Argon gas plasma welding

Process equipment fabrication

Turning the clean energy vision into reality

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The growth in the clean energy sector and the associated emergence of new technologies, such as those required to secure the supply of low-carbon hydrogen or ensure energy efficient processing of energy reserves, is unstoppable. Whilst innovation continues and clean-tech start-ups emerge continuously, the role of traditional engineering, fabrication and construction workshops remains essential to convert these dreams into reality.

OPSCO Process Corp, is a Canadian company that has been providing innovative, customised solutions to the energy sector for over 55 years. Its roots lie in the manufacturing of heavy pressure vessels, and it has become an industry leader in modularised process equipment to support the energy transition. OPSCO supports many sectors with its manufacturing and fabrication facilities in Calgary, Alberta. It is committed to the development of cost-effective projects, in the traditional upstream, midstream, or downstream oil and gas sectors and in modern low-carbon energy systems such as hydrogen and carbon capture.

Liquefaction of methane using ammonia absorption chillers

Classical refrigeration cycles that are used for LNG liquefaction rely on electrical power and mechanical compression energy as the inputs to the refrigeration cycle.

The cold is achieved when hot compressed gases are cooled and then expanded. However, electricity is consumed, and power is not always abundant in locations where natural gas or biomethane must be liquefied to LNG. This is especially true for small-scale LNG plants that may be in remote locations, away from the electricity transmission grid.

The use of locally produced electricity from renewables to drive a mechanical refrigeration cycle may be possible but would require good sunlight or wind conditions. "In many places where methane liquefaction is required, such as Canada, we have neither the sunlight intensity nor the wind conditions that are required for renewable wind and solar power generation,", explains OPSCO's Executive Vice-President, Will Van Den Elzen.

"This is where the benefit of the ammonia absorption process comes to the fore – it can use waste heat from nearby processes, instead of electrical power, to drive the refrigeration cycle," he adds. Process integration allows energy efficiency, operating cost savings and contributes to environmental sustainability.

LNG is used in a diverse range of applications. Beyond its primary roles as being a major traded international commodity for regasification and power generation, shipping is increasingly turning to LNG as a low-emissions bunker fuel to comply with maritime air quality requirements. Liquefaction of excess methane to make LNG in upstream oil and gas operations is also an alternative to flaring, which simply burns excess methane releasing carbon dioxide emissions to the atmosphere without recovering the energy value of the natural gas.

Extension to bio-LNG and carbon capture

Small scale LNG liquefaction will be important to enable the cost-effective use of biomethane from remote locations, where there is no natural gas pipeline to put the biomethane for transmission to energy markets. Making bio-LNG can mean transportation by road, rail or ship is easier.

Furthermore, carbon dioxide (CO_2) liquefaction will become increasingly important in the drive to decarbonise and reduce CO_2 emissions. Liquefaction of captured CO_2 for subsequent distribution by train, truck, ship, to a CCS scheme will be essential in many locations as an alternative to high pressure compressed CO_2 transmission in pipeline infrastructure.

If waste heat instead of electrical power is available to drive the liquefaction, then it can be achieved without burdening the electricity grid and with reduced operating costs. The idea of using an ammonia absorption process as the chiller to liquefy the LNG or the CO_2 is therefore attractive, and it will often be the case that the flue gases or other parts of industrial processes where the CO_2 emissions emanate from will have waste heat available.

Turbo-charged technology

The basic technology related to ammonia/water absorption chillers has been known for 160 years. The earliest patent on the topic was prepared by the French inventor Ferdinand Caré in 1860. "Recent innovations have made the process that Caré conceived more robust to operate and enable a lower temperature to be achieved, which means the technology can be applied to gas liquefaction and small-scale LNG," says Van Den Elzen.

"One of the companies that we provide engineering services to and do fabrication work for is Cool Science," adds Van Den Elzen. "They have cemented their developments of this ammonia absorption refrigeration and LNG liquefaction technology in a comprehensive patent, which has been granted in many jurisdictions." The system can cope with a broad range of ammonia purities and has minimal control points which makes it very easy to operate.

Achievement of a very high vacuum on the ammonia suction of the compressor is the key innovation that Cool Science has built into its process to enable temperatures that previous embodiments of the technology have been unable to deliver. Van Den Elzen adds that, "a technology that is more than a century old has been turbo-charged through the implementation

Construction in the energy sector


High pressure gas cylinders


Infrastructure construction for clean energy transmission

of modern engineering and process control fundamentals. It builds on best practices used in adjacent energy processing sectors."

> "Until the hydrogen transmission infrastructure is mature, localised hydrogen production and utilisation can jump-start the hydrogen economy"

Anhydrous ammonia is also used as a refrigerant gas in compression-expansion thermodynamic cycles. It offers a high efficiency at very low cost and zero global warming potential. It also finds application in the heat treatment of metals, where it is cracked to produce hydrogen and a reducing atmosphere in annealing.

Small-scale steam methane reforming for distributed hydrogen production

It is hard to imagine what could derail the development of the emerging hydrogen economy. Positive sentiment and momentum related to the use of hydrogen as a renewable energy vector are at an all-time high. Many industrial, energy and transport applications will pull for significantly more hydrogen to displace fossil fuels.

The conviction to use hydrogen will stimulate major national infrastructure investments such as hydrogen distribution pipelines. Regional liquid hydrogen storage and distribution networks will also emerge. However, in no country does the hydrogen transmission and storage infrastructure yet exist. Until the hydrogen transmission infrastructure is mature, localised hydrogen production and utilisation can jump-start the hydrogen economy.

Van Den Elzen says that, "we also fabricate a range of modular steam methane reformers. They can be fed with methane from piped natural

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gas or biomethane and mains water to generate hydrogen." To drive the reaction kinetics in the reformer, heat energy must be applied at a high temperature. This is achieved by burning some of the natural gas to heat the catalysts inside the reactor tubes.

"Construction of process equipment for clean energy systems builds on our traditional competence in boilers and pressure vessels. Working with future-fuels will secure the relevance of our company for future generations of welders and metal workers."

Cutting and welding gases galore

Industrial gas mixtures in cylinders and pure industrial gases stored on-site and bulk cryogenic liquids are essential for fabrication of process equipment.

Various grades of stainless steel and carbon steel are used according to the fluids that will be handled in the process vessels. The gases required for welding each grade of steel and the fabrication process also differ.

For cutting thick sheet metal or pre-heating large areas prior to welding, fuel gases supplied in cylinders are used. The most intense heat and highest temperature flame can be generated using acetylene and oxygen. 'MAPP gas' (methyl acetylene priopadiene) is also in general use at OPSCO as a fuel gas. Whilst acetylene is broadly favoured for cutting, MAPP gas is ideal for oxy-fuel heating.

Cylinder gas mixtures are used as shielding gases for welding. Pure argon or a mixture of argon and carbon dioxide are used for welding carbon steel grades. Van den Elzen confirms that, "in the workshop we stick with two main shielding gas mixtures for carbon steel, 25% CO_2 in a balance of argon and argon with CO_2 at a blend ratio of 90% to 10%."

More complex gas mixtures containing 90% helium, 7.5% argon and 2.5% carbon dioxide are used for stainless steel. "We prefer to use bottled gas mixtures rather than mix-on-site," says Van den Elzen. "We find the repeatability of the cylinder gas pre-mixes is more reliable than blending the gases ourselves from pure bulk gases."

Oxygen is delivered to OPSCO as bulk cryogenic liquids. Argon is used in high quantities as a backing gas, in addition to its use as a shielding gas. Nitrogen is also used for purging, pressure testing and drying applications.

"For our main gases, we prefer bulk supplies because there is less cylinder handling and the storage takes up less space", explains Van Den Elzen. "There are piping manifolds to supply the gases around our factory to the various work centres where they are used." gw