

Biogas to Hydrogen Upgrading

Shikaoi Hydrogen Farm®



“Air Products is poised to be the leader in alternative fuel supplies for biogas, hydrogen, and emerging technologies. It is exciting to be part of a company that is driving the future of transportation fuels.”

John Hoffmann, Business Development, Air Products Prism Membranes



Fuel of the future

Clean and renewable

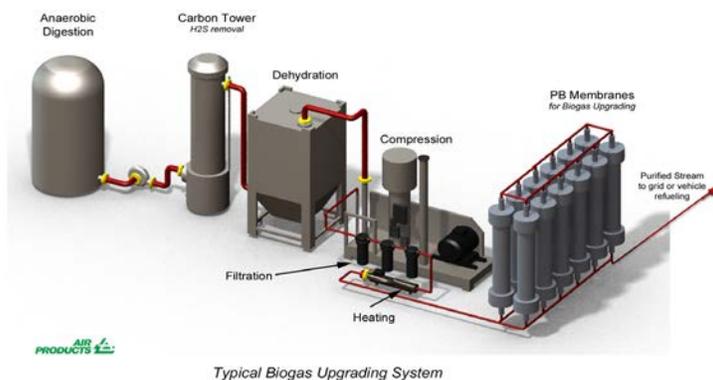
The biogas-to-hydrogen upgrading concept has been studied for a number of years. Until now, the concept has been theoretical. Air Products PRISM PB Membrane technology is part of a five-year business project sponsored by the Ministry of the Environment in Japan for low-carbon hydrogen technology.

The system operating in Shikaoi, Hokkaido Japan utilizes a waste stream from agricultural activities, like animal droppings, general organic wastes, and spent crop items which are digested in an anaerobic digester. These anaerobic digesters (AD's) utilize natural microorganisms to break down the materials through a digestion process. This process releases large volumes of carbon dioxide and methane, a mixture called biogas.

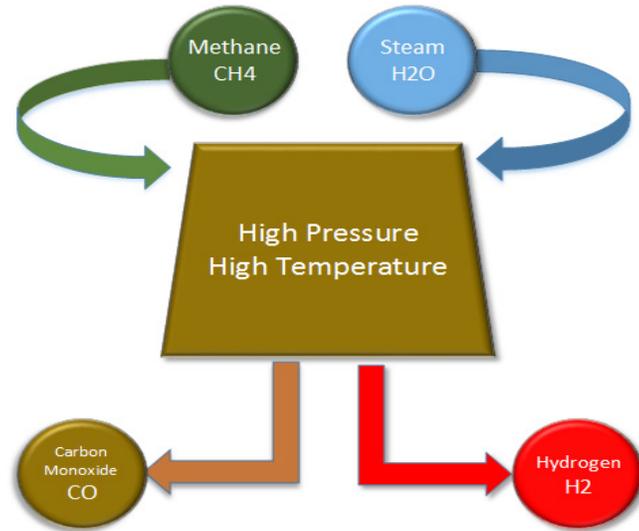
Upgrading is key

Clean gas is efficient gas.

The biogas has a low heating coefficient as the large volumes of carbon dioxide interfere with the combustion process. A series of Air Products PB Membrane separators are used to strip off the carbon dioxide molecules leaving a purified stream of methane. The membrane separators act like a molecular filter. The smaller carbon dioxide and water molecules diffuse through a hollow fiber membrane at high pressure leaving the larger methane molecules to exit through the process. With the carbon dioxide removed, the methane (CH₄) can be used for fuel.



The next step is to split the hydrogen molecules (H₂) from the methane (CH₄) to get the final product. This is completed with a steam/methane reformer. High pressure and temperature steam is generated from water (H₂O) and combined with the methane (CH₄) to create a reaction that produces a flow of H₂ molecules and CO molecules. The hydrogen is purified and then compressed to feed two streams: internal combustion vehicles, like forklifts at 5,000 psi, and hydrogen-cell vehicles at 10,000 psi.



First of Its Kind

Turning theory into reality

The Shikaoui Hydrogen Farm[®] is a five-year business project entrusted by the Ministry of the Environment in Japan for low-carbon hydrogen technology. The project demonstrates an integrated hydrogen energy-based supply chain,



leveraging local renewable energy sources for hydrogen generation, storage, transportation and use. The hydrogen is returned to local livestock farmers and neighboring facilities as a source of renewable energy and fuel. Hokkaido's first hydrogen-vehicle fueling station is installed at the Farm, which delivers fuel to hydrogen-powered vehicles.

Air Products (NYSE:APD) is part of a consortium with Air Water Inc., Kajima Corporation, NIPPON STEEL & SUMIKIN Pipeline & Engineering Co. Ltd., to develop the retail automotive hydrogen fueling infrastructure in Japan. The group of companies introduced the Shikaoi Hydrogen Farm®, a hydrogen production supply facility derived from livestock biomass waste located in Hokkaido, Japan. Air Products supplies the PRISM PB Membrane technology for the biogas purification and SmartFuel® hydrogen fueling technology for this project.



Air Products' PRISM® PB membrane separators have been used extensively for biogas and process gas upgrading facilities worldwide. The PB Membrane separators are PED certified to meet the Class-III requirements for safe flammable gas processing. This eliminates the need for secondary pressure vessels, making them a flexible alternative where space and access are limited.



Air Products' SmartFuel® hydrogen fueling stations provide hydrogen fueling at 35 Mpa (5,000 psi) and 70 Mpa (10,000 psi) in compliance with JPEC (Japan Petroleum Energy Center) S0003. Use of the company's fueling technology is increasing and is already used in approximately 1,500,000 hydrogen fills per year. Air Products has been involved in over 200 hydrogen fueling projects in the United States and 20 countries worldwide.

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