Standard Operating Procedure:

Hydrofluoric Acid

Table of Contents

Principle of Operation

To safely use Hydrofluoric Acid.

Hydrofluoric Acid (HF) has a number of chemical, physical and toxicological properties that make handling this material particularly hazardous. Anhydrous HF is a clear, colorless, fuming, corrosive liquid. HF is also available in the gaseous state. All forms including the solution or the vapor can cause severe burns to tissue. Hydrofluoric Acid solutions are clear and colorless with a density similar to that of water. The most widely known property of HF is its ability to dissolve glass. It will also attack glazes, enamels, pottery, concrete, rubber, leather, many metals (especially cast iron) and organic compounds. Upon reaction with metals, explosive hydrogen gas may be formed. HF must be used and stored in polyethylene, polypropylene, Teflon, wax, lead or platinum containers.

Material Requirements

Equipment: substrate, Polypropylene beakers and vessels, plastic tweezers and/or any other HF-approved lab ware

Caution: HF etches glass, so glass is incompatible with HF.

Chemicals: Hydrofluoric Acid and deionized water

- Hydrofluoric Acid Hazards
    - Hydrofluoric Acid (HF) differs from other acids because the fluoride ion readily penetrates the skin, causing destruction of deep tissue layers, including bone. Pain associated with exposure to solutions of HF (1-50%) may be delayed for 1-24 hours. If HF is not rapidly neutralized and the fluoride ion bound, tissue destruction may continue for days and result in limb loss or death. HF is similar to other acids in that the initial extent of a burn depends on the concentration, the temperature, and the duration of contact with the acid.

Personal Protective Equipment: Trionic gloves on top of nitrile gloves, apron, safety glasses and face-shield

Procedure

Preparation

1. Read the SDS for Hydrofluoric Acid.
2. Read this document.

3. Identify the location of the HF Safety kit and Calcium Gluconate Gel.
4. Ensure that the fume hood in which the work will be performed is designated for HF use and is in good working order:
    a. The fume hood has adequate exhaust
    b. No alarms are visible
    c. The HF carboy is not full
    d. There are no visible spills in the hood
5. You cannot use HF alone. When using HF, you must ensure that there is at least one other person (your chemical buddy) in the vicinity of the process at all times. That person must call Public Safety (212-650-7777) in the event of an emergency and also watch over the process with you to ensure yours and everyone else's safety by preventing people coming near the hood or bumping you when you're handling the acid.
6. Ensure that all the PPE is in good working order and is free of defects.
7. Don the PPE.

HF Etch

1. Once all the PPE has been donned, carefully remove a bottle of HF from the HF storage cabinet.
2. Pour HF into an appropriate (and chemically compatible) vessel.
3. Immerse your sample in HF. Note: It is always best to ensure that the sample remains upright in the vessel. It is also very highly recommended to use locking tweezers so that the sample can be easily lifted from the vessel without agitating the solution.
4. The HF rate for glass is approximately 1 μm/min.
5. Place the sample into a second beaker filled with DI water to rinse it.
6. Remove the sample from the beaker and perform a final DI water rinse.

Cleanup

1. Carefully pour the HF waste and the contaminated DI water into the HF waste container. The first rinse of each beaker must also go into this waste container. .
2. Triple rinse all equipment with DI water and blow dry with nitrogen gun.
3. Clean up the bench and ensure that it is free of all liquids and debris.
4. Inspect all of the PPE to ensure that it did not come in contact with HF.

Emergency Response Procedure

In the event of an HF exposure your chemical buddy must call Public Safety (212-650-7777), and notify them of the nature of the emergency. When the ambulance arrives, the chemical safety buddy must explain to the emergency personnel the nature of the exposure, give them the MSDS, and request that the victim be transported to Columbia Presbyterian Medical Center, which is equipped to handle HF burns. Note: The

ambulance driver may not always comply with this request, in which case the proper emergency room should be left to the discretion of the driver.

Skin Exposure

1. Move the victim immediately under an emergency shower or other water source and flush the affected area with large amounts of cool running water for at least 5 minutes. Clothing, shoes and jewelry should be removed while the water is flowing onto the victim. Goggles should be removed last while the victim is facing the water flow. Colleagues must be EXTREMELY CAREFUL not to become contaminated while assisting the victim. Thick Neoprene or Nitrile must be worn.
2. While the victim is being rinsed with water, call Public Safety (212-650-7777) and inform the emergency dispatcher of the exposure and request emergency transport. Ensure emergency responders and treating physicians are aware of the nature of the chemical exposure. Provide a copy of the MSDS to emergency responders.
3. After the affected area is flushed with copious amounts of water for at least five minutes, apply 2.5% calcium gluconate gel according to this procedure. Massage gel into affected areas. Flush skin surfaces with water for at least 15 minutes if calcium gluconate gel is not available. In order to prevent cross contamination, the victim should self-apply the calcium gluconate gel. If the victim is unable to self-apply, anyone present can apply the gel after first putting on thick neoprene or nitrile gloves. Do not use latex gloves because they are not an effective barrier against HF. Note the time when the calcium gluconate gel was first applied to the contaminated skin and provide this information to the emergency responders. Re-apply gel every 15 minutes until medical assistance arrives.
4. After the emergency responders arrive they will call the Emergency Room doctor for instructions and may administer the calcium carbonate tablets (antacid tablets) in the Spill Exposure Kit.

Eye Exposure

1. Immediately flush eyes for at least 5 minutes with copious cool flowing water. Call Public Safety (212-650-7777), inform the emergency dispatcher of the exposure and request emergency transport. The victim should then be transported to a medical facility. MEDICAL PERSONNEL may apply a sterile 1% calcium gluconate solution to the victim's eyes after irrigation.
2. Ensure emergency responders and treating physicians are aware of the nature of the chemical exposure. Provide a copy of the MSDS to emergency responders.

Inhalation

1. *If a large volume of Hydrofluoric Acid gas is inhaled.* Immediately remove the victim to clean air. Call Public Safety (212-650-7777), inform the emergency dispatcher of the exposure and request emergency transport.
2. Ensure emergency responders and treating physicians are aware of the nature of the chemical exposure. Provide a copy of the MSDS to emergency responders.

3. Inhalation of Hydrofluoric Acid fumes may cause swelling in the respiratory tract up to 24 hours after exposure. Persons who have inhaled Hydrofluoric Acid vapors may need prophylactic oxygen treatment and must be seen by a physician as soon as possible.

Revision History:

- Revision 0.0- September 6th, 2017 Jasmine Sabio
- Revision 1.0- November 20th, 2024 Emma Anquillare, Shawn Kilpatrick, Samantha Roberts