

# Membrane Units for Fuel Gas Conditioning Heavy Hydrocarbon and Water Removal from Natural Gas



A packaged PEEK-Sep™ Membrane Unit

Membrane systems have become an accepted means to remove CO<sub>2</sub> from natural gas with the first commercial systems installed in the 1980's. The membrane process is inherently simple. However, for conventional systems this simplicity is lost due to the need for extensive pretreatment. The feed gas pretreatment can include extensive filtration, chilling, pre-heating, dehydration, removal of heavy hydrocarbons using cyclic adsorption systems and/or non-regenerable guard beds.

Air Liquide's PEEK-Sep hollow fiber membrane technology addresses a broad range of natural gas conditioning needs, including water and hydrocarbon dew point control, acid gas removal (CO<sub>2</sub> and H<sub>2</sub>S), nitrogen removal and Natural Gas Liquids Recovery (NGL'S). In most cases, multiple impurities are removed in a single treatment step. PEEK-Sep membrane products and separation process design are tailored towards customer-specific natural gas purification needs.

In the fuel gas conditioning application, the membrane permeates heavy hydrocarbons and water vapor from the natural gas feed generating a lean, high pressure product gas that meets both water and hydrocarbon dew point requirements. Water vapor and heavy hydrocarbons exit the system as a low pressure permeate stream tail gas.

The PEEK-Sep product line includes P-Guard and R-Guard modules designed for efficient heavy hydrocarbon removal, C<sub>2</sub><sup>+</sup>, that meets product purity requirement for most difficult feed gas compositions. The gas treatment can further include simultaneous removal of water, H<sub>2</sub>S, CO<sub>2</sub> and mercaptans in addition to removal of heavy hydrocarbons.

## Dew Point Control

Pipeline gas specifications are highly specific and typically require hydrocarbon dew point control to avoid condensation. Traditionally the dew point has been controlled by methanol injection or glycol dehydration followed by JT expansion or mechanical refrigeration to low temperatures. Refrigeration plants are attractive for treatment of gas feeds rich in heavy hydrocarbons, wherein sufficient NGL liquid product can be recovered to add value to the overall product streams.

The PEEK-Sep membrane solution provides gas treatment for rich feeds and lean feeds that meet pipeline hydrocarbon dew point requirements in cases where the amount of NGL is too low to allow for economic recovery. The membrane system is simple, reliable and does not require extensive feed gas pretreatment beyond an inlet coalescing filter. Heavy hydrocarbons and other impurities are removed as a low pressure permeate stream while generating a high pressure product stream that meets the pipeline specification. The permeate stream finds use as a fuel or is recompressed for further processing.

## Fuel Gas Conditioning

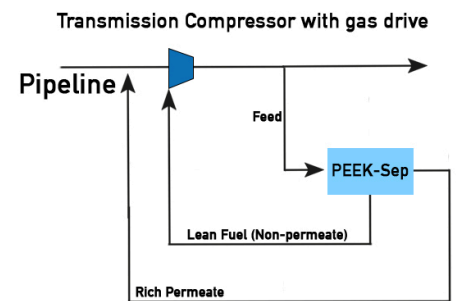
Fuel gas conditioning for power equipment such as gas engines is another application addressed by PEEK-Sep membrane systems. The heating value of the gas is adjusted to the target specification by removing C<sub>2</sub><sup>+</sup> hydrocarbons.

In some cases PEEK-Sep membranes are used to increase the heating value of the gas by removing an excessive amount of CO<sub>2</sub> or N<sub>2</sub>.

Flexible process design addresses diverse customer needs for fuel gas conditioning to meet a target methane number that improves engine performance, reduces maintenance and increases uptime.

## Compressor Station Conditioning

An example of pipeline gas treatment to condition fuel gas is shown in the figure below. If the gas-engine driving the compressor is affected by the heavy hydrocarbons in the pipeline gas, utilizing the PEEK-Sep membrane system allows improved operation with no loss of hydrocarbon values. A compact membrane skid is the only add on equipment required.



## Key Membrane Attributes

- No special pretreatment required
- Dehydrates the gas in addition to removing heavy hydrocarbons
- Removes CO<sub>2</sub> and H<sub>2</sub>S in addition to removing heavy hydrocarbons
- Unattended operation
- Hollow fiber membrane configuration provides for small system footprint

The PEEK-Sep membranes are robust and are not affected by condensed carry-over liquids including water, NGL's and methanol. This unique ability to tolerate liquids underscores equipment reliability. Some PEEK-Sep products are designed specifically for condensing mode operation with hydrocarbon liquids recovery. Condensed liquids are drained from membrane vessels in a same manner separators are drained. Condensation is not typical for treatment of lean streams but can occur where the feed gas is rich enough to allow for liquid recovery.



Air Liquide would be pleased to provide a performance and cost estimate for your process conditions. To obtain a budgetary quotation, please complete the information below and return to:

Udo Dengel  
Director, Sales & Marketing, Natural Gas Processing  
305 Water Street  
Newport, DE 19804 USA  
+1 202-468-5138  
udo.dengel@airliquide.com  
www.airliquideadvancedseparations.com

Name \_\_\_\_\_ Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_ Country \_\_\_\_\_  
Phone \_\_\_\_\_  
Email \_\_\_\_\_

**Feed Conditions**

Feed flow rate \_\_\_\_\_  
Feed pressure available \_\_\_\_\_  
Feed temperature \_\_\_\_\_  
Feed source \_\_\_\_\_

**Product Requirements**

Required Pressure \_\_\_\_\_  
Required Dew Point \_\_\_\_\_  
Maximum inerts permitted, % \_\_\_\_\_

**Feed Compositions, Vol. %**

Methane \_\_\_\_\_  
Nitrogen \_\_\_\_\_  
Carbon Dioxide \_\_\_\_\_  
Oxygen \_\_\_\_\_  
Hydrogen Sulfide \_\_\_\_\_  
Ethane \_\_\_\_\_  
Propane \_\_\_\_\_  
Butane \_\_\_\_\_  
Pentane \_\_\_\_\_  
C6+ \_\_\_\_\_  
Other \_\_\_\_\_  
Other \_\_\_\_\_

**Comments**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_