



PRISM[®] Membrane Systems
for ammonia plants . . .
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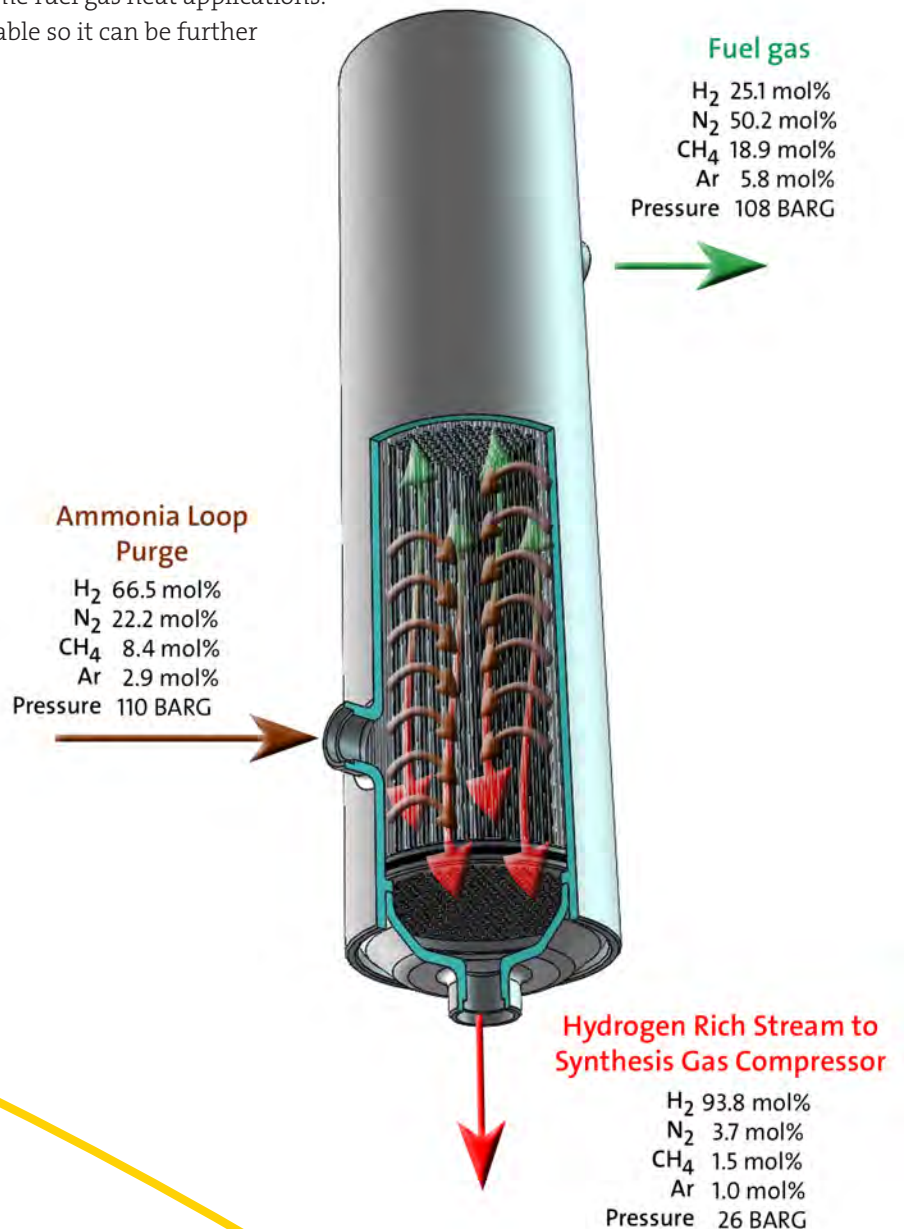
Air Products PRISM Membrane Systems are found in ammonia synthesis plants around the world operating efficiently and economically.

PRISM Membrane Systems increase the efficiency of ammonia plants by recovering hydrogen from purge gas streams.

How membrane separators work in ammonia plants

At 110–130 BARG, the synthesis loop purge-gas enters the membrane separator. The gas composition includes hydrogen and high concentrations of methane and argon that accumulate in the synthesis loop. Hydrogen molecules quickly permeate through the skin of the membrane and migrate out of the permeate port at a lower pressure (25–70 BARG). This upgraded hydrogen stream is returned to the synthesis loop to supplement the feed stock of synthesis gas.

Larger molecules do not permeate through the membrane wall. They form the 'non permeate' gas stream exiting the non permeate port at 100–120 BARG. The flow of non permeate gas, which contains argon, nitrogen, methane, and some hydrogen, is suitable for some fuel gas heat applications. In some cases, the argon is quite valuable so it can be further refined in other processes.



Ammonia plant application of PRISM Membrane Systems

Hydrogen recovery from ammonia purge gas

Ammonia is produced by introducing a synthesis gas stream into a catalytic reactor. The synthesis gas is comprised of hydrogen, nitrogen, and inert byproducts like methane and argon. Ammonia conversion does not completely synthesize in the first pass, so the process requires the components to be looped through a cycle. This process causes the inert byproducts to accumulate and purge.

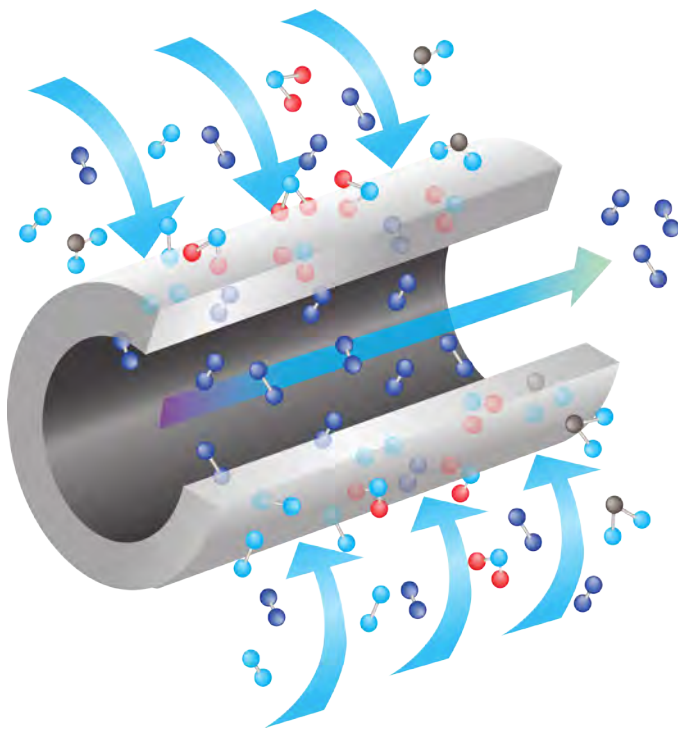
The resulting purge gas contains high concentrations of the synthesis gas components. It also includes ammonia, which is not removed by the liquefaction step. If not reclaimed, this can be a costly waste of ammonia.

PRISM Membrane Systems treat the purge stream by recovering ammonia as the product and returning the hydrogen to the synthesis loop. The system usually includes a water scrubber to recover ammonia lost in the purge. PRISM Membranes recover 90% of the hydrogen in the purge gas to increase ammonia production. The system is easily adjusted to meet fluctuating production of the ammonia plant.



How membranes work for gas separation

Gas molecules permeate across the thin skin of the hollow fiber wall driven by a partial pressure difference. The permeation rate is specific to the gas-polymer pair. The transport mechanism is a combination of solubility into and diffusion through the membrane. Separation capability is determined by the relative permeation rates of the individual gas components. The greater the difference in permeability, the greater the effective separation by diffusion.



Membrane separators contain thousands of hollow fibers.

**Air Products’
PRISM membranes:
experience,
performance,
and value.**



Membrane separator design

- Easy installation of single membrane bundle in each pressure vessel.
- Simple and durable differential pressure seal design.
- Axial packed fibers (rather than tightly wound configuration).
- Pressure vessels built to: ASME, PED, GOST, GB, and other international codes.
- Available in 4-inch (100mm) and 8-inch (200mm) diameter.

Membrane arrangements

Series and parallel

- Series arrangement allows easy capacity turn up and turn down while protecting downstream separators from pretreatment upsets.
- Parallel configurations accommodate larger flow volumes.

PRISM Separators have no ramp-up requirements so they can be activated immediately when process volumes increase.



Features:

Flexible

PRISM Membrane Systems provide operating flexibility when planned or unexpected process changes occur. Some turndown is absorbed by the flexibility of the system and increased capacity requirements are met by the addition of more separators. Additional turndown is accomplished by valving off separators which maintains recovery and purity. Multiple takeoffs from the permeate manifold provide streams of different purities and flow rates. Some applications require feed gas pre-treatment.

Compact

The compact membrane system fits into small or crowded plants. Its efficient and modular design will minimize site installation time and expense. Site preparation is minimal, requiring only a simple concrete support pad plus process and utility lines. Tie-ins to the pre-assembled system usually require no special shutdown. PRISM Membrane Systems can be moved because the separator assembly is skid mounted.

Efficient and economical

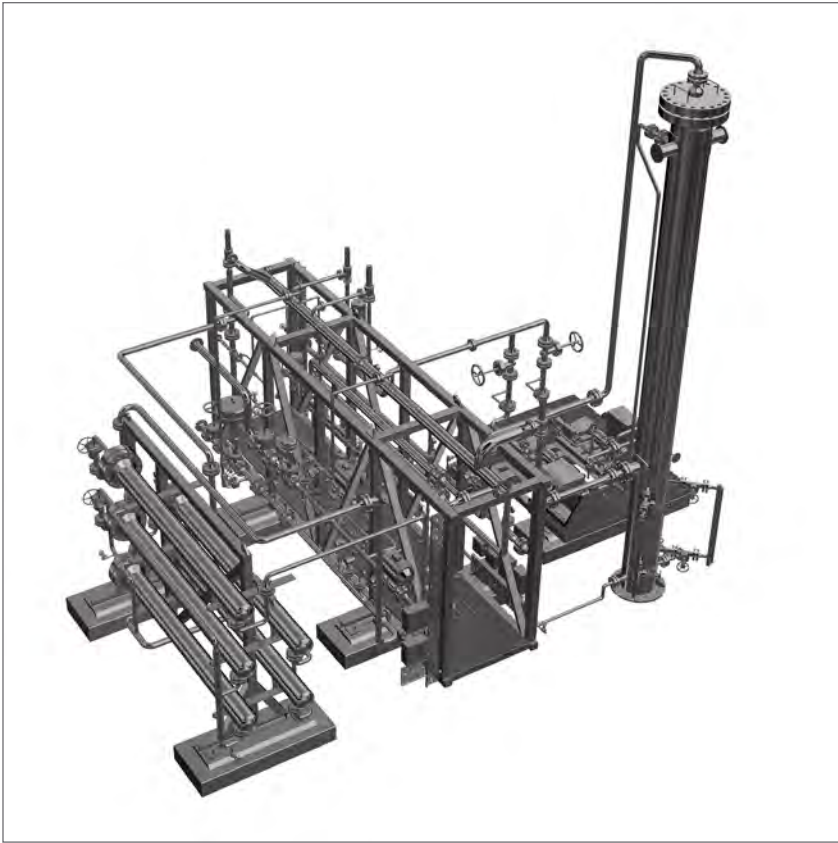
PRISM Membrane Systems have high recovery rates for Hydrogen, CO₂, and hydrocarbons with efficiencies of 80–95% for most applications. Utility consumption is normally limited to instrument air with steam (or water) used for temperature control. Typical purge systems operate at pressures suitable for generating the required separations, so no compression power is needed. Start-up and shutdown is simple: no cool down or preconditioning is required and recovery begins immediately after gas is fed into the system.

Low maintenance

The PRISM Membrane separators have no moving parts to monitor, repair, or replace. They are virtually maintenance-free when properly installed and operated within design conditions. PRISM Membrane separators require virtually no adjustments or operator attention. They will maintain proper operation under varying process conditions and tolerate small concentrations of contaminants like water, ammonia, hydrogen sulfide, carbon dioxide, hydrocarbons and aromatics.

Long life

The robust design and construction ensure long service life in ammonia plant applications. PRISM Membrane separators have been operating in a wide variety of services — some since 1977.



Why choose Air Products?

We have the most experience in designing and building spec-compliant systems for ammonia loop purge applications. Some of the first PRISM Membrane separators were commissioned in 1977.

Over 500 PRISM Membrane Systems for Process Gas applications are operating around the world. These include 230 systems in ammonia purge gas recovery, 90 systems in oil refinery applications, 60 systems for carbon monoxide purification, 50 systems for methanol purge gas recovery and 50 in other petrochemical applications.

For more information regarding Air Products PRISM Membrane Systems for ammonia production applications, please contact one of our technical sales specialists.

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