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Process Safety Beacon

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Messages for Manufacturing Personnel

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Process safety in the laboratory

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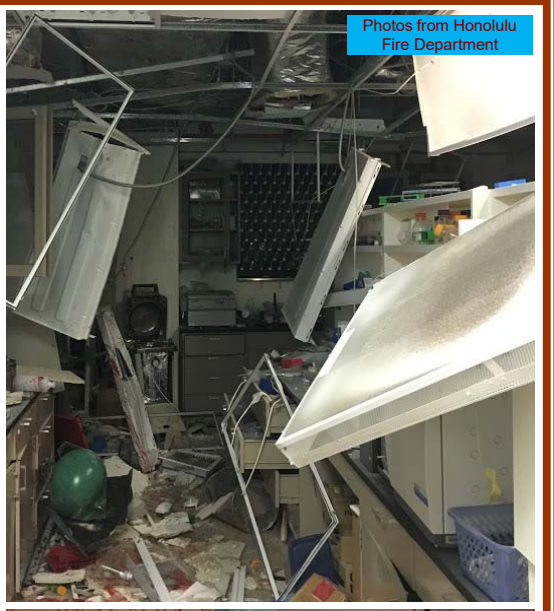
On March 16, 2016 there was an explosion in a laboratory at the University of Hawaii in Honolulu. A research assistant was seriously injured, losing her arm. The total financial loss was nearly $1 million.

The laboratory was conducting research using a flammable mixture of hydrogen, oxygen, and carbon dioxide. The mixture was stored in a 50 liter (13 gal) tank at about 6 barg (90 psig) pressure, and fed to a bioreactor containing bacteria. The tank was rated for 11.6 barg (168 psig) and was intended for use for dry compressed air only. The tank, and other equipment such as instrumentation, was not bonded and grounded. Static sparks had been observed in the laboratory with ungrounded metal equipment prior to the explosion. The explosion occurred on the 11th run using the tank. It was estimated by investigators to be equivalent to the detonation of about 70 gm (2½ oz.) of TNT – nearly half the amount of explosive in a US Army M67 hand grenade.

The investigation determined that the likely immediate cause of the explosion was a static discharge (see August 2016 *Beacon*) which ignited the flammable mixture. *However, more fundamentally, there was a failure to recognize the hazard of the flammable atmosphere in the tank, and how easily the mixture could be ignited*. A mixture of gas containing hydrogen and oxygen is explosive over a wide range of concentrations, and the ignition energy is extremely low. The equipment, facilities, procedures, and training were not adequate for such a highly hazardous mixture of gases.



Did you know?

- Hydrogen-air mixtures are explosive in concentrations from 4% to 75% hydrogen, and the range is wider as oxygen concentration increases – 4% to 94% hydrogen in pure oxygen.
- The energy required to ignite a flammable mixture of hydrogen and air (21% oxygen) is very small. A spark you can barely feel has about 50 times as much energy as needed to ignite the mixture, and a typical spark that you experience has over 1000 times the energy required for ignition. At higher oxygen concentrations, the mixture is even more easily ignited.
- Process safety incidents can occur in laboratories or pilot plants as well as in manufacturing plants. A small quantity of material does not mean that the hazard is small.
- This incident occurred in a research laboratory, but a plant laboratory may also contain enough hazardous material or energy to potentially cause a serious incident – for example, a cylinder of compressed gas in a quality control laboratory.

What can you do?

- Wherever you work – in a process plant, a research laboratory, a pilot plant, a quality control laboratory, a maintenance shop, or anywhere else – make sure you fully understand the hazards associated with all of your materials, equipment, and operations. ***You can't manage the risk from a hazard that you don't know about!*** Hazard recognition is the first critical step to ensure safety in any activity. Apply the same discipline to process safety management in a laboratory or other work environment as you would in a manufacturing plant.
- Use appropriate hazard identification and analysis tools to understand laboratory or other workplace hazards – for example, checklists, what-if analysis, job safety analysis, and more rigorous process hazard analysis tools for complex operations.

You can't control a hazard that you haven't identified!

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