

Safe Use of Hydrofluoric Acid and soluble Fluorides

Health & Safety Department



WARWICK

What is Hydrofluoric Acid?



- Hydrofluoric Acid (HF) is a weak inorganic acid
- Used primarily in industrial processes
 - Glass etching
 - Metal and ceramic cleaning
 - Electronics manufacturing
- Properties
 - Clear, colourless and highly corrosive liquid
 - Miscible in water
 - Acrid, irritating odour
 - EH40 Exposure limit 1.8 ppm



HF - Chemical Properties

- HF will react with concrete, enamels, glazes, rubber and many organic compounds
- In reactions with metals, HF generates hydrogen gas which can pose an explosion hazard
- In reactions with concrete, HF generates silicon tetrafluoride, itself a toxic, corrosive gas

HF - Hazards

- Poison 
- Extremely corrosive liquid and vapour 
- Severe injury
 - Skin or eye contact – readily absorbed
 - Inhalation
 - Ingestion
- Amputation or death if untreated

HF - Health Effects

- **Skin Contact**
 - Tissue destruction, necrosis, hypocalcemia, hyperkalemia, hypomagnesia
- **Eye Contact**
 - Severe burns, cornea destruction, blindness
- **Ingestion**
 - Severe burns to the mouth, oesophagus and stomach
- **Inhalation**
 - Coughing, choking, bronchospasms, acute pulmonary edema

HF - Toxicity

- Upon skin contact, HF readily penetrates through the skin and forms insoluble salts with calcium and magnesium
- Soluble salts are also formed but dissociate rapidly, releasing fluoride ions which cause deep tissue destruction.
- Pain is believed to result from nerve irritation caused by the influx of potassium ions compensating for the depletion of calcium ions.

HF- Symptom Onset

- Concentrations

> 50 % solutions lead to immediate, severe burning pain with blisters

20 – 50 % solutions lead to redness, swelling, and blistering after 8 hours

< 20 % solutions may not produce symptoms for up to 24 hours

HF - Safe Working Practices

- Prior to use of HF, all users must familiarize themselves with the MSDS, standard operating procedures, emergency response and first aid
- All users must pass a test and be assessed for practical competence
- Follow the Operator-Observer (O-O) system
- Lone working or after hours work with HF is not permitted. Undergraduates not permitted!
- All work must take place in a dedicated HF workstation

HF - Safe Work Practices

- Each container of HF shall be clearly labelled
- HF shall only be stored in polyethylene or Teflon containers
- Secondary containers must also be compatible with HF (e.g. no glass, metal)
- HF containers shall be tightly-sealed when not in use and kept away from glassware

HF - PPE

- **Eyes** - Full-face shield to EN 166 B3 or better
- **Hands** - Medium or heavyweight Neoprene ® or MAPA Trionic E194 gloves used over disposable nitrile gloves
- **Body** - HF resistant full length long sleeved smock, HF resistant boots
- **Mask** - HF nuisance mask (for example 3M 9906)

HF - First Aid (1)

- **Skin Contact**

- Immediately move to nearest wash station/eyewash and rinse with Hexafluorine ®
- While rinsing, remove contaminated clothing
- Have someone else in the lab call 22222 for emergency medical assistance
- Continue rinsing with Hexafluorine ® for 5 minutes
- Apply calcium gluconate gel to the affected area using clean gloves

HF - First Aid (2)

- **Eye Contact**

- Immediately flush eyes with Hexafluorine and continue with water for up to 15 minutes
- While flushing eyes, have someone from the lab call 22222 for emergency medical assistance

- **Ingestion**

- Immediately drink large amounts of water to dilute the acid
- Call 22222 for emergency medical assistance
- Do NOT induce vomiting
- If available, milk, chewable calcium carbonate tablets or Milk of Magnesia should be administered

HF - First Aid (3)

- **Inhalation**

- Move the affected person to fresh air
- Call 22222 for emergency assistance, requesting an ambulance
- Keep affected person warm and comfortable
- If breathing stops, begin CPR
- Oxygen should be administered as soon as emergency medical personnel arrive

HF – Spills (1)

- **Inside the workstation:**
 - Work with the sash as low as practical
 - Neutralise the spill (MgO , CaCO_3 , Ca(OH)_2)
 - Sluice away with water, use 100 x excess
 - Continue to sluice to ensure no residues in workstation or sink trap

HF – Spills (2)

- **Outside the workstation – < 100 mLs:**
 - Evacuate non-essential staff from area
 - Fit PPE (HF nuisance mask, gloves, face shield)
 - Control and absorb spill using Spill-X-A
 - Allow time to absorb
 - Collect contaminated material and dispose of as hazardous waste, clearly labelled “HF Waste”
 - Report incident to Health & Safety office

HF – Spills (3)

- **Outside the workstation – > 100 mLs:**
 - Evacuate immediate area, take hexafluorine and calcium gluconate gel if required
 - Sound fire alarm and evacuate building
 - Report incident to senior member of staff
 - Ensure Security Staff are informed about HF spill and location before entering building

HF - Disposal

- Place HF and HF contaminated waste in tightly-sealed plastic containers
- Label HF waste containers with the words “Hazardous Waste” and “Hydrofluoric Acid”
- Submit a chemical waste pick-up request