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 concept has been studied for a number of years. Until now, the concept has been theoretical - create clean buring hydrogen fuel from renewable sources rather than synthesizing with fossil fuels. Today, Air Products PRISM PB Membrane technology is making this theory a reality.

The Shikaoi Hydrogen Farm® in Shikaoi, Hokkaido Japan uses a waste stream from agricultural sources, 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. The biogas, when upgraded into purified bio-methane, is the source gas used to synthesize hydrogen.

First of Its Kind

Turing theory into reality

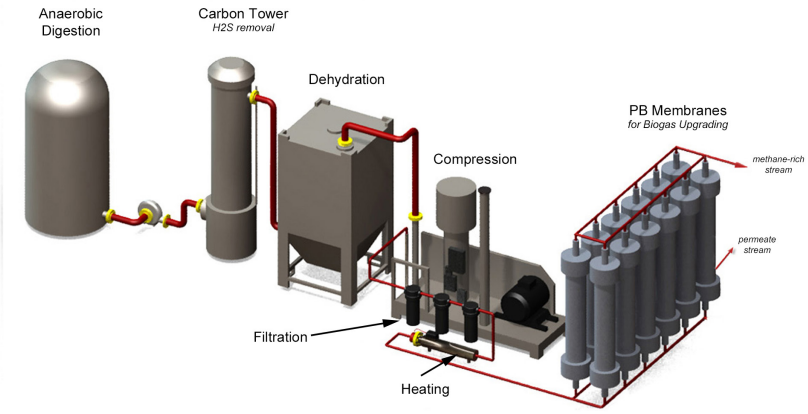
The Shikaoi Hydrogen Farm® is a five-year business project entrusted by the Ministry of the Environment in Japan for low-carbon hydrogen technology. The project demonstrates an integrated hydrogen energy-based supply chain, leveraging local renewable energy sources for hydrogen generation, storage, transportation and use. The Farm generates heat, hot water, and electricity, in addition to the hydrogen. The hydrogen is containerized and returned to local livestock farmers and neighboring facilities as a source of renewable fuel. Also, Hokkaido's first hydrogen-vehicle fueling station is installed at the Farm, which delivers fuel to hydrogen-powered vehicles.

PRISM PB Membrane Separators

Upgrading is key

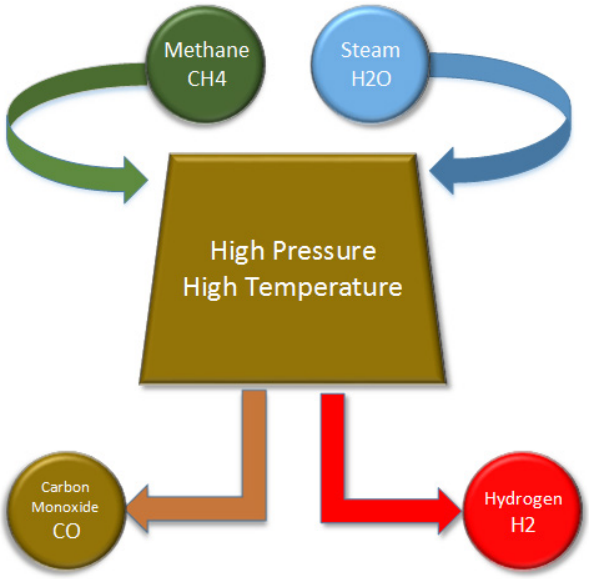
Clean gas is efficient gas.

The biogas composition has a low heating coefficient because large volumes of carbon dioxide and water vapor interfere with the combustion process. A series of Air Products PB Membrane separators are used to upgrade the biogas into a purified stream of methane. The PRISM PB Membrane separators act like molecular filters, allowing smaller carbon dioxide and water molecules to diffuse through a hollow fiber membrane at high pressure, leaving the larger methane molecules to exit through a separate port. With the carbon dioxide and water molecules removed, the methane (CH4) can be used for hydrogen synthesis and bio-fuel.



Typical Biogas Upgrading System
Not to scale

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 compressed into two streams of vehicle fuel: internal combustion vehicles, like forklifts, at 5,000 psi and hydrogen-cell vehicles at 10,000 psi.



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.

For more information, please contact us at:

Air Products Prism Membranes
11444 Lackland Road
Saint Louis, MO 63146 USA
T 1-314-995-3300
membrane@airproducts.com
or visit www.airproducts.com

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tell me more
airproducts.com