# DEALING WITH THE HAZARDS OF HANDLING HYDROGEN

## **Stephen B. Harrison**, from sbh4, explains the hazards of handling hydrogen in the oil and gas industry, and how the appropriate measures and mitigating actions can help minimise the risks

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In the oil and gas sector, hydrogen is used for the desulphurisation and hydrogenation of fuels. At present, most refinery hydrogen is produced by the thermal catalytic conversion of natural gas or naptha to produce hydrogen on a steam methane reformer (SMR). However, electrolysers are set to join SMRs as large-scale hydrogen producers in the oil and gas sector, as the 10MW electrolyser at Shell's Rhineland Refinery near Cologne demonstrates.

Handling hydrogen in the oil and gas sector demands specific attention due to the danger of fire and explosion. It is also stored and distributed at high pressure, meaning that a small leak can quickly escalate to a major hazard. For a leak to air, hydrogen has an LEL (lower explosive limit) of 4% and a UEL (upper explosive limit) of 75% - that is a very wide range. And spark ignition from electrical components or maintenance activities is an ever-present risk. But, with appropriate measures such as risk assessment, HAZOP and the implementation of appropriate mitigating actions, like gas detection, the risks associated with hydrogen production can be minimised.

The SMR also produces carbon monoxide, which is both flammable and toxic. So, the use of a system with multi-gas detectors including sensors that are specific to carbon monoxide might be appropriate. Wearable gas detectors, as part of the operator's daily PPE, would also be common practice around hydrogen plants. This is partly because plant facilities, such as: laboratories, filling stations and compressor rooms are generally indoors in a confined space. These enclosed buildings may also be hazardous areas that present the risk of oxygen deficiency because the inert gas nitrogen is often used to drive pneumatic process control systems.


The Teledyne MX32 gas detection control unit (Copyright Teledyne Gas and Flame Detection)

François Ampe, product line manager EMEA at Teledyne Gas and Flame Detection, said: "Gas detection works very well in enclosed buildings where there is no wind to disperse a gas leak. But in open outdoor spaces a leak can be diluted to an undetectable level by a strong wind current." Ampe goes on to explain how flame detectors can help in those situations: "On a steam methane reformer there is generally a natural gas pipeline feeding the plant and a hydrogen pipeline exporting product from the plant. We are surrounded by flammable gases. Flanges and valves in the pipework are potential gas leak points and the plant risk assessment may have determined that each one should be fitted with a gas detector close by. However, prevailing atmospheric conditions might mean that the methane or hydrogen gas leak is blown away from the gas detector and no alarm is registered – it can happen. This is where the complimentary use of a flame detector might spot the problem before it escalates to a major explosion."

There are various international technical standards that must be followed when considering the safety of hydrogen electrolyser installations, for example the 'ISO 22734-1: Hydrogen generators using water electrolysis process'. International standards must be used in combination with a detailed risk assessment. Ampe said: "According to this international standard, the first lines of defence are to implement good ventilation and the installation of a hydrogen gas detector. Furthermore, automated safety control systems can invoke the appropriate actions in the event of a gas leakage alarm. For example, a severe alarm would trigger an emergency shutdown of the electrolyser."

Onshore processing plant and offshore rig operating procedures in the oil and gas sector will generally specify that fixed gas detectors are 'bump-tested' at weekly or monthly intervals to demonstrate system functionality. Some policies mandate that the sensors must also be removed periodically for servicing and recalibration. These activities require the use of certified calibration gas mixtures which simulate the toxic, inert or flammable gases that are to be detected.

Alan Watkins, executive general manager at Coregas in Australia, said: "The main difference between the calibration gases that we supply for in-situ bump-testing and laboratory calibration is the size of the cylinder that is used. For the laboratory, a larger floor-standing calibration gas mixture cylinder will be preferred. This allows the technician to run as many tests as possible from a single cylinder. For in-situ testing, users prefer portable cylinders. For these smaller packages we now find that there is market preference for high pressure refillable gas cylinders because they are much more environmentally sustainable than so-called 'disposable' cylinders."


Calibration gas mixture cylinders are available in various sizes to meet different application needs (Copyright Coregas)

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