SCOPE

This Information Sheet provides generic information and advice for developing and implementing Safe Working Procedures for staff, students, contractors and visitors working at Curtin University who are required to handle Hydrofluoric Acid (HF) or solutions containing HF.

Introduction

HF is an extremely corrosive and toxic acid which has many uses including mineral digestion, surface cleaning, etching and biological staining. HF has unique properties which make it significantly more hazardous than other more commonly used acids. Small amounts of HF on the skin can be fatal; therefore the risks associated with working with HF should be taken extremely seriously.

HAZARD SUMMARY

A permit is required from the Department of Health, WA for purchase and use of concentrated HF in laboratories. A solution of HF greater than 0.1% is regarded as hazardous (X n harmful) according to the ASCC criteria. More concentrated solutions of HF are progressively more hazardous with the most commonly available concentrations (30%-70%) being very corrosive (C+) and extremely toxic (T+).

Dangerous goods: HF is classified as a dangerous good by the criteria of the ADG code as a DG class 8 (corrosive substance) with subsidiary risk 6.1 (toxic substance). Concentrated HF is a schedule 7 poison.

Airborne (vapour) exposure limit: TWA 3 ppm.

Associated risk phrases:
R26/27/28: Very toxic by inhalation, in contact with skin and if swallowed.
R35: Causes severe burns.

Note: Highly concentrated HF will fume on contact with air.

HEALTH HAZARDS AND SYMPTOMS OF EXPOSURE

The health hazards of HF are dependent on concentration and type of exposure. Physiological damage progresses via two mechanisms; corrosive burns resulting from its acidic nature (hydrogen ions) and chemical reaction with calcium resulting from tissue penetration of fluoride ions. The combination resulting in decalcification and destruction of soft tissue and bone.

<table>
<thead>
<tr>
<th>Health Hazard</th>
<th>Description</th>
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<tbody>
<tr>
<td>Skin</td>
<td>HF is corrosive and readily destroys tissue. Skin exposure to concentrated HF immediately results in serious and painful destruction of tissue. As well as burns, systemic fluoride poisoning (decalcification and necrosis of bone) may result. As little as a 2% body burn from 70% HF may cause death. Skin contact at lower concentrations (typically &lt;20%) may not produce pain or burning or any visible signs until hours after exposure, however severe delayed tissue damage is still possible. All skin or eye contact with HF should be immediately reported for medical evaluation.</td>
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<tr>
<td>Eye</td>
<td>Exposure to the eyes may result in severe pain, spasm of the eyelids, corneal damage resulting in blindness or permanent eye damage.</td>
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<tr>
<td>Inhalation</td>
<td>Inhalation of HF vapour can seriously damage the lungs. Delayed reactions are also possible. HF is a colourless liquid with a strong irritating odour at low concentrations. Airborne concentrations of up to 15 ppm will irritate the eyes, skin and respiratory tract. Thirty ppm is considered dangerous to life and may cause irreversible health effects while exposure to above 50 ppm may be fatal.</td>
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<tr>
<td>Ingestion</td>
<td>Severe exposure may lead to breathing difficulties, muscle spasms, convulsions, nausea, vomiting and death.</td>
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<tr>
<td>Chronic</td>
<td>Skin ulcers, fluorosis (symptoms; weight loss, bone and teeth embrittlement and anaemia) and general ill health</td>
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# RISK MANAGEMENT

All work with HF requires the approval of the Head of School/Division. The *Occupational Health and Safety (Hazardous Substances) Regulations 1996* require that a current SDS be obtained that all staff and students complete and document a full chemical risk assessment in consultation with their supervisors. Safe working procedures and emergency procedures must be developed prior to work commencing.

## Hazard Control

Control measures must be put in place to minimise exposure to HF. A thorough examination of work processes is essential. If in doubt seek expert assistance.

## Elimination

Elimination of HF operations should be the first element of the hierarchy of controls considered.

## Substitution

In some cases substitution can be achieved using a less aggressive chemical. Great care must be taken if another fluorine containing compound is used as in the process HF may be generated (e.g., bifluorides). Thoroughly review the SDS of all fluorine containing compounds prior to use. Consider purchasing HF in less concentrated form so as to avoid handling the concentrated acid.

## Engineering

Engineering controls must be in place to ensure that recommended exposure standards are not exceeded.

1. All ventilation systems must be correctly installed, maintained and fit for purpose. All operations with HF must be done in an appropriate fume cupboard preferably with a scrubber system.
2. Have a dedicated fume cupboard for HF work.
3. Restrict access to areas where HF is in use.
4. Provide appropriate signage indicating HF in use.
5. Eyewash stations, emergency showers and hand washing facilities must be available in each work area. Regular maintenance of these facilities is essential.

## Administrative

1. Ensure that personnel are thoroughly trained and familiar with the properties and hazards of HF. Training records must be kept.
2. Conduct a risk assessment for the intended use of HF.
3. Develop and follow safe working procedures.
4. Train personnel in safe procedures, personnel protection, first aid and emergency procedures.
5. Purchase HF in minimum quantities. The maximum container size purchased should not exceed 500ml so as to minimise the need to decant. Most 500ml containers have an applicator designed to reduce flow when pouring. Ensure containers are in good condition.
6. Do not work alone or after hours when handling HF. Have a buddy system in place. Make sure that all normal assistance services are in place (e.g., supervisor, first aiders, emergency service).
7. Solutions containing HF must not be stored in glass containers. Store HF in polyethylene of Teflon containers.
8. All HF solutions must be appropriately labelled.
9. Labelled waste containers for the safe disposal of HF solutions must be provided.
10. Systems need to be put in place to manage the area in case of power failure or fume cupboard malfunction.

## Personal Protective Equipment (PPE)

Appropriate personnel protective equipment must be provided and used when working with HF. PPE must be appropriately selected, individually fitted and workers trained in correct use and maintenance:

<table>
<thead>
<tr>
<th>Face</th>
<th>Safety glasses in combination with a face shield.</th>
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<tr>
<td>Hands</td>
<td>Double gloving is advised. Use of an outer PVC or neoprene/natural rubber blend, together with an inner nitrile surgical/examination glove, is recommended. This combination enables ease of removal and avoids hand contamination. Gloves should be disposed of after use.</td>
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<tr>
<td>Body</td>
<td>PVC apron complete with sleeve protection.</td>
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**Feet**

Fully enclosed leather or rubber shoes must be worn to protect the feet.

**Note:** Contaminated PPE and clothing should be neutralised and disposed of.

**Storage**

The requirements for storage are outlined in AS/NZS 4452:1997, *Storage and handling of toxic substances* and the conditions of the Poisons Permit.

1. HF must be stored in a secure (locked), cool, dry, well ventilated area.

2. Containers should be stored close to ground level in a chemically resistant tray (bund). Retention measures must be in place to contain any spilt HF.

3. HF should be stored separately from other acids to avoid confusion or mistaken selection.

4. Dangerous goods segregation rules should be strictly observed. Separate from oxidising agents, alkalis, acids, metals, silica, ceramics, organic materials, heat sources and food stuffs.

5. Store all HF and HF waste in well labelled chemically compatible containers.

6. HF containers should be transported in high wall plastic trays so as to contain any accidental spillage.

**Spill Containment**

Due to the volatile nature of HF the greatest caution should be used when dealing with a spill. HF will produce highly toxic and dangerous gases on contact with ceramic surfaces, concrete and road surfaces. Do not use kitty litter or sand.

1. Where there is any spill outside of an area where there is adequate ventilation (ie a fume hood), evacuate the area. Prevent others from entering the area. Dial 5 to report the spill.

2. A small spill inside a fume hood should be managed by a competent person.

3. PPE requirements as above.

4. A comprehensive spill kit should be available in the work area.

5. The contents of the spill kit should be carefully researched so that it is fit for purpose. Workers must be trained in spill management.

6. If it can be contained a small spill can be diluted and then neutralised with limestone. Saturated sodium bicarbonate can also be used but calcium carbonate is preferred as it will react with the HF to form insoluble calcium fluoride which is insoluble and can be disposed of more easily.

**EMERGENCY MANAGEMENT**

All workers with HF must be made aware of Curtin University of Technology emergency procedures. (Dial 5). Any incident that involves contact with HF must be regarded as a medical emergency. Urgent first aid is extremely important, even for minor exposure. Australian Standard AS 2243 requires that calcium gluconate gel (in date) is immediately available within easy reach. No first aid should be administered if there is the possibility of contamination. Prevent further contamination of injured person or rescuer. Wear the appropriate PPE.

**Skin Contact**

Seek urgent medical attention. Prompt decontamination is essential.

1. Drench with water to wash off all acid.

2. Remove contaminated clothing etc as soon as possible. Place in labelled plastic bag for further treatment.

3. Continue to drench affected areas.

4. Apply calcium gluconate gel on and around affected area (wear gloves).

5. Continue to apply gel until expert medical treatment is available.

6. The calcium gluconate gel and SDS should accompany patient to hospital.

**Eye Contact**

Seek urgent medical attention. Consult an eye specialist.

1. Remove contact lenses.

2. Flood eye with gently running water for at least 15 minutes, ensuring that the flow of water does not contaminate the unaffected eye.

3. Continue flushing with water or isotonic saline during transport.

4. Sterile 1% calcium gluconate solution may be used in eyes under medical supervision.
Ingestion
Seek urgent medical attention.
1. Do not induce vomiting. Vomited material should be regarded as contaminated.
2. If conscious rinse mouth out with water. Give water to drink to dilute acid.
3. If conscious and able to drink give small amounts of milk or calcium containing antacid.

Inhalation
Dial 5. Do not enter contaminated area.
1. Rescuers should wear respiratory apparatus.
2. Remove affected person to fresh air.
3. Oxygen can be administered by a trained person.
4. Seek urgent medical assistance.
5. Medical attention must be sought even if there are no symptoms.

POWER FAILURE OR FUME HOOD FAILURE
In the event that the there is a malfunction of the fume cupboard it is vitally important to make the workplace safe. Do not enter an area where HF operations are taking place if there has been a power failure or fume cupboard alarms are operating.
1. Cease all HF operations, decanting etc
2. Switch off electrical devices.
3. Lower the fume cupboard sash.
4. Exit the laboratory.
5. Evacuate the immediate area.
7. Report the fault to management.

HF INFORMATION PACK
As part of safe working procedures is it is highly advisable to have an HF Information Pack available for emergency personnel and medical practitioners. It is recommended that the information pack contains:
- A copy of the Risk Assessment;
- A copy of the SDS; and

HF CHECKLIST
Below is a checklist to be used prior to starting work with HF.
- Risk assessment completed for the use of HF and operational procedures.
- Full review of Emergency Procedures.
- Fume Cupboard for HF work is in full working order. Check:
  - Power
  - Extraction
  - Sash operability
- Emergency shower and eye wash are immediately accessible and in full working order.
- Signage is clearly visible to all building occupants, highlighting the use of HF in the laboratory and emergency contacts listed.
- Spill Kit is available.
- Calcium gluconate gel is available and in date.
- The HF container is sound and the pouring mechanism is suitable for use.
- Full PPE is available for both the operator and buddy. All personnel trained in the use of PPE.
- The HF information pack is complete and available in case of an incident.

References