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Process Safety Beacon

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## Practice Process Safety in the Lab

On March 16, 2016, an explosion in a laboratory (Photos 1 and 2) at the Univ. of Hawaii seriously injured a research assistant, causing her to lose her arm. The total financial loss was nearly $1 million. Investigators estimated that the explosion was equivalent to detonating about 70 g (2.5 oz) of TNT — nearly half the amount of explosive used in an M67 hand grenade.

The lab where the accident occurred used a flammable mixture of hydrogen, oxygen, and carbon dioxide. The mixture was stored in a 50-L (13-gal) tank at about 6 barg (90 psig). The tank (Photo 3) was rated for pressure up to 11.6 barg (168 psig), but was intended only for use with dry compressed air. In addition, the tank and associated instrumentation were not bonded and grounded. Before the explosion, static sparks from ungrounded metal equipment had been observed in the lab.

The investigation determined that the immediate cause of the explosion was static discharge (Aug. 2016 Beacon), which ignited the flammable mixture. However, a root cause of the explosion was failure to recognize the flammable atmosphere in the tank as a hazard. A mixture of gas containing hydrogen and oxygen is explosive over a range of concentrations, and the energy necessary for ignition is extremely low. The equipment, facilities, procedures, and training were not adequate for such a highly hazardous mixture of gases.




Photos courtesy the Honolulu Fire Dept.

## Did you know?

- Hydrogen-air mixtures are explosive at concentrations of 4–75% hydrogen, and 4–94% hydrogen in pure oxygen.
- Ignition of a mixture of hydrogen and air does not require much energy. A spark that you can barely feel has about 50 times as much energy as is needed to ignite a hydrogen-air mixture, and a typical static spark has over 1,000 times the energy required for ignition. As oxygen concentration increases, ignition of the mixture requires even less energy.
- Process safety incidents can occur in processes at any scale, including in laboratories, pilot plants, and full-scale manufacturing plants. A small quantity of material does not mean that the hazard is small.
- This incident occurred in a research lab, but a plant lab may also contain enough hazardous material or energy to cause a serious incident.

## What can you do?

- Make sure you fully understand the hazards associated with all of the materials, equipment, and operations you encounter in your job. Hazard recognition is the first step to ensure safety in any activity, because you can't manage the risks of a hazard that is not identified.
- Apply the same discipline to process safety management in a lab or other work environment as you would in a manufacturing plant.
- Use appropriate hazard identification and analysis tools, including checklists, what-if analyses, and job safety analyses, as well as more-rigorous tools, such as hazard and operability (HAZOP) studies for complex operations, to understand workplace hazards.

***You can't control a hazard that you haven't identified.***