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EH&S Fact Sheet

Environment, Health and Safety Information for the Berkeley Campus

Hydrogen Safety

Introduction

Hydrogen (H_2) is an extremely flammable, colorless odorless compressed gas that is used in many research laboratories. It has virtually no toxic effects on the human body, but it can displace air causing asphyxiation if enough is released in an enclosed room. The biggest danger when dealing with hydrogen is that is has a wide explosive/flammability range (4%-74% in air). This means that even a small leak can cause a hazardous fire.

Hydrogen is very light and quickly rises if released, and also has the unique characteristic of making certain metals brittle after prolonged use. So, use caution when working with metal tools and devices.

Fire Hazards

When hydrogen is in air it can ignite with extremely low energy input. For instance, hydrogen only needs 10% of the energy (0.02 millijoules) required to ignite a gasoline-air mixture. Even a static spark from a person or clothing can ignite hydrogen gas. Hydrogen needs only a minimum of 10% oxygen or a maximum of 41% of oxygen in air to ignite. Also, because the flame is almost invisible in daylight, finding and fighting a hydrogen fire can be difficult.

Protective Measures

- There should be no open flames or smoking in areas where hydrogen is used.
- Work in an area with plenty of ventilation. If possible, work in a fume hood or use a canopy hood as fugitive vapors, if not captured, may collect near the ceiling.
- Ground all equipment and piping used with hydrogen, and make sure that you are properly grounded before working with hydrogen. Rubber soled shoes prevent you from being grounded, so you should touch a grounded object to discharge built up static electricity before beginning work.
- Wear appropriate lab safety gear for the work being performed: safety glasses/ goggles, lab coat, gloves and preferably a face shield.
- If working with liquid hydrogen you must have appropriate insulated gloves and protective shoes in addition to the appropriate safety gear. (Cryogenic liquid hydrogen can cause severe burns to the skin due to the extremely low temperature.) *Presently, there is no known liquid hydrogen use at UCB. If you plan to use or are using liquid hydrogen you must first check with EH&S and the Campus Fire Marshall.*
- Remove electrical equipment or electronic devices from the vicinity of hydrogen gas unless the device is certified "intrinsically safe". Even invisible small sparks from electronic devices could ignite hydrogen.
- Use metal piping with hydrogen. Do not use non-conductive or plastic tubing. Be sure to dissipate static charge when flowing hydrogen gas by electrically bonding and grounding the cylinder, metal piping and apparatus being used.

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Storage and handling

- Hydrogen cylinders must be stored with valve's protective cap in place. If the cap has been removed, the cylinder must be stored upright and secured with non-combustible straps or chains.
- Hydrogen cylinders must be stored more than 20 feet away from cylinders of oxygen or other oxidizers, e.g., bromine, chlorine, fluorine (which we do not have) or be separated by a noncombustible wall extending not less than 18" above and to the sides of the stored material.
- Never open the cylinder valve before making sure all your connections are secure as the static discharge from flowing gas may cause hydrogen to be ignited.
- NEVER USE ADAPTERS.
- Be aware of leaks! Hydrogen has a low viscosity which makes it to have a high leakage rate. A leak as small as 4 micrograms/second can support combustion.
- Due to hydrogen's low molecular weight, this gas will diffuse rapidly in a room and will collect near the ceiling. It is important to only use hydrogen in well ventilated locations.
- There must be no more than 1000 cubic feet of flammable gases per fire control area unless there are adequate engineering controls. Contact EH&S for an evaluation if there will be more than one large cylinder used in a room and one in storage. A standard large cylinder contains about 260 cubic feet of hydrogen. If there are inadequate engineering controls the fire marshal may restrict the volume of H_2, request that they be stored in an exhausted location and require hydrogen monitoring and alarms, or other safety controls. There should be fire sprinklers wherever hydrogen is used.
- All electronic equipment used near hydrogen gas must be grounded.
- Check that the pressurized system does not leak hydrogen with leak detection solution or pressure sensing.
- Close the cylinder valve when not in use. Do not leave the piping pressurized if not is use.

Hydrogen is incompatible with many materials and situations (check your MSDS for list of incompatibles):

- It ignites easily with oxygen, could explode when heated.
- It reacts violently or explosively or forms heat- and/or-shock sensitive explosive mixtures with oxidizers, halogens, halogen compounds, acetylene, bromine pentafluoride, chlorine oxides, fluorine perchloride, oxides of nitrogen (check MSDS for list of incompatibles).
- Mixtures with chlorine may explode on exposure to light.
- Mixtures with oxygen may explode in presence of platinum catalyst.
- It is incompatible with copper (II) oxide, difluorodiazene, iodine heptafluoride, lead trifluoride, liquid nitrogen, lithium perchlorate trihydrate, metals, nitrogen trifluoride, nitryl fluoride, palladium (II) oxide, palladium trifluoride, polycarbon monofluoride, potassium tetrafluorohydrazine, xenon hexafluoride.
- It forms hydrides when heated with alkalis, alkaline earth, and some other elements.

If you are using hydrogen in a research laboratory, you should prepare a standard operating procedure (SOP). The safety information in this fact sheet may assist you in drafting the SOP.