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Policy for Safe Use of Hydrofluoric Acid		
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PURPOSE: This policy establishes safe work procedures for personnel working with hydrofluoric acid (HF), a highly hazardous chemical. It outlines safe work practices and response in case of emergency to minimize health risks.

SCOPE: This policy covers all of the university campus, with a focus on the designated HF room in SRTC 465.

APPLICABILITY: This policy covers users of HF, the researchers whose work presents the highest potential for exposure, Facilities workers and first-responders to incidents involving HF releases.

INTRODUCTION

The hydrofluoric acid is a clear and colorless corrosive liquid. HF is also available as gaseous material. All forms of HF can cause severe burns to tissue, which makes its handling and use, especially hazardous. HF easily dissolves glass and can attack enamels, pottery, concrete, rubber, leather, many metals and organic compounds. Upon reaction with certain metals, explosive hydrogen gas may be formed. HF has many industrial applications but in an academic environment it is normally used in small quantities for fabrication of electronic components, etch glass, biological staining, mineral digestion, etc.

HF, though a weak acid, is physiologically a very potent chemical due to fluoride ions, which can bind with Calcium and Magnesium ions in the tissue. Concentrated HF, liquid or vapor, may cause severe burns, electrolyte imbalance, pulmonary edema and or life threatening cardiac arrhythmias. Even moderate exposure may rapidly progress to fatality if not treated promptly and properly. Symptoms of exposure may be delayed for several hours, therefore, immediate medical intervention; even in the absence of symptoms is necessary.

PROCEDURE

I. Working safely with HF

- **Chemical Fume Hood:** Always work with HF in a fume hood. **Before use, always check the fume hood is certified and working properly.** Procedures involving even small quantities of dilute HF solutions must not be performed on the lab bench. Avoid older fume hoods with soapstone work surfaces. Prevent contamination of the work surfaces by placing plastic trays or bench paper on the work surface before starting HF procedures. Make sure that you have turned the scrubber on before starting your work in the hood. Be sure to turn it off before leaving the room.
- **Gloves:** Working in a fume hood protects the worker from inhalation exposure, and, to a certain extent, splashes, but the hands are still vulnerable to HF exposure. HF readily penetrates skin and becomes trapped

under fingernails. Always double glove. Chloroprene gloves (minimum .6 mil thickness) should provide ample protection.

- **Body Protection:** When working with HF, wear clothing and personal protective equipment (PPE) that provides protection in the event of a spill: long-sleeved shirt, long pants, and closed shoes. Always wear a lab coat, chemical-resistant apron and sleeves. Do not wear shorts and sandals in laboratory.
- **Eye Protection:** Goggles, along with a face shield, should be worn when handling HF to prevent eye/face exposure.
- **Buddy System:** You must always work with a buddy when HF is being used. The buddy does not need to go through training if they are just an observer.

II. Limitations on the Use of HF:

Hydrofluoric acid is an extremely hazardous material. Lab personnel should work in the buddy system. NO ONE should work alone. For safety reasons the use of hydrofluoric acid by the University staff or students should preferably be limited to office hours (You must discuss change in procedures with your PI/supervisor). Only persons who have read and understood this document and who are suitably trained should be allowed to use this substance. Furthermore:

- Do not eat or drink where HF is handled or used.
- Wash hands thoroughly with soap and water after handling HF.
- Inform any first responder called to deal with an incident involving HF about the hazards associated with this substance.
- Provide (with appropriate protective gloves) a copy of this policy and SDS to the responder.

III. Emergency Measures During Exposure to Hydrofluoric Acid

Avoid all types of exposure to HF. Contact with even dilute HF solutions may not produce immediate pain, but may result in severe burns without immediate treatment.

If skin exposure occurs, remove contaminated clothing and immediately wash the affected area with copious amounts of water for at least 15 minutes. Have someone else call for medical assistance during this time. After washing the affected areas, apply calcium gluconate first aid gel (Calgonate). Calcium gluconate binds HF and prevents it from penetrating deeper into tissues. This is critical.

- **Inhalation:** Immediately remove victim to clean air until emergency personnel arrives on scene. Unlike external splashes, inhalation exposure is a serious medical emergency as it is more problematic because there are no immediate decontamination procedures. Keep person calm until medical help arrives.
- **Eye Exposure:** Immediately flush eyes for at least 15 minutes with copious amounts of water until emergency personnel arrive on scene.

ALL HYDROFLUORIC ACID EXPOSURES ARE A MEDICAL EMERGENCY! IMMEDIATELY CONTACT 911 AND CAMPUS SECURITY (503-725-4404) AND ARRANGE FOR IMMEDIATE MEDICAL TRANSPORT. A COPY OF THIS POLICY and SDS MUST BE GIVEN TO THE MEDICAL PERSONNEL.

IV. Waste disposal procedures and accidental releases.

Spent HF solutions are disposed of as hazardous waste through EHS. Drain disposal is not allowed. You must consult EHS at 503-725-4312 for disposal if you have any question.

V. Spill Management

All areas where HF is used must have proper spill control kit. Small spills can be neutralized by covering with acid neutralizer/sodium bicarbonate, and absorbed with spill control pads/absorbents. Once the spill is contained isolate the room and leave the area immediately. Call EHS for help. **PSU does not advocate for any lab personnel neutralizing acid spills.**

If it is a large spill immediately evacuate all persons in the area and close all doors. Any type of spill/accidental release of HF must be reported immediately to EHS during working hours at 503-725-4312 or 503-334-9705 after hours call the Public Safety at 503-725-4404.

VI. Incompatibles and Storage

Store HF in a cool and dry place away from incompatible materials separated from other chemicals. **NEVER STORE HF IN GLASS CONTAINERS!** Hydrofluoric acid reacts with many materials therefore avoid contact with glass, concrete, metals, water, oxidizers, reducers, alkalis, combustibles, organics and ceramics. HF must be stored in tightly closed containers made of polyethylene or fluorocarbon plastic, lead, or platinum. Secondary containment of polyethylene must also be used.

Protect containers from physical damage. Storage facilities should have adequate ventilation and constructed for containment and neutralization of spills. Handling and storage of HF requires special materials and technology for containers, pipes, valves, etc., which is available from suppliers. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

MEDICAL SURVEILANCE:

- Immediately wash the contaminated area with copious amount of water (for at least 15 minutes) then carefully apply calcium gluconate gel as per instructions of the manufacturer.
- Take injured person to the local area Hospital for further assessment and treatment by the medical personnel. It is recommended that the person be accompanied.
- If transport is not available an ambulance must be called; speed of treatment is of the essence.

Any Department working with HF must keep Calcium gluconate gel on-site. It is the responsibility of the PI to maintain an up-to-date stock. PI must inform employees about the presence and location of the gel, advise to use it and this policy before they allowed working.

DELAY IN FIRST AID OR MEDICAL TREATMENT OR IMPROPER MEDICAL TREATMENT WILL LIKELY RESULT IN GREATER DAMAGE OR MAY, IN SOME CASES, RESULT IN A FATAL OUTCOME.

INFORMATION AND TRAINING

- All personnel wishing to use the HF room must go through the EHS online training annually in order to renew badge/key pad access.
- A Safety Data Sheet (SDS) on HF and copy of this policy must always be kept in the immediate work area where HF is used.

RESPONSIBILITIES

- **PI**
 - Must ensure personnel are trained in the safe use of HF and this policy.
 - Require employees to work in a buddy system.
- **Facilities**
 - Check integrity of fume hoods periodically to ensure they are working properly.
 - Ensure their employees DO NOT work on fume hoods when they are in use.
 - Ensure employees responding to repair and emergencies are familiar about HF hazards and use appropriate PPE.
- **EHS**
 - Provide fume hood certification annually.

- Follow up on exposure or spill incidents
- Review and update this policy as necessary
- Provide training
- Ensure stocks of calcium gluconate are on hand in case of emergency.
- Ensure HF spill kit is present and workers know how to use in case of a spill.
- Coordinate with users for routine maintenance of fume hoods.

VII. ATTACHMENTS

ATTACHMENT A

Toxicological Properties of Hydrogen Fluoride

I. Properties of hydrogen fluoride. Hydrogen fluoride gas and hydrofluoric acid have nearly the same toxicological properties in living tissues/systems, and can be considered interchangeable; for the purposes of this section of the policy, the term “HF” will be used to denote either the gas or the liquid acid.

In aqueous solution, hydrofluoric acid is only a weak acid, having a $pK_a = 3$ (in contrast, HCl has a $pK_a = -8$, and perchloric acid has a $pK_a = -10$). In terms of acid strength (i.e., degree of dissociation in water), HF is similar to formic acid. HF does not dissociate strongly in water because HF molecules form hydrogen bonds with water molecules and because there is a large negative change in entropy when HF molecules react with water (less entropy = more order). Other hydrogen-halide molecules form only weak van der Waals forces with water molecules.

HF interacts corrosively with a wide variety of materials. This property makes HF both useful and hazardous. HF dissolves most metals, natural rubber, concrete, glass, fiberglass, ceramics and glazes. HF does not attack metallic Lead and Platinum, polyethylene, polypropylene, Teflon, Plexiglas (= acrylic), and wax.

Airborne concentrations of HF are difficult to detect precisely using direct-reading electronic instrumentation, and HF-specific test strips tend to have a large margin of error. However, HF has good warning properties, detectable by humans at concentrations as low as 0.04 ppm (the OSHA Permissible Exposure Limit (PEL) for HF is 3 ppm)

II. Toxicology of hydrogen fluoride. In the body, HF readily penetrates skin, corroding soft tissue and bone. Inhaled HF vapor/gas is corrosive to the respiratory system and can cause delayed pulmonary edema. Systemic HF poisoning removes Ca^{2+} from soft tissues and bones, creating a disturbance of Ca^{2+} concentrations (hypocalcaemia). Ca^{2+} regulation is critical for normal cell function, neural transmission, bone integrity, blood coagulation and intracellular signaling. Sudden death following acute HF exposure is common.

Use the utmost care in preventing exposure to even the most dilute HF solutions. Although exposure to concentrated HF solutions (>50%) will cause immediate pain, more dilute solutions (20% - 50%) may not cause any pain on contact and may go undetected for hours. Delays in first aid/treatment of HF exposure result in painful, slow-to-heal burns and systemic HF poisoning.

ATTACHMENT B

Policy for Handling and Treatment of Personnel Exposed to Hydrogen Fluoride

PURPOSE This policy ensures proper decontamination, emergency handling and treatment of personnel exposed to hydrogen fluoride (HF) at Portland State University.

APPLICABILITY: This policy covers all PSU personnel.

SCOPE Occupational exposure to hydrogen fluoride is a true medical emergency. Personnel exposed to HF liquid solution or condensed vapors must be decontaminated with copious amount of water (drenching for at least 15 minutes) to avoid secondary contamination. Rescuers should don proper personal protective equipment (PPE) before coming in contact with contaminated individuals and clothing.

PROCEDURE HF is a highly corrosive and odorous substance that can cause immediate or delayed severe injury. Systemic effects include cardiac arrhythmia and electrolyte abnormalities, which can lead to sudden death. Inhalation of HF vapors can cause respiratory irritation, swelling and fluid accumulation in the lungs (pulmonary edema). Symptoms may be delayed for several days, especially in case of exposure to dilute solutions of HF (less than 20%). The following procedures should be followed:

1. Decontamination

- Rapid decontamination is critical. Contaminated clothing should be removed, double bagged and labeled as hazardous waste.
- Exposed skin should be washed with water for 15 minutes.
- Burned areas of the skin should be treated with topical calcium gluconate (Calgonate) gel.
- If eyes are affected, irrigate with water for at least 15 minutes.

2. First Aid

- In an emergency, attention should be given to the airway breathing and circulation of the exposed person.
- Properly protected responders (trained and attired) should remove the exposed person from the contaminated area.
- In case of ingestion, an exposed person who is conscious should be given 4 to 8 ounces of water or milk. In addition, 4 ounces of an anti-acid, such as Maalox, may be given.

3. Transportation

- After decontamination, the exposed person should be transported as soon as possible to the nearest Emergency Room.

RESPONSIBILITY

1. Supervisor/Buddy in Room

- Provide a copy of policy, SDS and attachments to the EMS personnel.
- Notify Environmental Health and Safety (EHS) Department at (503)725-4312 with the workers name, location and nature of the incident, telephone contacts as well as the name and location of the medical facility the exposed person was taken to for medical treatment.
- Notify Public Safety about the hydrogen fluoride exposure at 503-725-4404.
- Complete the Incident Form on the EHS website (<https://www.pdx.edu/environmental-health-safety/>) and call (503)725-4312.

2. EHS

- Shall investigate the incident and make appropriate recommendations to avoid recurrence.

Author: **Lindsay
Henderson**

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