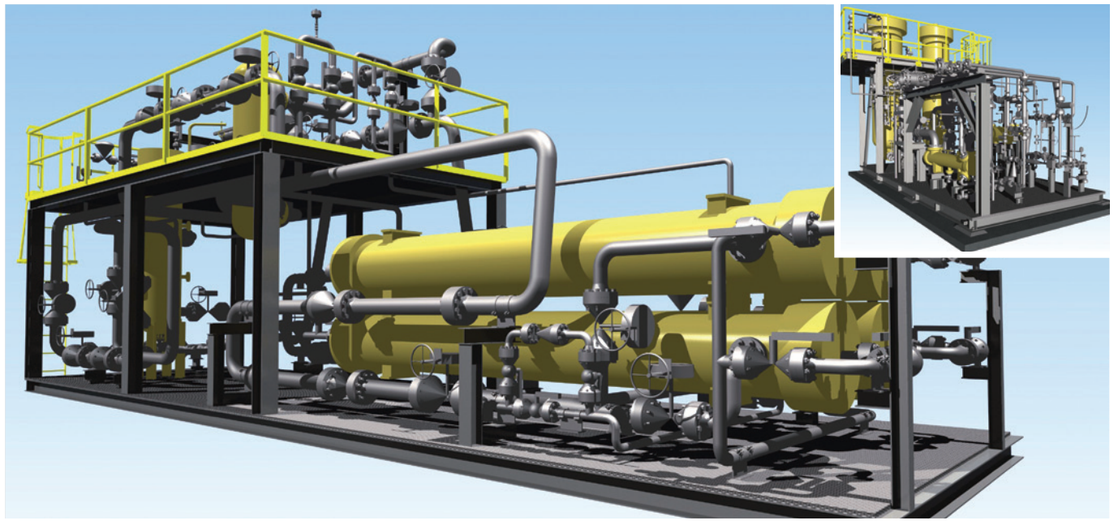
MAHLER ADVANCED GAS SYSTEMS

Permags-Pro

Process gas membrane systems



The basic process

Process gas membrane systems are designed for the recovery of process gases from crude feed or off-gas streams. Often referred to as HRU (Hydrogen recovery unit), a membrane separation system is not only limited to the recovery of hydrogen. Also the adjustment of synthesis gas ratios, recovery and separation of methane, helium, carbon dioxide, as well as oxygen and nitrogen from ambient air have to be mentioned as few of many possible applications in the industry. The process is continuous and divided into two main steps.

Pretreatment and conditioning of the feed

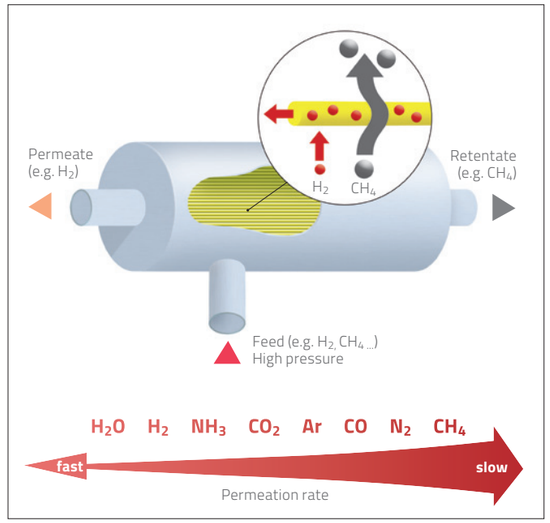
The pretreatment section consists of a filter unit which protects the small membrane fibers from solid particles and fluids. The design of this protection system depends on the feed conditions. Humid feeds require coalescers, while dry gas streams are treated by means of a particle filter.

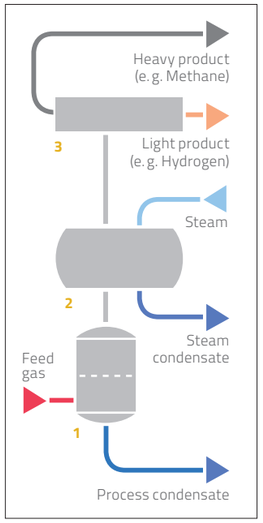
Subsequently a heat exchanger is applied to control the temperature of the process gas. Temperature is a crucial parameter for the performance of the unit and ensures stable operation also during part-load and changing process conditions.

Separation step

Crude feed gas at high pressure enters the membrane modules and is separated into two streams, which are defined as permeate and retentate. The permeate stream is reduced in pressure and usually contains smaller molecules like hydrogen, thus often referred to as "hydrogen rich product". The retentate is equal in pressure to the feed gas and is made-up of mostly larger molecules like methane. The performance of the separation step depends on:

- Membrane material
- Surface area of the membranes
- Feed temperature
- Feed pressure
- Differential pressure across the membrane modules
- Flow rate of the feed





1 Pre-filter 2 Heat exchanger
3 Membrane

Applications

The permeation process

Permeation is the working principle of a membrane system. For this reason membranes and membrane modules are often referred to as "permeators" and the process as "permeation". Mahler AGS only applies state of the art membrane modules from renowned suppliers. A membrane bundle consists of numerous hollow fibers which can be as thin as a human hair and are made up of special kinds of polymers. Each polymer is different in its effect on the separation process. Some polymers are designed to achieve maximum recovery, while others are optimized for high purities. Also the resistance to chemicals, humidity and physical forces are different for each polymer.

The way a permeator works can be compared to a particle filter operating on molecular level. The crude feed gas flow is directed through the membrane fibers. Small molecules can pass the wall of the hollow fibers. The molecules permeating the fibers are now separated from the feed gas and are obtained as the pressure reduced product. The residue which cannot permeate through the wall of the hollow fibers forms the retentate product. Depending on the application the flow direction of the permeate can be either from inside of the fibers to the outside or vice versa.

Petrochemical industry, chemical industry, efineries, oil & gas industries, ammonia and methanol production

- Recovery, separation and purification of feedstock and rejection of inert gasses from purge gas streams
- Syngas ratio adjustment
- Separation of carbon dioxide from natural gas
- Drying of gases

Nitrogen generation

PLANT FEATURES

All kind of possible feedstocks, e.g. air, natural gas, off-gas, crude hydrogen, ammonia purge gas, syngas

Capacities from 500 to 200,000 Nm³/h and even more

Feed pressure between 20 - 200 bar(abs)

Recovery up to 99.9 %

Purities up to 99.99 vol.-%

Completely pre-manufactured skids

- Unattended and automated operation
- Continuous process without any moving parts
- Installation on a common, single base frame (standard unit)
- Options for vertical and horizontal installation for spatial optimization
- Dimensions equal to a 40" container (standard unit)

Online adjustment of recovery and product purity possible

High availability and reliability

Design for long lifetime