



H₂ Incident Reporting and Lessons Learned

Incident Report

Hydrogen Explosion in Microbiological Anaerobic Chamber

No Incident Date defined.

Severity: Incident	Was Hydrogen released? Yes	Was there Ignition? Yes No Ignition Source Defined.
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Description

An explosion occurred involving a Microbiological Anaerobic Chamber of approximately 2 m³ capacity, containing an explosive mixture of hydrogen and air. A fire followed the explosion, but was rapidly extinguished by staff using fire extinguishers, prior to the arrival of fire service personnel. The pressure wave from the explosion blew windows out of the laboratory, with glass hitting a passerby on a path outside, and glass shards landing up to 30 m away. Ceiling panels were dislodged in the laboratory and adjacent rooms, and a worker using the apparatus at the time was taken to hospital by ambulance to have burns treated. They have subsequently fully recovered from their injuries. Another worker in the lab at the time required medical observation but was otherwise unharmed.

Mixtures of inert gases and hydrogen are intended to be routinely used in the type of anaerobic chamber involved in the incident. The mixtures used in the chamber involved were produced locally in the laboratory using nitrogen, carbon dioxide, and hydrogen. The hydrogen in the mixture reacts with any oxygen present in the chamber, on a heated catalyst, to eliminate oxygen and keep the chamber anaerobic. The local operating procedures used in the lab allowed high concentrations of hydrogen to be introduced into the chamber. A worker inadvertently admitted air to the chamber whilst undertaking maintenance, allowing the hydrogen enriched atmosphere in the chamber to mix with air, and subsequently ignite, most probably on contact with the oxidation catalyst in the chamber, resulting in the explosion and subsequent fire.

Hydrogen gas has a very wide range of flammability when mixed with air (approx 4 – 74 %). Oxidation catalysts can ignite explosive gas mixes without heating, spark or flame. Local operating procedures and practices varied from manufacturer's advice. An unknown concentration of hydrogen was present in the chamber, presenting a significant fire and explosion risk.

Setting

- Laboratory

Equipment

Process Equipment

- Microbiological Anaerobic Chamber

Damage and Injuries

- Lost Time Injury
- Minor Injury
- Property Damage

Probable Cause(s)

- Failure to Follow Standard Operating Procedures

Contributing Factors

- Decision Making
- Human Error

No Characteristics Defined.

The incident was discovered During Operations.

Lessons Learned/Suggestions for Avoidance/Mitigation Steps Taken

The practice of making gas mixtures in the laboratory should be eliminated, and gas mixtures with a known low hydrogen concentration should be purchased for use. The concentration of hydrogen used should be such that it is not possible to form an explosive mixture on dilution with air. (i.e. hydrogen concentration less than 4% after mixing with air from a leak, damage to the chamber, or inadvertent admission of air to the chamber) A gas monitor with inbuilt alarm should be purchased and installed to continuously monitor both hydrogen and oxygen concentrations in the chamber, and provide visible and audible indication of any problems. The manufacturer's instructions and manuals should be closely followed. All users should be fully trained in the use of the equipment, and should be fully conversant with the potential hazards and how to manage the associated risks.

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