

NATURAL GAS MEMBRANES

ProSep's membrane technology and packaging capabilities provide customers with cost-effective CO₂ removal/separation, H₂S removal, N₂ removal, dehydration, and hydrocarbon dew point control solutions.



BENEFITS

- + Longer life than cellulose acetate
- + Resistance to liquid hydrocarbon and water exposure
- + Higher hydrocarbon recovery
- + Interchangeable with conventional membrane elements
- + Low capital investment for membrane system
- + Easy start-up and shutdown
- + Minimal utilities required
- + Scalable membrane skids configured for any operational environment
- + Low maintenance and OPEX
- + Wide range of feed gas pressure, compositions and flow rate (high turndown)
- + Low weight & space requirements
- + Flexible to fit special footprint configurations particularly important for offshore applications

EXPERIENCE

ProSep has designed, engineered, fabricated, installed, and commissioned over 200 membrane separation units for natural gas applications in 15 countries worldwide.

We have extensive experience with gas separation membrane performance characterization and the potential contamination effects that may occur.

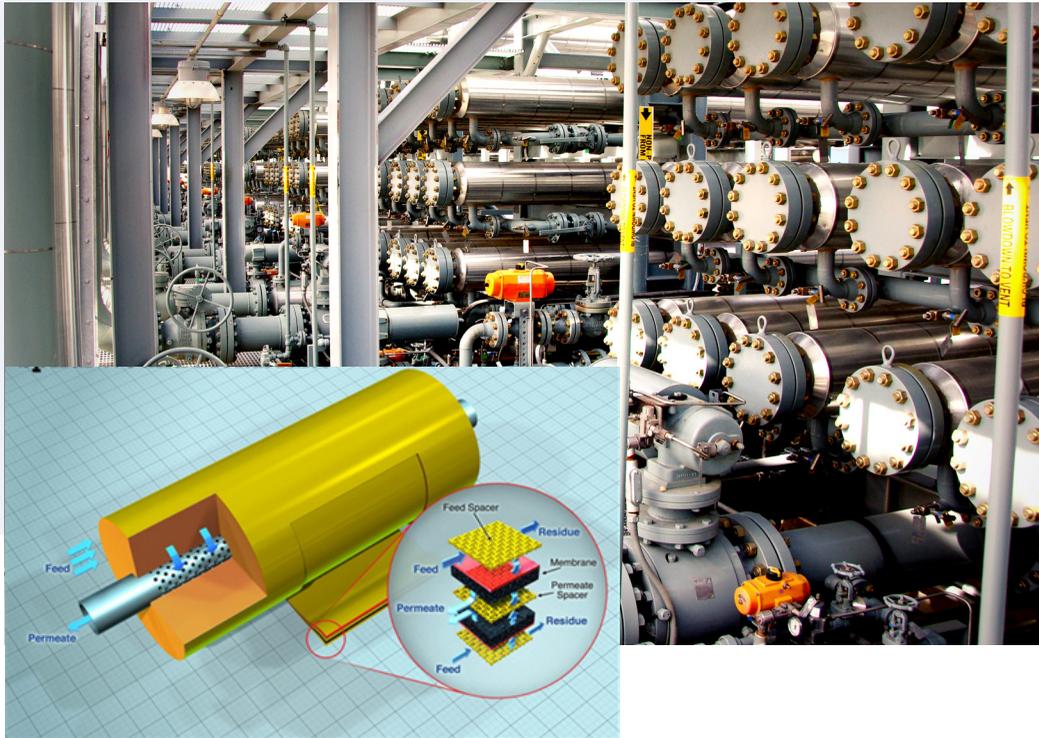
ProSep can provide turnkey solutions from project design through fabrication, commissioning & start-up to post-installation service, including parts replacement.

CO₂

Historically, CO₂ removal in natural gas streams has been conducted using amine systems. However, over the past twenty years membrane systems have gained notable traction in this market segment with ProSep leading in innovation and system design.

Ease of operation, flexibility, and lower capital requirements routinely make membranes the system of choice for CO₂ removal from natural gas streams. ProSep's membrane systems successfully treat feed gas at a wide range (between 3% - 88%) of inlet pressures and feed gas concentrations.

The same CO₂ membrane systems used to sweeten our customers' natural gas sales line can also be used to concentrate CO₂ for injection for EOR applications.

PROSEP CO₂ REMOVAL MEMBRANES IN FIELD, VENEZUELAAPPLICATIONS
CO₂ REMOVAL

- + Pipeline sales gas conditioning
- + Enhanced oil recovery (EOR) operations
- + Fuel gas conditioning
- + Replacement and/or de-bottlenecking of amine plants

OTHER
MEMBRANE
APPLICATIONS

In addition to CO₂ removal from natural gas streams, ProSep membrane solutions have also been used for:

- + Natural gas dehydration
- + Hydrocarbon dew point control
- + H₂S removal

HOW IT WORKS

Separation by use of membrane technology in natural gas treatment is a concentration driven process directly related to the pressure of the feed and permeate gas streams (the differential pressure across the membrane), as well as the membrane characteristics. Separation is driven by the component partial pressure difference across the membrane layers. ProSep has developed a deep understanding of this process through our experience with a wide variety of applications.

Our membrane element is produced as a flat sheet and formed by packaging several of these flat sheets into a spiral wound module which

is then inserted into steel pressure-containing tubes.

A spiral wound module (illustrated above) consists of membrane envelopes that are constructed of a single membrane sheet folded and glued along the sides with the active surface facing outward. Spacers are used to keep the membrane sheets separated to ensure optimal conditions for both the feed and permeate streams to flow. The open end of each membrane envelope is attached to a perforated stainless steel permeate discharge header.

PROSEP MEMBRANE SKID FOR CO2 REMOVAL & MEMBRANE MODULES IN FIELD, TEXAS, USA



GAS PRE-TREATMENT SKID

Protection from contaminants is provided by pretreatment equipment consisting of all or any one of the following:

- + High-efficiency coalescing filter(s)
- + Guard bed(s) containing activated carbon adsorbent
- + Polishing filter(s)
- + Thermal swing adsorption (TSA) unit(s)
- + Mechanical refrigeration unit(s)

This equipment is designed to remove small liquid aerosols, particulate matter, and certain heavy and aromatic vapor-phase hydrocarbon contaminants as required.

PROSEP'S MEMBRANE SKID

ProSep's membrane skids are modular in design and construction lending themselves to easy scalability as production volumes and concentrations change. ProSep membrane skids are designed to allow seamless addition or removal of membrane elements to compensate for process changes.

Our 56,000 sq.ft. purpose built fabrication facility has the capabilities to undertake the manufacture of large structural fabrications, vessels and piping spools, as well as being able to fully manufacture packaged membrane equipment.



PROSEP MANUFACTURING, HOUSTON, TX



PROSEP MEMBRANES INSTALLED CALIFORNIA, USA AND COLOMBIA



PROCESS

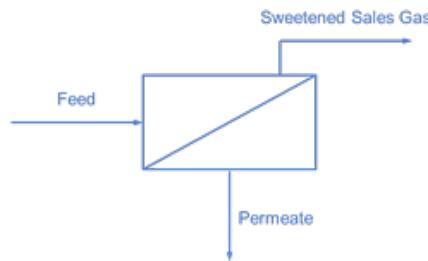
Typically membrane based CO₂ removal includes a pretreatment section and a membrane separation section which may involve one or two stages.

ONE STAGE AND TWO STAGE MEMBRANE SYSTEMS

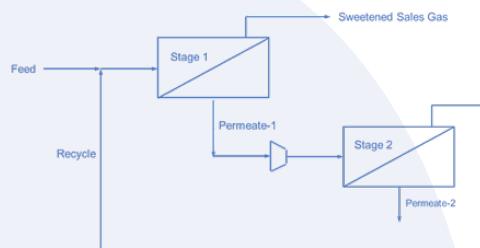
Depending on the design operating conditions, ProSep membrane systems are provided in one or two-stage designs.

- + One stage configuration
- + Two-stage configuration

In some instances a two-stage system may be required to achieve maximum undesirable component content in the permeate stream and maximum hydrocarbon recovery to the sales pipeline. Performance of two-stage systems can achieve up to 99% hydrocarbon recovery in the sales gas stream. This configuration also leads to an increased gas volume in the sales gas stream.



ONE STAGE CONFIGURATION



TWO STAGE CONFIGURATION

WHY PROSEP?

- + Recognized as a global leader in the CO₂ membrane market as well as process application and optimization
- + Experience with new, robust, top of the line membranes as well as other sweetening membranes including flat sheet and hollow fibre designs
- + Global presence with over 200 membrane systems installed
- + Well-documented global reputation and track record for performance, value and safety
- + Offer design, fabrication, commissioning, maintenance and lease options for membrane skids
- + Provide timely response to fulfill our customer needs globally