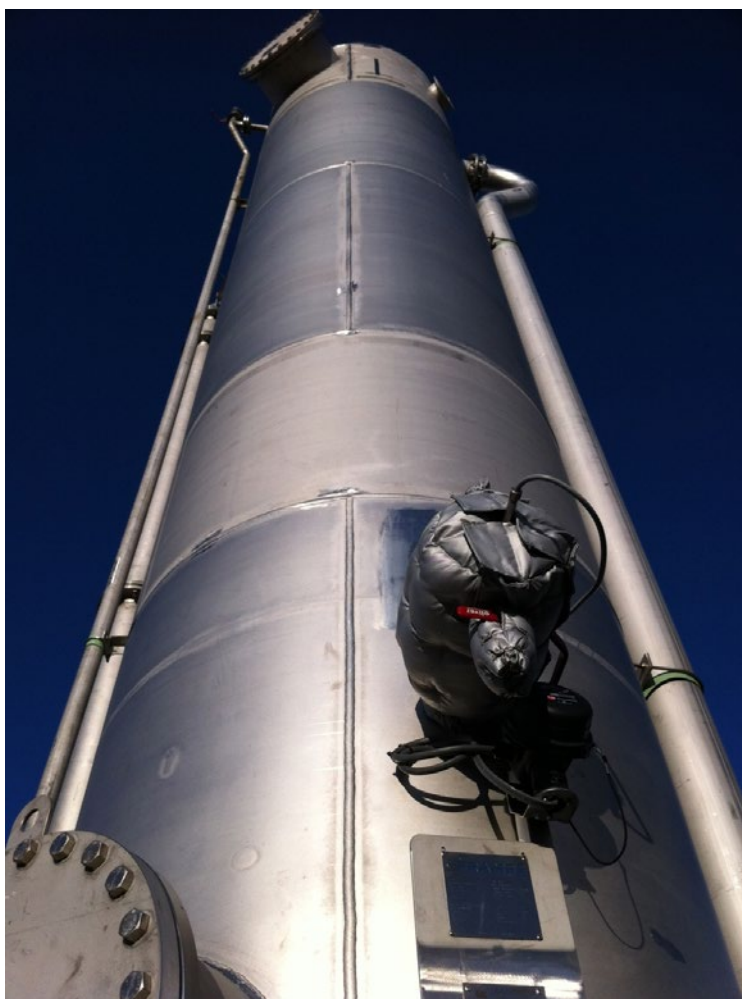


HYBRISOL®



CO₂ absorption column HVC Middenmeer

Product Definition

A world powered by renewable energy is not only possible, it is inevitable. Biogas is expected to become one of the main energy sources in the future. Frames Renewable Energy Solutions is a supplier of biogas upgrading technology and enables customers to create profitable businesses. HYBRISOL®, a technology developed by Frames, is the most cost effective upgrading technology currently available.

Biogas is a source of methane as well as CO₂, and both gases can be converted into saleable products in order to maximize profitability and minimize CO₂ emissions. The Frames HYBRISOL® process

uses physical solvent absorption and membrane technology to produce a saleable biomethane stream and, as an added bonus, a very pure stream of CO₂ gas. The pure and dry gaseous CO₂ stream is suitable for immediate use in various processes or can be liquefied for later use.

Furthermore, the Frames HYBRISOL® process removes virtually all water and VOC's - like terpenes - from product streams. The combination of physical absorption and membrane separation results in major operational cost synergy.

Product Description

Biogas contains the valuable gases methane and CO₂, but also trace gases like H₂O, H₂S, NH₃ and VOC's. The exact composition is primarily determined by the used feed material. H₂S is a highly toxic gas that first needs to be removed from biogas using, for example, the Frames LAMINOL® technology. The Frames HYBRISOL® technology can then remove remaining trace gases such as NH₃, H₂O and VOC's.

The main VOC's in biogas are terpenes like D-limonene, alpha-pinene and p-cymene, which need to be removed because they can mask the odor of THT added to natural gas. The best process for removing terpenes from biogas is adsorption based on activated carbon, but this is accompanied by high operating costs. HYBRISOL® technology removes terpenes in a single step to below the odour threshold at merely a fraction of the cost of using activated carbon adsorption. Water is first removed via physical absorption and subsequently via membrane separation. This results in a product gas dew point of less than -40°C.

Physical solvent is used to remove terpenes, water and CO₂ from biogas. In conventional physical solvent systems, the rich solvent is regenerated

HYBRISOL®



CO₂ removal HVC Middenmeer



Flaring system HVC Middenmeer



Overview green gas installation HVC Middenmeer

via air stripping. HYBRISOL® technology prevents the CO₂ product being diluted by air, by using an atmospheric flash to remove the CO₂ from the solvent. The CO₂ product is very pure (>98.7%) because no terpenes and almost no water will flash from the solvent under these conditions.

The combination of physical absorption and membrane separation creates a process that produces a green gas and a CO₂ product stream, which are both free from terpenes and water. HYBRISOL® is characterized by a low recycle ratio (~18%), low operating costs (~0.185 kWh/Nm³ raw gas) and low methane slip (< 0.5%).

Process Description

The Frames HYBRISOL® process treats the H₂S-free biogas which is first compressed to 10 barg, cooled to 5°C in two steps and then sent to the bottom of the absorber. Semi-lean solvent enters the absorber at the top and absorbs the H₂O, CO₂ and terpenes from the raw biogas. The partly treated biogas, which is dry, free from terpenes and lean in CO₂, leaves the absorber via the top and is sent to a membrane unit where the remaining CO₂ and water is removed and a saleable product gas is obtained. The CO₂ concentration in sales gas can be accurately controlled by adjusting the permeate pressure. The CO₂ permeate, which is rich in methane, is sent back to the inlet of the compressor.

The rich solvent from the absorber is first flashed in a high pressure flash, where most of the methane is recovered. This flash gas is used as stripping gas in the high temperature solvent reclaimer and subsequently sent to the inlet of the compressor. The solvent leaves the high pressure flash and is sent to the atmospheric flash, where most of the CO₂ is removed as a gaseous and pure CO₂ product stream.

A small fraction of the solvent circulation is sent to a reclaimer unit where water and terpenes are stripped from the solvent using elevated temperatures. The reclaimer unit produces a water condensate stream and a concentrated terpene mixture.

HYBRISOL®

Project Management

Good project management is like being a football manager – you have to direct and coordinate all efforts in order to optimize the results of the team.

At Frames, we work as a coordinated team that focuses on integrated solutions. Our multidisciplinary teams ensure smooth integration of Frames technology unit operations with technologies provided by partners or sub-contractors, in order to create a total biogas processing solution. By combining our project management system with the skills of our project managers, we can punctually deliver equipment for all projects, while paying particular attention to our health, safety, environment and quality requirements, as well as those of our clients.

Thanks to a network of international partners and a worldwide supply chain, our clients benefit from smart services provided by a strong and global project management company.

Technical Details

- The patented HYBRISOL® process maximizes resource yield and plant profit
 - The process produces two product gases from raw biogas, i.e. green gas and CO₂ gas,
 - Terpenes and other VOC's are removed without using activated carbon
 - Gas product dew point < -40°C
 - Low methane slip < 0.5%, which is zero when CO₂ gas is liquefied
 - Low recycle ratio of less than 18%
 - Typical energy consumption of ~0.185 kWh/Nm³ raw gas*
- * Exact energy consumption depends on gas composition and is a little higher in summer and lower in winter

Added Value Frames

- HYBRISOL® is a state-of-the-art upgrading technology patented by Frames.
- We work with you to optimize total site productivity
- Fast commissioning for advanced cash flow
- Fully compliant with international safety and environmental standards
- Simple commissioning and years of trouble-free operation
- Worldwide presence for fast service provision

References

- HVC Middenmeer – the Netherlands
- Groot Zevent Vergisting – The Netherlands

Frames Family Tree



Onshore

Offshore

Floaters

Renewable Energy



Turn-key Biogas Installations

- Green Gas Installations (GGI)
- Combined Heat and Power (CHP)
- Compressed bio-methane (CBM)
- Liquefied bio-methane (LBM)

Biogas and Bio-synthesis Gas Upgrading (CO₂, H₂S, VOC, NH₃ & H₂O)

- Hybrisol®
- Laminol®
- Ammonia Scrubber
- Hydrogen separation

Bio-methane Grid Injection

- Metering
- Odorizing
- N₂-injection
- LPG-addition

Turn-key CO₂ Installations

- Bio-CO₂ for horticulture
- Industrial capture and application of CO₂
- Carbon Capture and Storage (CCS)

Flue gas CO₂ capture

- Galloxol®
- Liquefied CO₂

Oil & Water



Multiphase Separation

- Production Separators (High & Low Pressure)
- Test Separator
- Degasser & Knock-Out Drum
- Water Oil Separator (WOSEP)

Compact Inline Separation

- SwirlSep

Electrostatic Coalescers

- Dehydrator
- Desalter

Produced Water Treatment

- Deoiling & Desanding Hydrocyclones
- Gas Flotation
- Media Filtration
- Solids Removal & Cleaning
- Stripping

Separation Internals

Heat Exchangers

Gas



Gas Separation

- Demisting
- Scrubbers
- Filters
- SwirlSep

Heat Exchangers

- Shell & Tube Heat Exchangers

Air-Cooled Coolers

Gas Sweetening (H₂S & CO₂)

- Amines
- Thiopaq O&G
- Solid Bed Scavenger
- Membrane
- Molecular Sieve

Gas Dehydration

- Glycol (TEG)
- Molecular Sieve

Dew Point Control

- Low Temperature Separation (LTS)
- Solid Desiccant

Hydrate Inhibition

- MEG/DEG Recovery
- Methanol Recovery
- MEG/DEG Desalination

Light Hydrocarbon Recovery

- Condensate Stabilization
- Fractionation

Fuel Gas Treatment

Flow Control & Safeguarding



Hydraulic Systems

- Wellhead Control
- Subsea Hydraulic Power Units
- Hydraulic Power Units
- IWOC (Intervention Workover Control Systems)
- TUTU (Topside Umbilical Termination Unit)
- Cargo Ballasting Systems

Safety Instrumented Systems

- High Integrity Protection Systems (HIPS)

Chemical Injection

- Chemical & Methanol Injection Systems
- Chemical Distribution Systems
- Seawater Electrochlorination Systems

Valve Automation Center

- Actuators and Actuated Valve Packages
- Control Systems

Automation

- Buoy Telemetry
- Tank Farm Control & Safeguarding

Wellsite Packages

Services



Asset Life Cycle Management

Maintenance & Field Services

Commissioning & Start-up

Spare Parts

Operator Training

Engineering Studies

- Conceptual
- FEED and Basic

Integrated Solutions

