Hydrogen Distribution & Delivery
UKHA Fact Sheet Number 3

UNITED KINGDOM HYDROGEN ASSOCIATION

HYDROGEN DISTRIBUTION & DELIVERY

Hydrogen is used extensively across a range of industries from chemical processing and oil refining to powering space exploration. Before becoming a mainstream energy carrier and contributor to a cleaner and more sustainable future, hydrogen has to be conveyed to the point of use and stored there until required. The distribution and storage of hydrogen are intricately bound together and depend on both the scale of the operation and the nature of the application.

HOW IS HYDROGEN DISTRIBUTED TODAY?

Hydrogen is currently transported and stored around the UK in gaseous form using tube trailers or cylinders and in liquid form in cryogenic liquid hydrogen tankers and to a very limited extent via pipeline.

Tube trailers are commonly used to supply industrial users with gaseous hydrogen, where the quantities involved are considerable. The cylinders are permanently fixed to the trailer and are discharged in situ not off loaded. A tube trailer will typically hold a couple of hundred cubic metres. Smaller users, such as laboratories employ cylinders with storage capacities of just a few cubic metres that can be easily manhandled.

Liquid hydrogen (cooled to -253C) is transported by road in super-insulated cryogenic tankers with capacities of 40,000 to 60,000 litres. Liquid hydrogen is preferred for delivering larger quantities over a relatively long distance.

Pipelines present the most cost effective means of transporting large quantities of gaseous hydrogen over long distances. Presently, the UK hydrogen pipeline infrastructure is very small and dedicated to single large industrial users and limited to a few regions near large petrochemical refineries and chemical plants such as in Teesside.

OTHER MEANS OF DISTRIBUTION

Hydrogen can also be transported using a carrier – a chemical substance that incorporates atoms of hydrogen and other elements – such as methanol, ammonia and metal hydrides.

In the case of methanol and ammonia, the carrier is transported from the point of production to the point of use where it would be decomposed catalytically at elevated temperatures to produce hydrogen.

Air Products Tube Trailer

Metal hydrides are another alternative means of storing and distributing hydrogen. Certain metals and alloys have the ability to absorb and release gaseous hydrogen reversibly via the formation of hydrides.

Hydrogen delivery via pipeline

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CHALLENGES

Hydrogen has a very good energy content by weight (about 3 times more than gasoline) but it has a very low energy content by volume (about four times less than gasoline). This makes storage and distribution to the point of use very costly. The ability to store hydrogen safely, reliably and cost effectively is one of the challenges facing the widespread use of hydrogen as a form of energy.
The storage of hydrogen is particularly challenging for vehicle applications where more severe constraints exist in terms of acceptable mass and volume. Much work is currently being gone on trying to develop low cost reliable means of storing both liquid and gaseous hydrogen.

How hydrogen is produced can influence the method and cost of delivery. Centrally produced hydrogen from large scale plants, as is the case in the UK, results in longer transport distances that increase delivery costs. Decentralised production at the point of use, such as refuelling stations or power generation sites eliminates the delivery costs but results in higher production costs.

Pipelines
Several technical and commercial challenges exist to the development of a hydrogen pipeline delivery infrastructure.

- The high initial capital cost
- Technical concerns including the potential for hydrogen embrittlement of the steels and welds used in pipeline construction
- The prevention of leaks and permeation of hydrogen from pipelines and other containment materials.

One transitional option to overcome some of these challenges would be to blend hydrogen produced centrally into natural gas and utilise the existing natural gas pipeline infrastructure. Several years ago, domestic gas was derived from coal (so-called ‘coal’ or ‘town’ gas) and delivered safely and reliably through steel pipelines. This gas consisted of around 50 vol% of hydrogen and 35 vol% of methane.

DELIVERY INFRASTRUCTURE

Once delivered to the point of use, the intended application of the hydrogen will dictate the infrastructure required. For stationary applications such as electricity generation and industrial processes, hydrogen storage and delivery systems generally involve bulk storage tanks or cylinders. For mobile applications a dedicated hydrogen refuelling station will be required.

A hydrogen refuelling station primarily consists of a compressor, high pressure storage, a dispenser and associated instrumentation and control systems.

Hydrogen refuelling infrastructure may take several forms. It may be designed to deliver compressed gaseous hydrogen or liquid hydrogen into a vehicle. In addition, the refuelling station may be a small mobile or relocatable system or a large stationary facility that is integrated with an existing public vehicle refuelling station.

The Linde Hydrogen Center near Munich – photo courtesy of The Linde Group

For more information and access to additional fact sheets, please visit www.ukha.org.

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