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## Safety Hazards Associated with Old Compressed Gas Cylinders

The recent explosion of a lecture size cylinder of Hydrogen Fluoride (HF) in a laboratory at a sister UC campus has renewed concerns that compressed gas cylinders can be especially dangerous. Potentially compressed gas cylinders can possess both mechanical and chemical hazards. Amassing a large amount of energy resulting from compression of the cylinder, gas cylinders should be handled as potentially explosive.

(An exploded Lecture Gas Cylinder)

What might have occurred to set off this time bomb? Over time, moisture entering the cylinder will initiate internal corrosion. Fluorine in the HF gas may have reacted with the iron in the cylinder walls, combined with moisture, to form iron (ferric) fluoride. This corrosive process forms hydrogen, a true gas, and the pressure inside the cylinder increases as more and more hydrogen is formed by the corrosion. In addition, the chemical reacts with the metal, weakening the cylinder until the cylinder fails. The customary shelf life for HF cylinders is between one or two years, depending on the vendor. The cylinder that exploded above was determined to be at least seven years old. Many older cylinders containing HF, as well as Hydrogen Bromide (HBr) that are in use or in storage should be periodically inspected by a cylinder specialist for pressure levels and safety. For example: A typical cylinder pressurized to 2000 psi contains energy equivalent to nearly one and a half pounds of TNT. Failure of the cylinder and/or valve can create an extremely dangerous projectile.

Additional hazards arise from the highly toxic properties of many of these gases; there are usually no visual warnings or odors. Some gases are toxic at concentrations below the odor threshold and some gases can quickly paralyze the sense of smell. Even harmless gases such as nitrogen may displace the oxygen in an unventilated room and cause asphyxiation. The best protection against accidents is knowledge of proper handling and storage techniques.

## Other gas cylinders compounds that should be of concern:

- Hydrogen fluoride, Anhydrous (hydrogen pressure buildup and cylinder corrosion)
- Hydrogen bromide, Anhydrous (hydrogen pressure buildup and cylinder corrosion)
- Hydrogen sulfide, Anhydrous (anecdotal reports of pressure buildup)
- Hydrogen cyanide, Anhydrous (violent polymerization can occur)
- Hydrogen chloride, Anhydrous (corrosion of fittings and cylinder)

## Things to remember while storing and handling compressed gas cylinders:

(Refer to Chemical Safety Manual, Chapter 2, Section D.4; "Storage and Handling of Compressed Gases")

- Cylinders shall be stored upright, secured to a stable structure, and capped when the cylinder is not being used. Storage and use areas should be well ventilated and away form any ignition sources.
- 2. Proper protective clothing such as goggles, face shields, rubber gloves, and aprons shall be worn when working with acid and alkaline gases. Corrosive gases should be used only with compatible equipment.
- Cylinders should not be completely emptied; approximately 25 pounds of pressure should remain in the cylinder. The tank valve should be closed to prevent contamination from air and water. Remove the regulator, replace the cap, mark the cylinder empty, return the cylinder to the storeroom and secure properly.
- 4. Refer to glove manufacturer's chemical resistance chart when working with acidic gases, such as hydrofluoric acid. Breakthrough times for gloves will vary depending on the concentration of the solution, the type of rubber material (PVC, neoprene, butyl, or viton) and the thickness of the glove. Gloves should be inspected for any discoloration, swelling, fine cracks, and pinholes prior to using them. Gloves must be decontaminated at the end of each use to prevent further degradation of the rubber material.
- 5. The acquisition of gases should be ordered in the smallest practical quantity and lowest concentration for the application and within the storage quantity limitations. Gases shall be purchased in either returnable cylinders, or the vendor must agree (in writing) to take back used, non-returnable cylinders (empty or not). Non-returnable cylinders, specifically those containing toxic substances, are very costly to dispose. The purchaser of these cylinders may be required to bear disposal costs.

Any questions concerning compressed gas cylinder safety should be addressed to your department safety advisor (DSA). In the event of a gas cylinder emergency, contact the Office of Environmental Health and Safety's (OEH&S) Emergency Response Team, by dialing **9-911**.