



SEPURAN[®] Noble

Membrane technology
for helium and hydrogen generation

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Gas separation with SEPURAN®

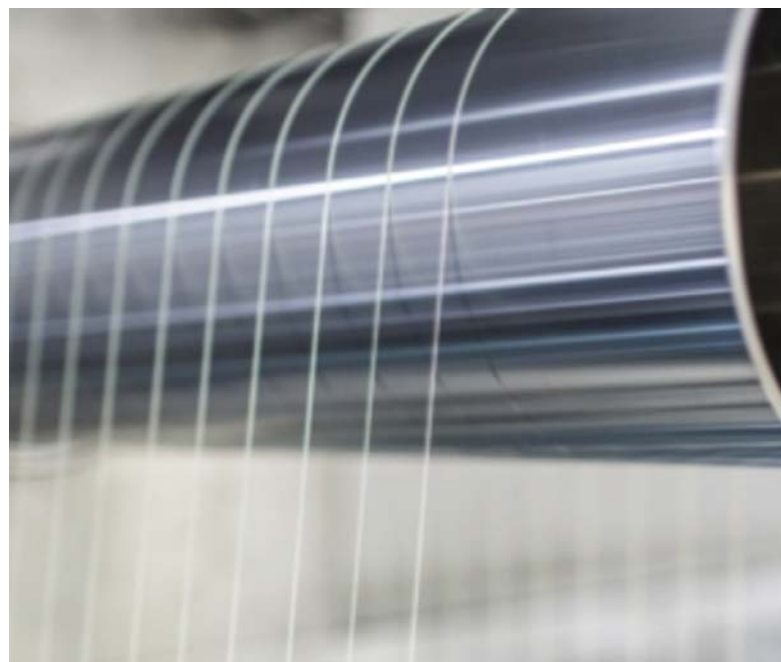
Evonik, the creative industrial group from Germany, is one of the world leaders in specialty chemicals. As a technological leader in the field of high-performance polymers we offer hollow-fiber membranes for efficient and energy-saving gas separation.

Advantages:

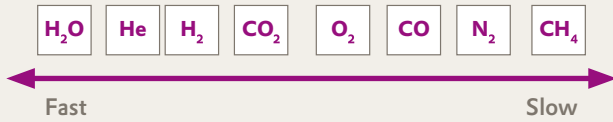
- Very high selectivity
- Low energy consumption
- Separation at room temperature
- Low space requirements
- Continuous separation process
- Simple modular setup
- Flexible and easily expanded
- No other auxiliary materials, such as water and sorbents, required
- No emissions into the environment

Fields of application:

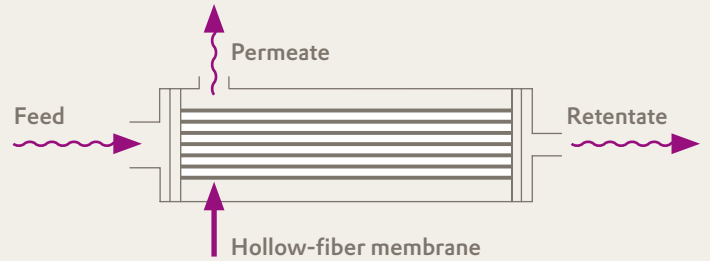
- Helium recovery
- Helium generation
- Hydrogen generation
- Air separation
- Extraction of methane



Relative permeation rates of various gases



Functioning of a membrane cartridge for gas separation

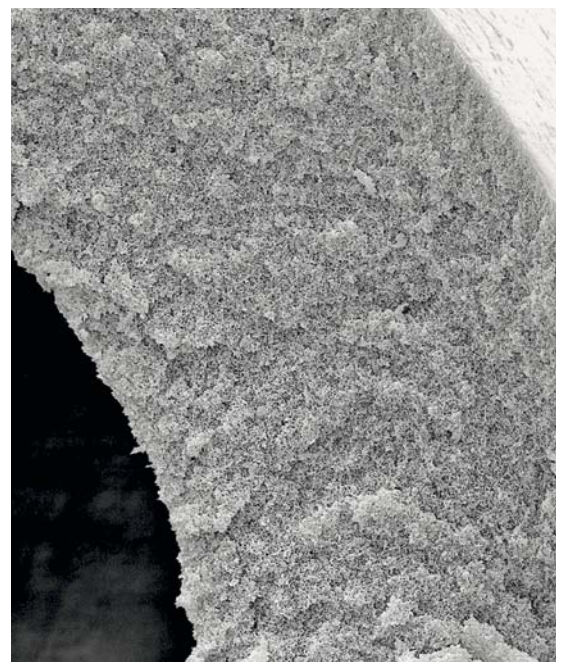


How does membrane separation work?

Membranes for gas separation are produced in the form of hollow fibers by a phase-inversion process. Gas separation membranes work on the principle of selective permeation through a membrane surface. The driving force for gas permeation through the membrane is the difference between the partial pressures of the gas on the retentate side (the internal side of the hollow fiber) and the permeate (external) side.

The greater this difference, the greater the permeation of gas through the membrane. In the separation of gases, permeation of hydrogen and helium through the membrane is strongly favored while components such as carbon monoxide, methane and nitrogen are retained. The permeation rate of each gas depends, on the one hand, on its solubility in the membrane material as well as on its diffusion rate. Gases with higher solubility and lower molecular size penetrate the membrane faster than large,

less soluble gases. The ratio of the transport speeds of two gases is termed selectivity. The higher the selectivity, the higher the energy efficiency of the resulting membrane process. Different membrane materials show different separation characteristics. The driving force required for the separation is obtained through a partial pressure gradient.





SEPURAN® Noble

The SEPURAN® product family includes a number of different membrane systems for gas separation in a variety of applications. SEPURAN® Noble has the highest selectivity of the entire product family and was specially developed for helium extraction and hydrogen generation.

The SEPURAN® Noble cartridges and modules consist of several thousand hollow fibers produced from high-performance polymers in Austria. The fibers are bundled and their ends embedded in a resin. The bundles are inserted into a stainless steel vessel. The membrane system can now withstand a gas mixture under pressure. As many membrane systems as required

may be linked together, depending on the particular application and the size of the plant.

This simple and modular setup, with minimal space requirements for the membrane system, offers a further advantage. Due to the very high selectivity of the membrane, separation processes with high energy efficiency are achieved.



Evonik offers different SEPURAN® Noble membrane modules and cartridge systems for the most varied applications and plant sizes:

The SEPURAN® Noble membrane modules are ready-for-connection solutions, i.e. they can be directly incorporated into the plant and used. They can be used, in particular, for smaller applications, at low pressures up to 25 bar.

The SEPURAN® Noble cartridge system was additionally developed in order to meet customer and market demands.

This consists of a membrane cartridge and a stainless steel housing. It is used for large applications and high pressures of up to 40 bar.

The stainless steel housing for the SEPURAN® Noble cartridge is manufactured by our external partners, taking into account the respective country-specific requirements. This provides the advantage that plant engineering companies can flexibly adapt the pressure housings to the local pressure regulations.

The variable cartridge system offers additional options for customers:

- Greater flexibility in terms of the housing design
- Low weight
- Adaptable to the local pressure regulations
- Versatile stainless steel elements



SEPURAN® Noble for helium

Helium is a chemical element, it is colorless, odorless and tasteless. It is completely inert in relation to chemical reactions and radiation. Its thermal conductivity goes far beyond the other gases. Highly pure helium can be produced from natural gas or recovered from industrial processes which utilize helium. It can be used in a wide variety of industries and applications.

In many applications, mixtures of helium and e.g. air, nitrogen or argon are mostly used. By recovering the very valuable helium from these gas mixtures, very high cost savings can be realized. Recovery can take place by means of membranes. The very selective SEPURAN® Noble membrane developed by Evonik, together with the clever membrane configuration of Evonik, combines high product gas purity with a high helium yield.

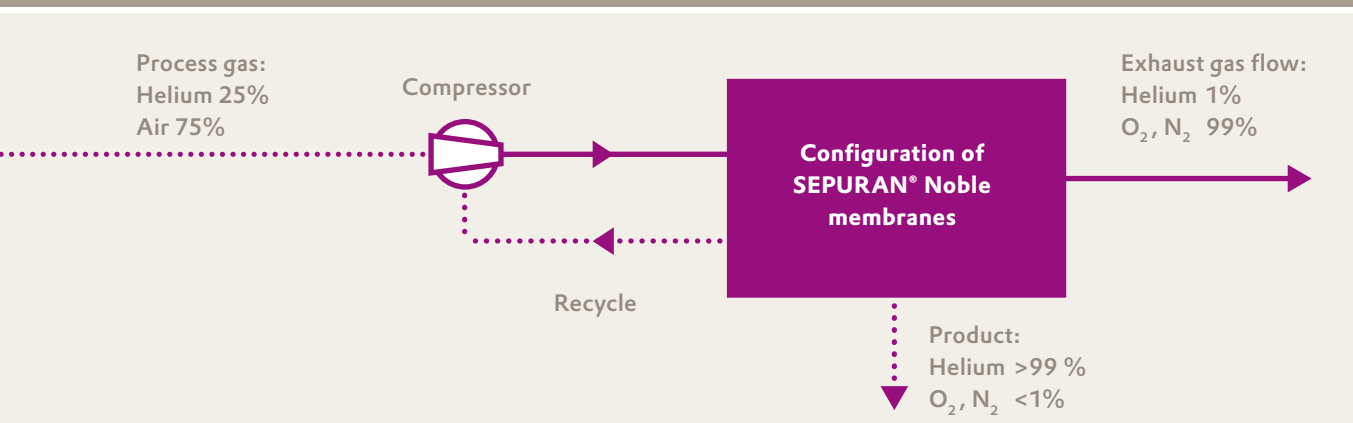
Advantages

- Highly selective membranes
- Multiple membrane stage configurations based on customer-specific needs for maximum and flexible recovery rates
- Existing production process can be economically and technically optimized
- Easy to operate, install and flexibly expandable
- Stable, space-saving and low maintenance
- Service life of up to 10 years
- Membrane technology can be used with pressure swing adsorption (PSA) and enables highly pure helium to be efficiently produced when inlet concentrations of helium are very low
- Gas flows with low helium content can be generated in one step with simultaneously high recovery rates.

Typical fields of application

- Optical fiber industry
- Medical devices, MRI technology
- Leak detection
- Lifting gas
- Balloon filling
- Welding and metal work
- Electronics industry
- Oil and gas production
- Refrigerants

Our membrane configuration for efficient helium recovery



SEPURAN® Noble for hydrogen

Hydrogen is a chemical element, it is colorless, odorless and tasteless. Under normal conditions, hydrogen is present as molecular hydrogen H_2 . Molecular hydrogen can be produced by steam reforming and subsequently by a water gas shift reaction or it occurs as a by-product of different reactions. The largest consumers of hydrogen are refineries as well as ammonia and methanol production facilities.

Hydrogen is used in the most varied chemical reactions. In the case of many of these reactions, the hydrogen used is not fully consumed and can thus be purified and recycled.

The very selective SEPURAN® Noble membrane developed by Evonik enables high product gas purity, a high hydrogen yield as well as reduced energy consumption.

Advantages

- High efficiency in purification through highly selective membranes
- Stable and long-lasting
- Space-saving and flexible
- Easy to install and operate
- High yields and purities
- Advantageously combinable with other separation processes such as pressure swing adsorption
- Multiple membrane stage configurations based on customer-specific needs
- Service life of up to 10 years

Typical fields of application

- Recovery of purge gas
- Ammonia production
- Methanol production
- Desulfurization
- Hydrocracking
- H_2 -PSA
- H_2/CO ratio adjustment
- Debottlenecking PSA and cryogenic systems
- Gas to liquid (GTL)
- Fischer-Tropsch synthesis



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