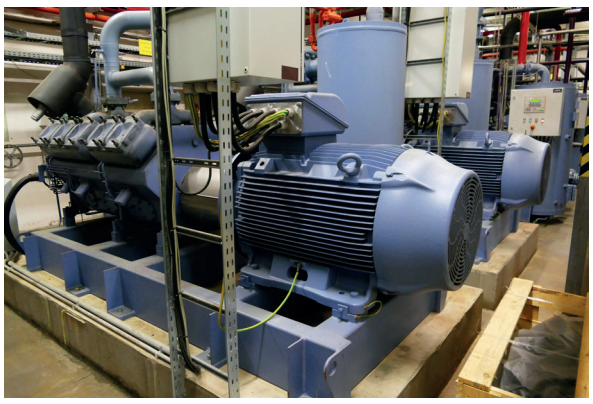
SAFETY WITH AMMONIA AND LOHCs AS HYDROGEN CARRIERS

Hydrogen is difficult to store and transport as a gas. As a liquid it is not much better. Given the challenges of handling hydrogen, much of the green hydrogen produced in the coming decades will be converted to ammonia to facilitate cost-effective supply chains.

Liquid organic hydrogen carriers (LOHCs) will also play a role in hydrogen storage and distribution. These are volatile aromatic organic chemicals with physical properties like liquid hydrocarbon fuels such as gasoline or diesel. Flammable, and toxic, gas detection is required to use them safely.

Whichever way we look, flammable and toxic gases have been, are and will continue to be part of the hydrogen story. Getting to grips with gas detection is therefore essential for a safe energy transition.



Ammonia refrigeration compressor

Ammonia – the carbon-free hydrogen carrier

Ammonia gas detection builds on experience in the refrigeration industry where ammonia has been used as a refrigerant gas for decades. In refrigeration applications, the EN378 standard advocates alarm levels at 500 and 30,000 ppm of ammonia to protect the plant from an ammonia explosion.

Whilst these high levels are appropriate to protect the equipment, employees must be protected at lower levels. For toxic detection the COSHH regulation specifies a limit of 25ppm over 8 hours and 35 ppm over 15 minutes. These are the levels that are generally built into portable gas detectors that operators wear as part of their personal protective equipment.

Catalytic bead gas sensors can be used to detect ammonia. The electrochemical cell is also common. However, these sensors are easily poisoned and must be changed after exposure to an ammonia gas leak. Background traces of ammonia also desensitise the sensors over the long term.

The gas detection sensor control system should be mounted outside the area where the leak is expected to be. This allows the operator to safely examine the control system to understand what is happening in the room where the leak is being detected, without putting themselves at risk of toxic exposure.

Liquid hydrogen storage

Silyzer electrolyser for hydrogen production, Copyright Siemens Energy

Aromatic hydrocarbon gas detection for LOHCs

Hydrogenious benzyltoluol LOHC supplied to the HRS Erlangen, Copyright HyPlus

An increasingly popular mode of hydrogen storage and transportation is the use of a liquid organic hydrogen carrier (LOHC). Several aromatic organic chemicals, such as benzyltoluene, can perform as an LOHC.

Hydrogen is loaded into the LOHC using a chemical reaction called hydrogenation. The LOHC can then be shipped as a liquid. When required, the loaded LOHC can be dehydrogenated using heat and catalysts to release the hydrogen. The LOHC can then perform another round trip to transport hydrogen.

The physical properties of an LOHC are like that of diesel – a flammable liquid at room temperature and pressure. This enables them to be used in storage and distribution equipment that has previously been aligned to refined products.

Ammonia storage

Gas detection for vapour leaks of the LOHC can be achieved using a PID detector. However, it is likely that the main areas of concern would be a hydrogen gas leak during hydrogenation and dehydrogenation of the LOHC. For the hydrogenation and dehydrogenation facility, using a pellistor hydrogen detector in parallel with a PID detector for the LOHC would be ideal.

Liquid hydrogen distribution by road

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