Chemical safety fact sheet: Hydrofluoric acid

Hydrofluoric acid (HF) is an especially hazardous material used in applications such as glass etching, biological staining, mineral digestion, and electronics manufacturing. HF can be either in anhydrous form or in aqueous solution; both are clear, colorless liquids. HF can also be produced in situ when fluoride-containing chemicals react with acid or water, in which case, the same HF precautions are required.²

Hazards

HF is very corrosive like other mineral acids but also severely toxic, with an ability to readily penetrate skin and remove calcium from the tissues (e.g., skin, muscles, and bone) causing destruction and necrosis of deep tissue layers, even in dilute solutions.¹³ Improper handling may lead to:

• Severe, painful burns and tissue destruction.
• Permanent eye damage or blindness.
• Fluoride poisoning. Exposure to anhydrous HF and more concentrated solutions by inhalation, skin contact or ingestion lead to hypocalcemia (low calcium levels), hyperkalemia (high potassium levels), hypomagnesemia (low magnesium levels) and potentially cardiac arrest.²³
• Delayed symptoms of pain and toxic effects several hours after contact (from exposure to lower HF concentrations). The latency period for symptoms (redness, swelling and blistering) to appear after exposure to 20% HF or lower concentrations may be up to 24 hours.¹
• Fire or explosion due to the generation of hydrogen gas from corrosive action of HF on metals.¹

Review the HF Safety data sheet and acquire your lab-specific training before working with this material.

Mandatory control measures

• Exposure prevention is the priority, but all HF users must be fully aware of first aid response measures. See Emergency procedures below and prepare a ‘grab and go’ package to provide to emergency room personnel in case of exposure.
• A tube of 2.5% w/w calcium gluconate gel must be on hand for potential skin exposures. Keep gel stored in a cool location and replace before the expiration date. Tubes are single use.
• Do not work alone or during off hours. Make sure you have a buddy in the laboratory who is aware that you are using HF and knows the emergency procedures and location of the calcium gluconate gel.
• Prepare and use HF only in a properly functioning chemical fume hood. A “Danger – HF in use” sign must be displayed on the fume hood when samples are left unattended.
• Create a laboratory specific procedure for the process in which HF is to be used and incorporate information from this document. Update the procedure as the process changes.
• Wear a lab coat and an acid resistant apron.
• Wear splash-proof goggles or a face shield.
• Wear long, HF-resistant gloves (e.g., butyl, neoprene or SilverShield®) over a pair of disposable nitrile gloves. Long gloves should cover the hands, wrists and forearms.
• Wear long pants and closed-toe shoes.
Safe handling and use

- Purchase the smallest amount and lowest concentration of HF needed or prepare the minimum quantity and concentration needed. Add acid to water when preparing necessary dilutions.
- Prepare and use HF only in a properly functioning chemical fume hood. Position the fume hood sash between you and the reaction.
- Use absorbent liners or shallow pans on the work surface to ease clean up of any drips or spills.
- **Never use glass to prepare or store HF.** Use only compatible containers and tools such as those made from polyethylene or PTFE (Teflon®). HF reacts with glass, but also glazes, enamel, pottery, concrete, rubber, leather, many metals and many organic compounds.²
- Ensure compatibility of HF before mixing it with any chemicals or waste. HF reacts with some metals to generate flammable hydrogen gas.¹
- Keep a solution of calcium hydroxide \([\text{Ca(OH)}_2]\) at the ready. Use it to neutralize rinse water containing trace HF and clean surfaces, followed by soap and water, upon completion of work.

Waste handling

- Dilute waste solutions (< 1%) containing HF may be neutralized in a treatment step as part of your process and disposed down the drain, as long as the waste stream does not contain excess levels of restricted contaminants (e.g., metals, suspended solids). Refer to the table of restricted waste in the EHS laboratory safety manual. To neutralize, work in a fume hood and slowly add a saturated solution of calcium hydroxide \([\text{Ca(OH)}_2]\). Perform neutralization slowly to avoid an exothermic reaction, which can vaporize HF. Alternatively, a two step neutralization with calcium chloride \((\text{CaCl}_2)\) and an appropriate base (e.g., sodium hydroxide, \(\text{NaOH}\)) may be used.
- Collect concentrated HF solutions or those with restricted contaminants as hazardous waste.
- Collect liquids in a compatible container (LDPE or HDPE) and apply a chemical waste label.
- Collect contaminated gloves, absorbent liners and any other items with trace contamination in a double plastic bag and apply a chemical waste label indicating “Contains hydrofluoric acid.”
- Submit a request for waste pickup through the online system.

Emergency procedures

Ensure you know the location of the 2.5% w/w calcium gluconate gel, nearest emergency eyewash, safety shower and chemical spill kit. Inform your supervisor and complete an incident report after any incident.

**Grab and go package:** it is strongly recommended to print out the following resources so they are ready to take to the hospital in case of exposure:

- HF Safety data sheet.
- SFU fact sheet for HF (this document).
- Your lab specific procedure.

First aid response

- All contact or suspected contact with HF must be treated immediately.
For all exposure scenarios, ask a coworker to call 911 and Campus Security at 778-782-4500 and advise of hydrofluoric acid (‘HF’) exposure, providing concentration, amount of exposure, exposure route (skin, eyes or respiratory), and time since exposure.

• **Skin contact:** Remove contaminated clothing, rinse affected area with copious, tepid running water or nearest safety shower for 5 min. With gloved hands, apply calcium gluconate gel liberally and massage it into the affected area. Skin does not need to be dried. Reapply the gel every 10-15 minutes and continue massaging until person receives medical attention.

• **Eye contact:** Immediately flush eyes with water for 15 min. DO NOT apply calcium gluconate gel to the eyes. Seek immediate medical attention.

• **Inhalation:** Move person to fresh air. Seek immediate medical attention.

**Spill response**

For small (< 50 mL) spills of 48% hydrofluoric acid (or less), take the following steps:

- Alert others and clear the immediate area where the spill occurred.
- **Only attempt clean up if you have been trained, are equipped and feel comfortable to do so.**
- Retrieve the laboratory spill kit and put on additional PPE as necessary.
- Use HF specific absorbents (e.g., Chemizorb HF or Spilfyter Kolor-lock HF) to neutralize spill.
- If HF-specific absorbents are not on hand, wipe up spilled liquid with an absorbent pad.
- Place pad into a heavy (high mil) plastic bag and, working in the fume hood, slowly add a neutralizing solution of calcium hydroxide \([\text{Ca(OH)}_2]\). Alternatively, a two step neutralization with calcium chloride solution (CaCl₂) and a suitable base (e.g., sodium hydroxide solution, NaOH) may be used.

*Not recommended for direct HF neutralization because of adverse reactions*¹,²

sodium or potassium hydroxide (NaOH, KOH); sodium or potassium carbonate \((\text{Na}_2\text{CO}_3, \text{K}_2\text{CO}_3)\); silicon-based absorbents (Spill X-A, vermiculite).

- Perform neutralization slowly to avoid an exothermic reaction which can vaporize HF.
- Use paper towel and a saturated Ca(OH)₂ solution to wipe down the affected surfaces, then repeat twice with water. Discard cleanup materials into the waste bag.
- Double bag the waste, discard any disposable PPE, then seal the bags and apply a chemical waste label, indicating “neutralized HF spill cleanup”.
- Submit a request for waste pickup through the online system.
- **For large spills (> 50 mL) of any concentration or spills that require assistance,** evacuate all personnel from the laboratory, post a warning on the laboratory to restrict access and call Campus Security at 778-782-4500.

**References**