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Hydrofluoric acid (HF) is an extremely corrosive acid used for many purposes including mineral digestion, surface cleaning, etching, and biological staining. HF's unique properties make it significantly more hazardous than many of the other acids used on campus.

This TIPS Sheet discusses how to protect yourself against the dangers of HF. You will also find emergency procedures for dealing with HF exposures.

Please post these procedures wherever HF is used or handled.

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FATALITY DUE TO ACUTE HYDROFLUORIC ACID EXPOSURE

A fatal accident occurred in an Australian factory in 1995, resulting in the death of a technician. The technician was seated when he knocked over a small quantity (between 100 and 230 ml) of hydrofluoric acid (HF) onto his lap, splashing both thighs.

The technician sustained burns to 9% of his body, despite washing his legs with water at 6 liters/min. No calcium gluconate gel was applied to the affected area and contaminated clothing was not removed during the flushing process. His right leg was amputated 7-days after the incident. He subsequently died from multiple-organ failures 15 days after the spill.

The incident investigation showed that this death could have been prevented if appropriate emergency procedures, safety equipment and personal protective equipment had been

Hydrofluoric Acid

available during the handling of the hydrofluoric acid.

HEALTH HAZARDS

The health hazards of HF depend upon the type of exposure and the concentration.

EYE AND SKIN EXPOSURE

HF is corrosive and readily destroys tissue. HF exposure to the eyes may result in blindness or permanent eye damage. HF readily penetrates human skin, allowing it to destroy soft tissues and decalcify bone. Chemical burns from HF are typically very painful and are slow to heal. Skin exposure to highly concentrated HF (~ 50% or greater) immediately results in **serious and painful destruction of tissue**.

If the exposure covers a large amount of skin surface area, excessive amounts of calcium can be inactivated leading to **systemic fluoride poisoning**, hypocalcaemia, and hypomagnesaemia. **Heart function is diminished in hypocalcaemia** (reduced calcium levels in the blood), whereby the heartbeat becomes abnormal, and cardiac arrhythmia (ventricular fibrillation) can occur. **Liver and kidney damage may also occur in high exposure conditions**. Hypomagnesaemia leads to neuromuscular hyperirritability (a pathological response of muscles and nerves to slight stimuli).

One of HF's **most insidious properties** is that skin contact at lower concentrations may not produce pain or burning sensations **until hours after the exposure**. Because of the ability of HF to produce delayed serious tissue damage without necessarily producing pain, **all skin, eye, or tissue contact with HF should receive IMMEDIATE first aid and medical evaluation even if the injury appears minor or no pain is felt**.

INHALATION OF HF VAPOR

Inhaling HF vapors can seriously damage the lungs. Delayed reactions up to and including fatal pulmonary edema (flooding of the lungs with body fluids) may not be apparent for hours after the initial exposure. The Washington

Industrial Safety Health Administration (WISHA) limits employees' exposure to airborne concentrations of HF to 3 parts

per million (ppm) ceiling limit that should not be exceeded at any time. Airborne concentrations of 10-15 ppm will irritate the eyes, skin, and respiratory tract. A concentration of 30 ppm is considered **"Immediately Dangerous to Life and Health"** (IDLH) and may have irreversible health effects. At airborne concentrations above 50 ppm, even brief exposure may be fatal.

CHRONIC HF EXPOSURE

Long-term or chronic exposure to HF may result in fluorosis, a syndrome characterized by weight loss, bone embrittlement, anemia, and general ill health.

SAFETY PRECAUTIONS FOR HF USE

EMPLOYEE INFORMATION AND TRAINING

Employees who handle HF must receive documented training on the hazards of HF and what to do in the event of an exposure or a spill. A Material Safety Data Sheet (MSDS) on HF should always be kept in the immediate work area where HF is used. The MSDS together with this TIPS Sheet are an excellent basis for training employees on the hazards of HF. Periodic refresher training should be provided, including procedures to follow in an emergency and where to find the calcium gluconate gel. EH&S can offer assistance in providing this training. Please call 543-7201 for further information.

SAFE WORK PRACTICES

If possible, avoid working alone when you're using HF. Do not eat, smoke, or drink where HF is handled, since the chemical can be swallowed. Wash hands thoroughly after handling HF. Refer to your lab standard operating procedures for more information.

STORAGE

Store all HF and HF waste in labeled chemically compatible containers (e.g., polyethylene or Teflon™). **Glass, metal, and ceramic containers are NOT compatible with HF**. HF should never be stored with incompatible chemicals such as ammonia or other alkaline materials. Always place HF on a low protected shelf or other location where it will not be accidentally spilled or knocked over.

WASTE

HF waste should be placed in a labeled chemically compatible container with a **screw cap** lid. Complete a Hazardous Waste Collection Form, and send it to EH&S Box 354110 or fax it to 206-685-2915.

Call EH&S 206-616-5835 if you need waste labels or forms or have any questions regarding the disposal of HF waste. See the EH&S web site for more information on waste disposal <http://www.ehs.washington.edu/epowaste/chemwaste.shtm>.

RESPIRATORY PROTECTION

HF should be used with adequate ventilation to minimize inhalation of vapor. Concentrations greater than 5% should always be handled inside a properly functioning chemical fume hood. EH&S can evaluate work practices and monitor air-borne levels of HF, call 206-543-7388.

EYE PROTECTION

Always use chemical goggles together with a face shield when handling concentrated HF. Due to HF's highly corrosive nature, safety glasses with side shields do not provide adequate eye protection.

BODY PROTECTION

Wear a laboratory coat with a chemical splash apron made out of natural rubber, neoprene, or viton. Never wear shorts or open-toed shoes when handling HF.

HAND PROTECTION

Typically, a 22 mil. gauge viton or nitrile gloves are worn when working with HF. **Always consult the manufacturer's glove selection guide when selecting a glove for HF. Do NOT use latex exam gloves, as they are not effective against HF.** If you have any questions about selecting a glove to use for handling HF, contact an industrial hygienist from EH&S at 206-543-7388. Double gloving is recommended in case of leaks. Gloves that have not been contaminated with HF may be disposed of in the common trash. If gloves become contaminated with HF, remove them immediately, thoroughly wash your hands, and check your hands for any sign of contamination. (Remember that contact with diluted HF solutions may not exhibit any pain for some hours after contact). Contaminated gloves must be disposed of as HF waste.

EMERGENCY RESPONSE

Since HF is corrosive and rapidly damages tissue, WISHA requires access to an eyewash and safety shower.

SKIN CONTACT/SAFETY SHOWER

Spills of HF shall be flushed for a **maximum of 5 minutes**. This chemical is so aggressive in its attack on skin and bone that the most important response is **to apply a calcium gluconate gel antidote as soon as possible**. Remove contaminated clothing **immediately** (wear manufacturer recommended protective gloves when handling contaminated clothing). After 5 minutes in the safety shower, treatment of the skin with **calcium gluconate gel should be initiated and continued**, using manufacturer recommended gloved hands, while awaiting medical emergency treatment. White specks appearing around the contaminated area indicate that the desired reaction has taken place. (If cloudiness or separation occurs, then the gel must be re-applied.)

FIRST AID TREATMENT - CALCIUM GLUCONATE GEL

Calcium gluconate gel is a topical antidote for HF skin exposure. Calcium gluconate works by combining with HF to form insoluble calcium fluoride, thus preventing the extraction of calcium from tissues and bones and the resulting burns. Keep calcium gluconate gel nearby, whenever you're working with HF. Use disposable clean nitrile gloves to apply calcium gluconate gel. **EVEN AFTER APPLYING CALCIUM GLUCONATE, IT IS ESSENTIAL THAT YOU SEE A PHYSICIAN RIGHT AWAY.**

EYE CONTACT/EYEWASH

The eyewash should be used for **15 minutes**. **Do not** place calcium gluconate gel in the eyes. **SEEK IMMEDIATE MEDICAL ATTENTION.**

TO EXPEDITE THE EMERGENCY RESPONSE PROCESS, IT IS VERY IMPORTANT THAT:

- Refer to **EMERGENCY FIRST AID PROCEDURES** (for a color laminated copy of these procedures, call 543-0467)
- Take this **TIPS sheet and the MSDS to the ER (Harborview, when possible)**.
- **ER personnel call the Poison Control for further assistance.**

ER STAFF INSTRUCTIONS FOR TREATMENT OF EYE EXPOSURE TO HYDROFLUORIC ACID

1. Flush affected eye(s) with copious amounts of tap water for 5 minutes, if not already done.
2. Immediately start continuous drip to affected eye(s), using a (no stronger than) 1%* calcium gluconate (CG) solution.
* To make a 1% solution, add six standard ampoules of CG for injection (4.5 mEq in 10 mL) to each 500 mL of sterile Normal Saline.
3. No gels, ointments or oils should be used in the eye.
4. Consult immediately with an ophthalmologist.
5. Ophthalmic corticosteroid solutions may be used to decrease inflammation.

HF SPILLS

If HF is spilled outside of a chemical hood, evacuate the area, close the doors, post the area with a sign to prevent others from entering, and call 911. Attend to injured as described above. If the incident occurs during regular work hours (Monday-Friday, 8 a.m.-5 p.m.), also call EH&S at 543-0467. Small spills of HF inside a chemical fume hood can be neutralized with sodium bicarbonate if the workers performing the cleanup have the correct equipment, understand the hazards, and know how to clean up the spill safely and dispose of the waste properly.

HOW TO ORDER CALCIUM GLUCONATE GEL

You can obtain an 8-oz. bottle of 3% calcium gluconate gel from Environmental Health & Safety, by calling **543-0467**. The cost is **\$48.00 (no tax)**. Please provide a budget name and number.

Calcium gluconate has a **6 months shelf life** and should be kept cool, and replaced with a fresh supply after its expiration date has passed. The Principal Investigator is responsible for ensuring the product is available in the lab at all times.

EH&S CAN HELP

EH&S is available to assist with questions and training. Please call **543-7388** for questions about the safe handling of HF.

EH&S TIPS

HYDROFLUORIC ACID - May 2000 - For questions or more information, call 206-543-7388.

For more EH&S TIPS, newsletters, and other health and safety information see our web site at www.ehs.washington.edu.



FIRST AID FOR HYDROFLUORIC ACID EXPOSURE



SEEK IMMEDIATE MEDICAL ATTENTION
CALL 911

**SERIOUS TISSUE DAMAGE
WITH DELAYED ONSET**

SKIN CONTACT

- **IMMEDIATELY** (within seconds) proceed to the **NEAREST SAFETY SHOWER** and wash affected area **FOR 5 MINUTES**.
- **REMOVE** all contaminated **CLOTHING** while in the shower.
- **WITH NITRILE DOUBLE-GLOVED HANDS MASSAGE CALCIUM GLUCONATE GEL** into the affected area. If calcium gluconate gel is **not available, wash area for at least 15 minutes** or until emergency medical assistance arrives.
- **RE-APPLY CALCIUM GLUCONATE GEL** and massage it into affected area **EVERY 15 MINUTES** until medical assistance arrives or pain disappears.



EYE CONTACT

- **IMMEDIATELY** (within seconds) proceed **TO THE NEAREST EYE-WASH STATION**.
- Thoroughly **WASH EYES WITH WATER FOR AT LEAST 15 MINUTES** while holding eyelids open.
- **DO NOT APPLY CALCIUM GLUCONATE GEL TO EYES**.



INHALATION

- **GET MEDICAL ASSISTANCE** by calling 911.