HAFFMANS
BIOMETHANE &
GREEN CO₂

BIOGAS UPGRADING USING
MEMBRANE & CRYOGENIC TECHNOLOGY
FROM BIOGAS TO BIOMETHANE & GREEN CO₂
Biogas is a key renewable energy source that provides an alternative now and for the future. Upgrading biogas to biomethane, which can be fed into the public natural gas grid, offers additional potential. Pentair Haffmans’ advanced biogas upgrading technology has substantial advantages compared to conventional systems.

Biogas is produced through an anaerobic fermentation process in which biological material is broken down in an oxygen-free environment. Biogas consists primarily of methane (CH₄) and carbon dioxide (CO₂). When biogas is upgraded to biomethane using conventional techniques the process produces CO₂, a by-product. The CO₂, which contains a considerable amount of CH₄, is expelled into the air. This harmful ‘methane slip’ is not only bad for the environment, but also a wasted energy resource.

Pentair Haffmans’ biogas upgrading technology recovers 100 percent of the CH₄, and completely eliminates the methane slip. This results in a higher CH₄ yield and no emission of the harmful CH₄ greenhouse gas. The biomethane produced with Pentair Haffmans’ biogas upgrading technology has the same specifications as natural gas, which makes it fully compatible to the existing natural gas infrastructure and applications. Optionally, the CO₂ by-product can be recovered for use in a variety of applications, providing an additional income source.

Benefits
- High CH₄ yield
- No CH₄ slip
- No chemical use
- Green CO₂ as a profitable product
- Various system configurations
- Compact solutions
- Advanced Service Level Agreements

ABOUT PENTAIR PLC

Pentair plc (pentair.com) delivers industry-leading products, services, and solutions for its customers’ diverse needs in water and other fluids, thermal management, and equipment protection. With 2015 revenues of $6.4 billion, Pentair employs approximately 28,000 people worldwide. Pentair Haffmans’ proven products and technologies are used in the brewing, soft drink, wine, distillery, bioethanol, and biogas industries to recover foodgrade CO₂ from the fermentation processes. Whether you need a standard-size system or custom-designed solution, Pentair Haffmans manufactures and commissions components and standardized solutions.
MEMBRANE TECHNOLOGY
OUR MEMBRANE SOLUTION

Pentair Haffmans has extensive knowledge in membrane separation technology, specifically for the separation of $\text{CH}_4$ and $\text{CO}_2$. By partnering with us you can be assured of receiving the best solution for your specific biogas upgrading project.

The heart of the system is the membrane separation unit. Membrane technology for upgrading biogas is a relatively new technology, but already has an extensive proven record. The benefits of membranes against other types of separation systems such as water scrubbing, amine washing and pressure swing systems are recognized by the gas upgrading market.

Membranes for gas separation
To make an efficient $\text{CO}_2$/ $\text{CH}_4$ separation possible, the impurities must first be removed. One of the most important techniques for doing this is the use of activated carbon that absorbs undesirable substances.

The membranes separate the two major gas components: $\text{CH}_4$ and $\text{CO}_2$. The separation is accomplished through the pressure difference over the membrane surface. The high pressure biogas is fed into the membrane and the $\text{CO}_2$ passes through the membrane surface to the permeate - the low pressure side - much quicker than $\text{CH}_4$. The membranes are pressure driven, so the higher the pressure the more $\text{CO}_2$ will pass through the membrane surface.

The discharge from the membrane (the retentate) contains mainly $\text{CH}_4$ as the $\text{CO}_2$ has been pushed through the membrane surface. The $\text{CO}_2$ rich gas will leave the membrane on the low pressure side of the membrane (permeate).

Multistage solutions
Using a multi-membrane system 99 percent of the $\text{CO}_2$ can be removed from the biogas, which provides a cost efficient biomethane production system. Haffmans can also provide a two-stage membrane system together with a cryogenic system that operates with no methane slip. This system provides two valuable products: biomethane and 100 percent liquid $\text{CO}_2$.

Benefits
- No additional chemical or operating media
- Energy efficient separation of $\text{CH}_4$ from $\text{CO}_2$
- Separation at ambient temperatures
- Continuous separation process.
- No heat requirement
- Compact modular design, flexible and easily expanded
- Cost efficient for smaller capacities
- Cost efficient removal of $\text{CO}_2$
CRYOGENIC TECHNOLOGY
CO₂ RECOVERY & 0% METHANE SLIP

Pentair Haffmans goes one step further by recovering the CO₂ gas after the membrane separation unit. This system recovers 100 percent of the CH₄ by producing 100 percent pure CO₂ and sending all impurities – including the CH₄ – back to the membrane system, instead of reducing CH₄ emissions by burning the CO₂ rich stream coming from the membrane system.

The portion of environmentally-harmful greenhouse gases released to the atmosphere is reduced to zero, which makes this technology a future-proof investment. This is especially significant with regards to EU Regulations for further reduction of global warming emissions.

As the produced CO₂ complies with EIGA (European Industrial Gases Association) specifications, an additional option is to sell the liquefied CO₂ to a third party. Pentair Haffmans partners with a major industrial gas company and can assist plant operators.

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Benefits
- No methane slip
- No additional chemicals
- No heat required
- Compact, modular design
- Easy to operate
- Standardized containerized solutions
- Green CO₂ as profitable product

Liquid CO₂ for
- Dry ice
- Welding gas
- Greenhouses
- Fire extinguisher
- Food & Beverage production

The CO₂ produced in the recovery installation can reach high specifications for use in the beverage industry, greenhouses and food freezing applications. The CO₂ recovery installation is an important advantage in a sustainable operation and a CH₄ yield of 100 percent.
ENGINEERED SOLUTIONS
An increasing number of biogas producers want to have an effective carbon dioxide (CO₂) and biomethane recovery management to maximize revenue and minimize environmental impact.

Pentair Haffmans offers four solutions for biogas upgrading and CO₂ recovery using membrane and cryogenic technology. The overview shows the biggest differences in revenue streams and methane slip recovery.
TALK TO THE EXPERTS
LIFE CYCLE MANAGEMENT

Through comprehensive life cycle management, we ensure that your system continues to meet your expectations. We offer custom-made service plans that range from maintenance contracts to full Service Level Agreements. An experienced service team works with you to create the service program that is right for you.

Original spare parts
Pentair Haffmans provides competitively priced original spare parts. Spare part packages and stock consulting, based on our years of experience, help you reduce costs and keep your plant in operation.

Certified global service teams
Pentair Haffmans has a presence in more than 150 countries. No matter where your plant is located, our global network of professional service engineers with extensive know-how and experience ensures maximum performance of your system.

Remote service
At our remote service facility a data connection line instantly puts Pentair Haffmans’ experts online with your system. This service maximizes your plant’s uptime.

Plant audits/maintenance
On-site inspection and preventive maintenance of your biogas upgrading system is an efficient way to maximize your plant’s performance. All visits include a detailed report on the status and performance of your plant.

24/7 technical support
Pentair Haffmans offers unparalleled customer service and technical support. To help you achieve maximum plant efficiency, product specialists are available 24/7 by phone, email or remote service.

24/7 TECHNICAL SUPPORT
CERTIFIED GLOBAL SERVICE TEAMS
REMOTE SERVICE
DATA MONITORING/TRENDING
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ORIGINAL SPARE PARTS
PLANT AUDITS/MAINTENANCE
MORE CONTROL
BETTER ECONOMICS
OPTIMAL UTILIZATION
CONTRACT MANAGEMENT / SERVICE LEVEL AGREEMENTS