary to split the nail or drill 2-3 holes in the nail using a large gauge needle. Soaking in the 23% calcium gluconate should be continued. If pain does not subside, the nail should be removed and the nail bed massaged with 1.5% calcium gluconate gel. Infiltration of 5% aqueous calcium gluconate using a small gauge needle must only be done in the case of a severe burn due to the risk of obstruction of the microcirculation.

Eye Contact
Immediate response is necessary to prevent permanent damage to the eyes.

1. Flush immediately with water using the eyewash station for at least 15 minutes while holding eyelids open.
2. While flushing, emergency response personnel are to be contacted at x2000.
3. If 1% aqueous calcium gluconate is available, flushing of the eye may be limited to 5 minutes followed by intermittent irrigation with the 1% aqueous calcium gluconate for 20 minutes. Do not use treatments used for skin burns.
4. Transport injured person to the hospital emergency room for further treatment.

*Treatment information for medical personnel:* It is recommended that the eye(s) be irrigated with 1% aqueous calcium gluconate every 2-4 hours for the next 2-3 days.

Inhalation
1. If safe to do so move injured person to fresh air.
2. Contact emergency response personnel at x2000.
3. Keep injured person warm, quiet and comfortable.
4. Transport injured person to the hospital emergency room for further treatment.

*Treatment information for medical personnel:* 100% oxygen should be administered as soon as possible. A nebulised solution of 2.5% aqueous calcium gluconate given by nebuliser may also be administered with 100% oxygen or with intermittent positive pressure. Patients should be continuously monitored for edema of the upper airway. Respiratory obstruction may occur requiring a tracheotomy. Intubation should be avoided if possible. Inhalation of HF may also cause bronchospasm and therefore inhaled, oral or parenteral bronchodilators should be administered as required. Pulmonary function testing may assist in assessment of the degree and progress of the injury.

**Ingestion**
1. Do not induce vomiting, give emetics or baking soda.
2. Have injured person drink several glasses of water or milk to dilute the acid.
3. Have injured person take up to 30 calcium carbonate tablets with water.
5. Transport injured person to the hospital, emergency room for further treatment.

*Treatment information for medical personnel:* Lavage of the stomach with a solution of calcium containing antacid may be effective. Due to the corrosive effects, passage of the lavage tube must be done with extreme care. Corrosive effects are similar to other strong acids. Systemic toxicity is to be expected and will require aggressive treatment.

**Spill**

**Additional Spill Kit Supplies**
In addition to standard chemical spill kit supplies, the following should be maintained in the event of an HF spill:

- Calcium carbonate or
- Commercial HF spill kit
Spill Response Procedures

- Ensure protective clothing including an appropriate respirator is worn and that the HF antidote is readily available.
- Slowly apply solid calcium carbonate working from the outside in.
- After the acid is absorbed, mix thoroughly with plastic scoop to ensure neutralization.
- Use pH paper to test completeness of neutralization.
- Add more neutralizer if necessary.
- Once absorbed and neutralized, transfer to garbage bags or plastic container using scoop and/or dust pan if necessary.
- Label bag appropriately with hazardous waste disposal tag and complete hazardous waste disposal form.

References

Honeywell Hydrofluoric Acid – Recommended Medical Treatment for Hydrofluoric Acid Exposure, August 2006.

McMaster University Hydrogen Fluoride Emergency Protocol,