SPECTRUM
ACOUSTIC CONSULTANTS

The importance of noise control and acoustic design in the industrial production of Hydrogen

Chris Anderson, Director

Hydrogen plants play a critical role in the UK's transition to low carbon energy, but they also present complex industrial noise challenges. Specialist noise consultancy and acoustic design for hydrogen plants is essential to achieve planning approval, regulatory compliance, and long term operational success. But first a bit of background...

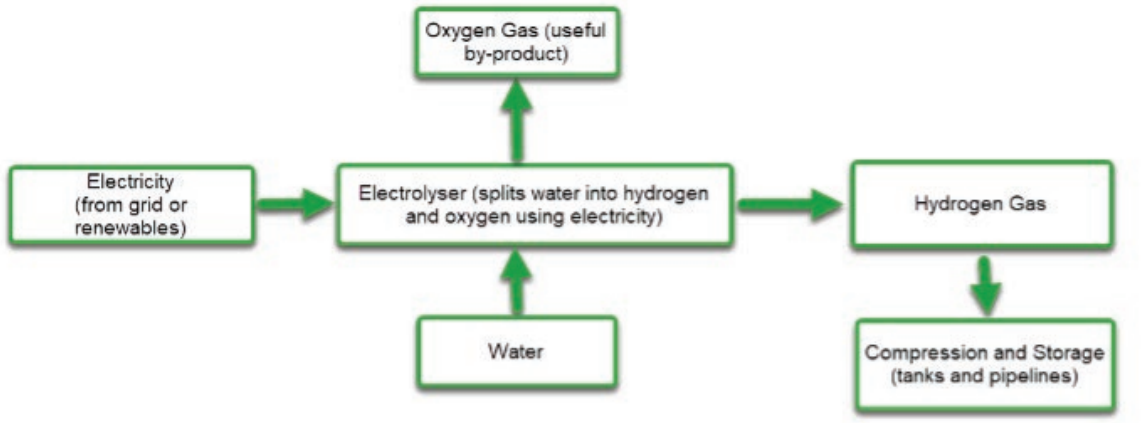
Why make Hydrogen in the first place?

Industrially produced hydrogen is useful because it acts as an energy storage medium that can be used as and when it's required, just like gas and petrol, but without the associated carbon emissions when it's produced using renewable electricity. It can be used to power trucks, cars, buses, trains and ships as well as industrial processes, and the exhaust product is free of carbon emissions at the point of use.

Great, but how do we get the hydrogen?

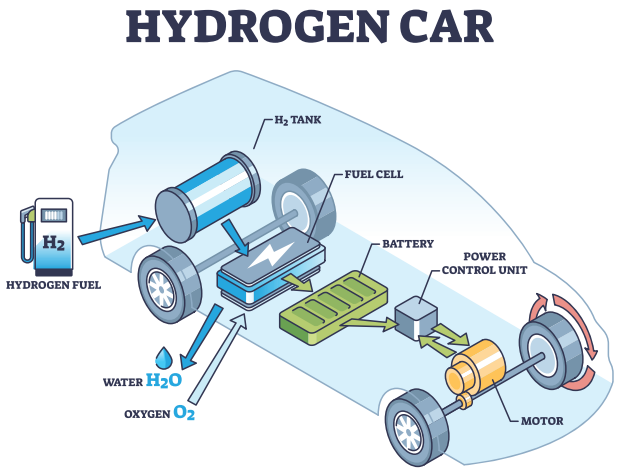
At school many of us did an experiment where we put two electrodes (+ve and -ve) connected to a battery into a beaker of water (H2O) and watched bubbles form on the electrodes; hydrogen bubbles (H2) were on one electrode, and oxygen bubbles (O2) on the other.

That process of separating hydrogen and oxygen from water is known as electrolysis, and this is what an industrial hydrogen plant does, but on a grand scale. The process involved in the industrial production of hydrogen is summarized below.



Ok, but how do you turn hydrogen back into energy?

In order to turn the hydrogen back into energy, the process is typically reversed in a kind of battery called a fuel cell, converting the hydrogen back into electricity and water by reversing the process described above. The generated electricity then powers an electric motor (e.g. in a car). An alternative method involves the combination of hydrogen and nitrogen to form ammonia, which is being developed as a fuel and hydrogen carrier for shipping and other applications.



So where does environmental noise come in?

Noise comes in during the generation of the renewable energy typically used for the hydrogen generation (electrolysis) process, as well as during the production, storage and distribution of the hydrogen itself.

Controlling noise from renewable energy sources

The electricity required for an industrial hydrogen plant typically comes from renewable energy sources, either directly or via the electrical grid. The renewable energy sources will typically include wind farms and solar farms.

Wind Farms generate noise due to the rotation of the wind turbine blades, and noise is assessed at the planning stage using the methodology described in the document ETSU-R-97 The Assessment and Rating of Noise from Wind Farms, DTI, September 1996. This methodology requires background noise levels to be measured at noise sensitive receptors in the vicinity of the proposed wind farm, typically over several weeks, and for predicted wind farm noise levels to be assessed against them over the range of operating wind speeds. Noise is typically controlled by locating the wind turbines an appropriate distance from noise sensitive receptors, selecting low noise wind turbines and, where applicable, limiting their operating modes.

Solar Farms are often assumed to be quiet since they have no moving parts. However, the direct current (DC) electricity they generate needs to be converted to alternating current (AC) for transmission via the grid, and this involves inverters which can be significant noise sources.

Additional electrical noise sources associated with renewable energy sources upstream of the grid connection to the hydrogen plant may include converters, rectifiers and transformers.

This noise would generally be considered at the planning stage by assessing predicted equipment noise levels against measured background noise levels at the nearest noise sensitive receptors in accordance with BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound. Noise from these sources is typically controlled by using enclosures, acoustic screening and low noise cooling fans.

Controlling noise from a Hydrogen generation plant

Once the electricity arrives at the Green Hydrogen Plant, there are many potentially significant noise sources that must be considered at the planning and early design stages, and the plant as a whole will typically be assessed for environmental noise impact using estimated equipment noise levels in accordance with BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound, along with environmental noise modelling in accordance with ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors.

The following table lists common noise sources associated with an industrial Hydrogen Plant, along with typical noise control measures associated with them.

Noise Source	Function	Typical noise mitigation measures	Comment
Electrolysers	Separate water into hydrogen and oxygen using electricity	n/a	Generally the electrolysis process does not generate high noise levels itself, however the associated equipment can be noisy, as discussed below.
Electrical equipment including inverters, converters, rectifiers and transformers	Associated with providing the electrical supply in the format required by each part of the industrial process.	Acoustic enclosure, low noise cooling fans, location inside a building, acoustic screens or pens, acoustic screening by buildings	Noise can be tonal.
Compressors and associated piping	Used for increasing gas pressures (e.g. for storage or distribution)	Acoustic enclosure, location within building, acoustic insulation on piping, below ground piping	Typically amongst the most significant noise sources and can be tonal.
Vents, valves and blowdown noise	Typically associated with hydrogen vents, pressure relief valves and purge systems	Absorptive or reactive silencers	Consider normal, start-up and emergency conditions.
Cooling Fans	Cooling gases and liquids associated with various stage in the hydrogen production process.	Low noise, low speed fans and inlet/outlet attenuators if practical.	Cooling fans can be a major noise source and can be difficult to attenuate.
Flares	Controlled combustion of excess gases	Low noise flare tip, acoustic screening by buildings, separation distance	Noise may be low frequency.
Pumps and associated piping	Pumps are used for multiple purposes including feedwater supply, electrolyte circulation, chemical dosing and firewater systems.	Low noise pumps and motors, acoustic enclosure, location within building, acoustic screening by buildings, acoustic insulation of piping.	Can be significant noise sources although generally much less so than compressors.

In many cases, there will also be an associated ammonia plant, incorporating an air separation unit that combines the hydrogen product with nitrogen to form ammonia. The ammonia then provides an easier method of transporting hydrogen, as well as being a useful product in itself (e.g. for fertilizer products). The noise sources associated with the ammonia plant will typically be similar to those associated with the hydrogen plant (e.g. compressors, pumps, vents, flares and piping).

Summary

Industrial hydrogen plants provide a means of utilizing renewable energy in such a way that it can be stored, distributed and used as and when required for a number of purposes, and as such the requirement for new plants in growing.

However, the processes and equipment associated with an industrial hydrogen plant generate environmental noise and it is therefore essential to consider this early on in a project, so that noise control can be allowed for in the design, costs and plant layout.

Spectrum Acoustic Consultants Ltd undertake noise impact assessments for wind farms, solar farms and Hydrogen Plants, as well as for all types of industrial development. For further information on noise and vibration studies please contact enquiries@spectrumacoustic.com