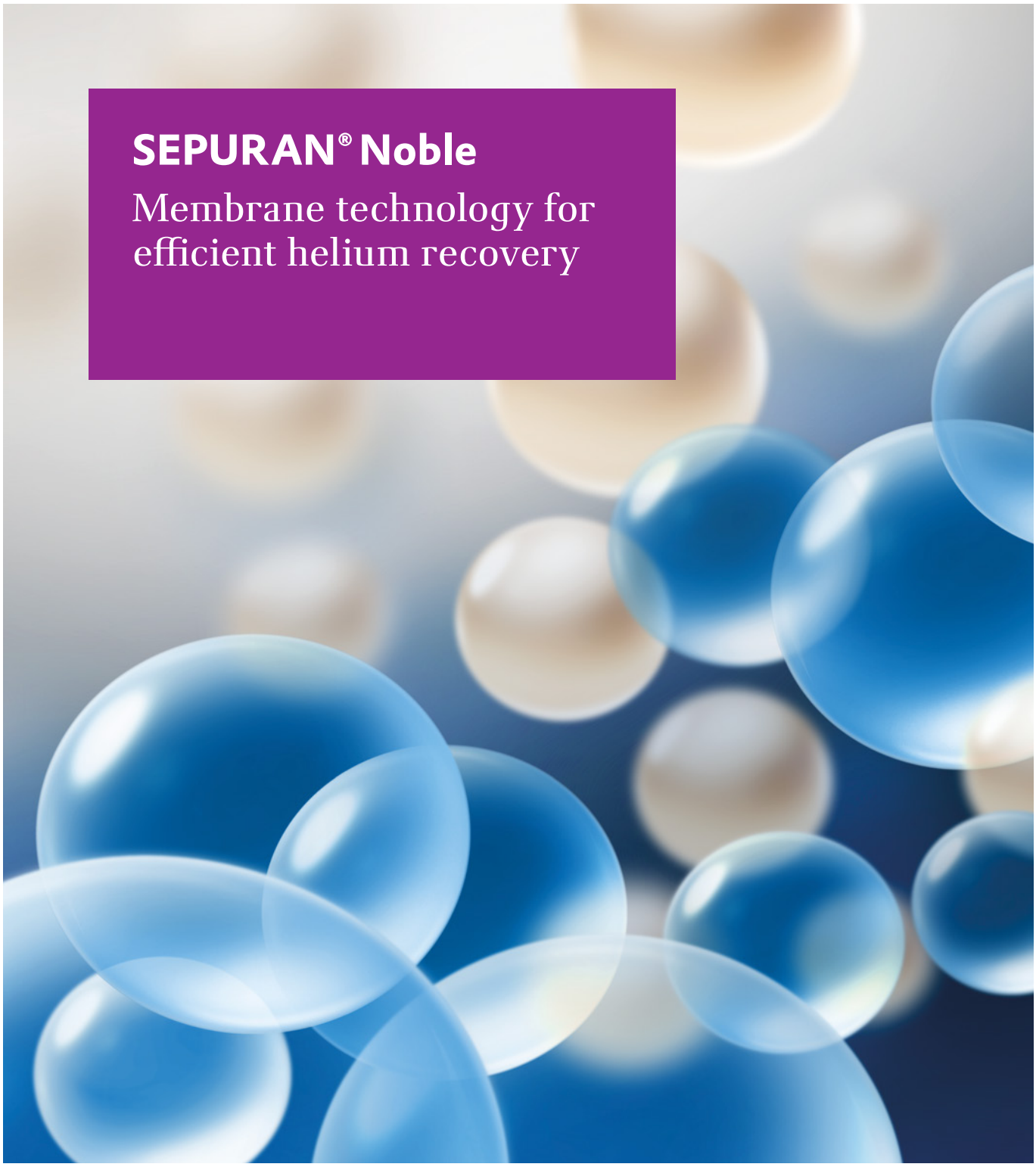


SEPURAN® Noble

Membrane technology for efficient helium recovery

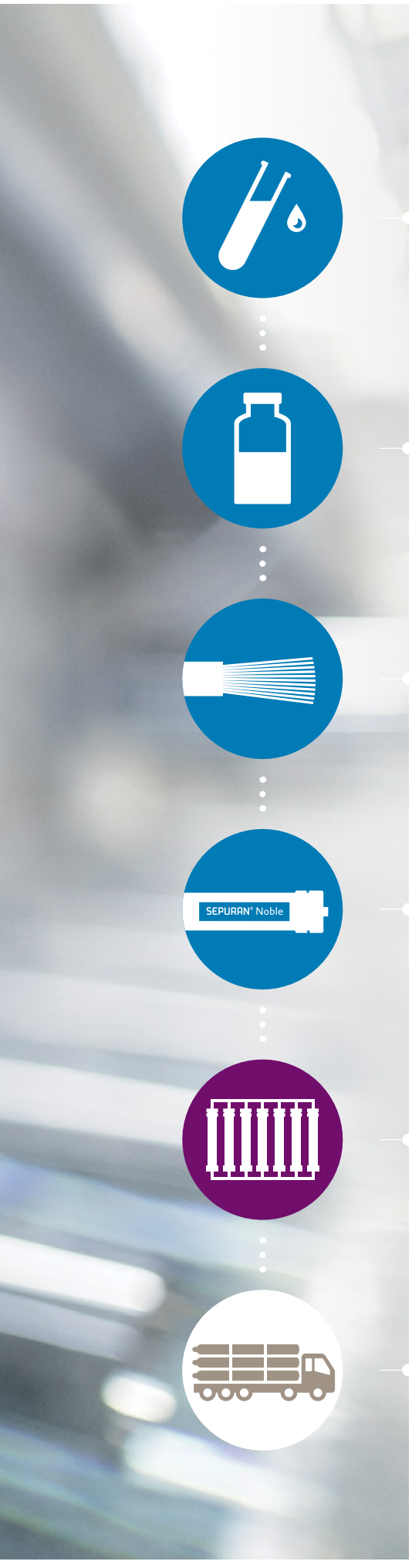
EVONIK
POWER TO CREATE

EVONIK, THE CREATIVE INDUSTRIAL GROUP FROM GERMANY, IS ONE OF THE WORLD LEADERS IN SPECIALTY CHEMICALS, OPERATING IN THE NUTRITION & CARE, RESOURCE EFFICIENCY AND PERFORMANCE MATERIALS SEGMENTS.

The Resource Efficiency segment supplies high performance materials such as high performance polymers for environmentally friendly and energy-efficient system solutions; we ensure sustainability – in business and everyday life.

SEPURAN® stands for customized hollow fiber membranes for efficient gas separation. The SEPURAN® Noble membrane has been especially developed for helium recovery and purification enabling highly pure helium to be efficiently produced even when inlet concentrations of helium are very low.

Evonik. Power to create.



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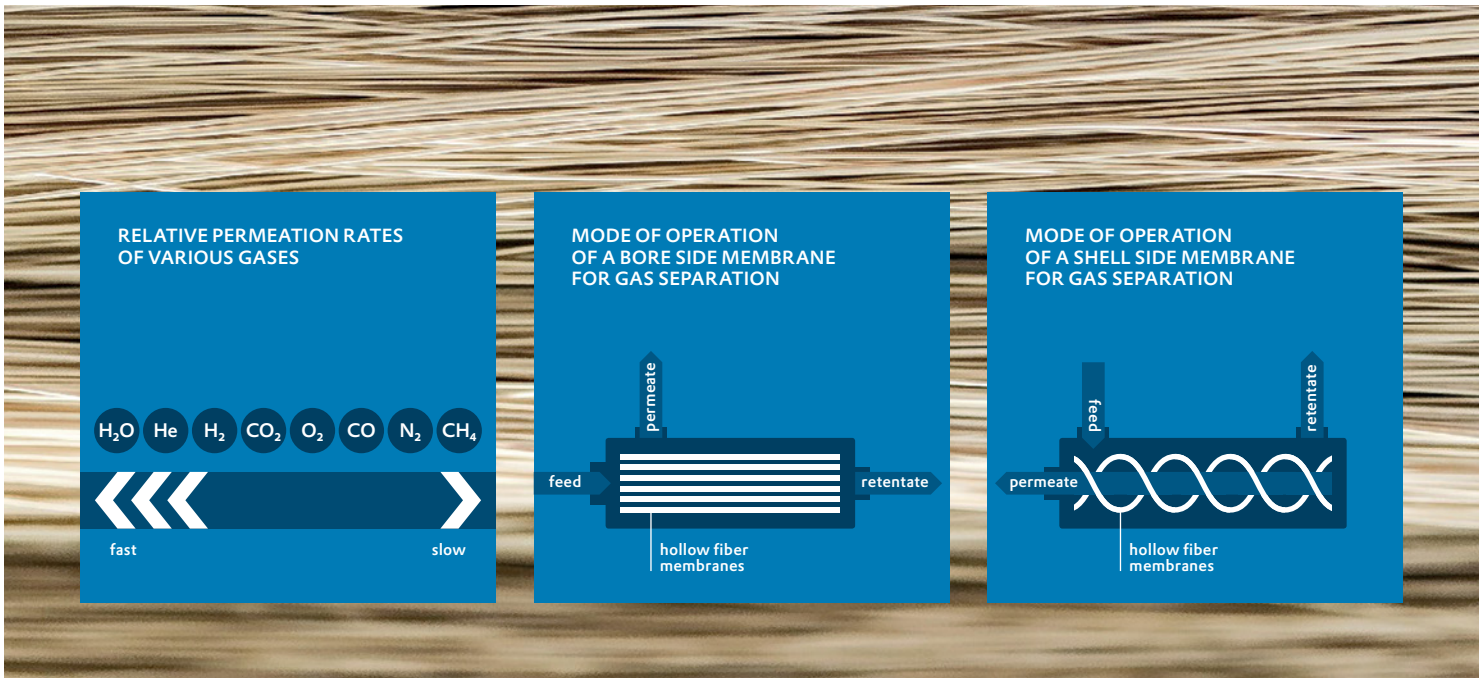


HOW DO THE MEMBRANES WORK?

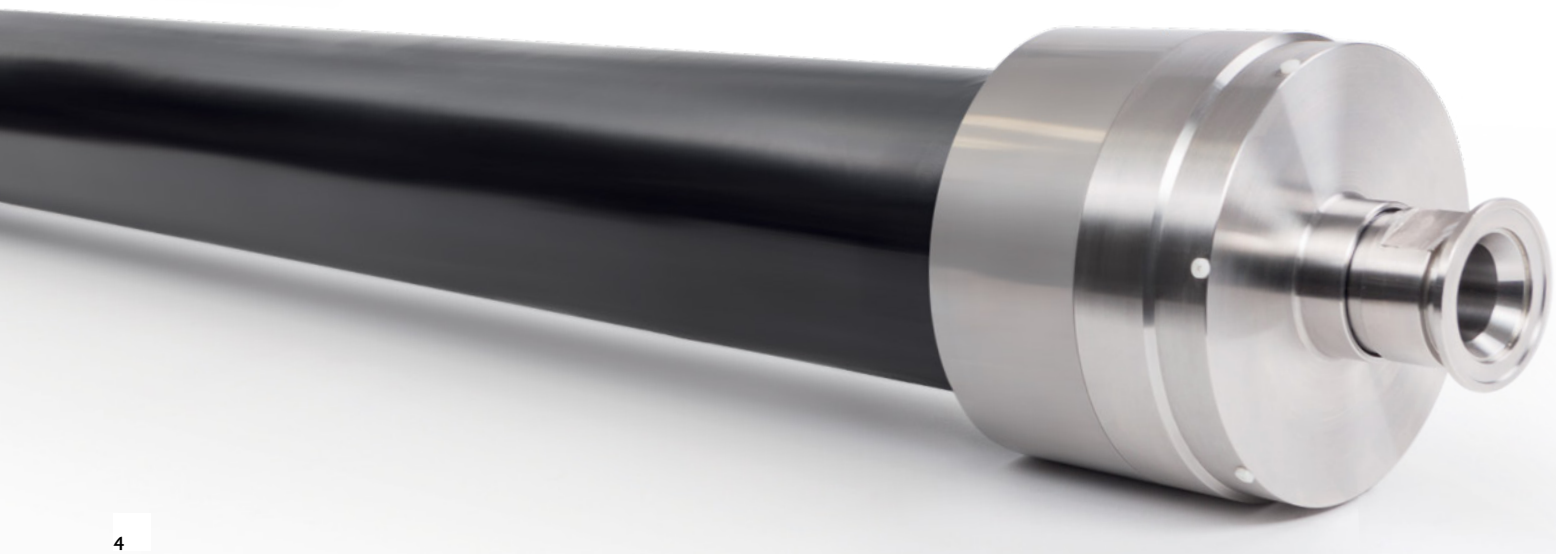
Gas separation membranes work on the principle of selective permeation through a membrane surface. The driving force for permeation of the gas through the membrane is the difference between the partial pressures of the gas on the retentate side (the interior of the hollow fiber) and the permeate side (the exterior of the hollow fiber).

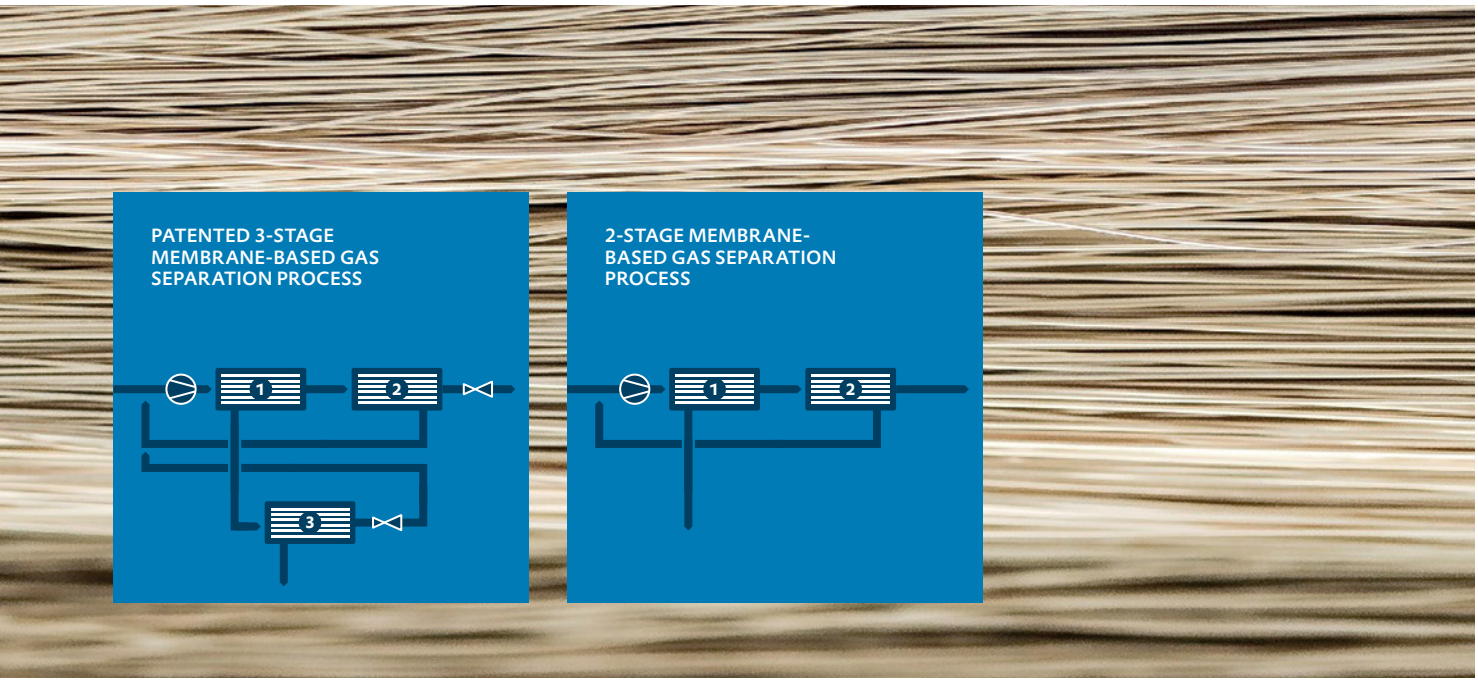
The greater this difference, the higher the proportion of the gas that permeates through the membrane. In a separation, such as between helium and methane, permeation of helium through the membrane is much faster while methane is retained within. The driving force required for the separation is obtained through a partial pressure gradient.

The permeation rate of each gas depends on its solubility in the membrane material and on the diffusion rate. Gases that have higher solubility and smaller molecular size permeate the membrane faster than larger, less soluble gases. The ratio of the transport speeds of two gases is called selectivity.

The higher the selectivity, the higher the energy efficiency of the resulting membrane process.

Different membrane materials have different separation properties.





HELIUM RECOVERY AND PURIFICATION

Our products

SEPURAN® Noble	2″ Module*	4″ Cartridge	6″ Cartridge	8″ Cartridge
Stainless steel	SS316	SS316	SS316	SS316
Trans membrane pressure	25 bar / 362 psi	40 bar / 580 psi	25 bar / 362 psi	80 bar / 1160 psi • 70 bar/1015 psi
Temperature	< 70 °C / 158 °F	< 70 °C / 158 °F	< 70 °C / 158 °F	< 50 °C / 122 °F • < 70 °C / 158 °F

Recovery advantages

- Helium recovery of more than 90 percent possible

Upgrading advantages

- High selectivity
- Low energy consumption

Overall features

- 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

HELIUM PURIFICATION

Linde and Evonik collaborate in the area of membrane-based gas separation.

In Canada, Linde Engineering built the world's first plant to recover high-purity helium from N_2-rich natural gas without the need for cryogenic technology using Evonik's membrane technology.

The village of Mankota in the Canadian province of Saskatchewan has around 240 inhabitants and one motel with 18 rooms. Apart from that, it's mostly grassland. A lot of flat grassland. With the next major town a three-hour car ride away, anyone travelling here should not expect to be overwhelmed by the sights. Six kilometres from the centre of the village, US company the Weil Group is recovering high-purity helium from nitrogen-rich natural streams using a new process developed by Linde Engineering that does not rely on cryogenic gas separation. This makes it cheaper and more energy-efficient than conventional processes in many cases. It also produces a very high helium yield.

Linde sources the membranes for this new process from its technology partner and specialty chemicals expert Evonik. At the heart of the system are hollow fibres made of high-performance polymers that Evonik embeds in cylindrical stainless steel cartridges. The pre-treated raw gas is fed into the membrane cartridge under high pressure. Small molecules in the gas mixture (for example, helium and hydrogen) and molecules with a high specific rate of diffusion (for example, gaseous water or carbon dioxide) can pass through the membrane faster than larger molecules and leave the membrane module as permeate on the low-pressure side (first exit). Larger molecules such as methane and nitrogen diffuse through the membrane at a much slower rate. As a result, the majority of these leave the hollow fibres again as retentate gas from the module's second exit (high-pressure side). The technical name for this process is the principle of selective permeation. Depending on the gas composition and the size of the plant, any number of cartridges can be combined in one or more membrane stages to optimise the yield.

HELIUM RECOVERY

Collecting and upgrading used helium leads to enormous cost saving.

Optical fiber production worldwide uses 10% of the overall He consumption. This helium can be recovered easily by using Evonik's membrane technology leading up to 90% of savings of this costly and rare noble gas."

Helium is expensive, and large users may find it worthwhile to recover the used noble gas; they too can benefit from SEPURAN® Noble. These large users include producers of optical fibers transmitting internet data and phone calls. The helium is particularly effective for cooling the glass fibers as these are drawn from the hot melt. This increases production speed: A single plant can produce more than two kilometers of fiber per minute. But helium cooling is costly: Many glass fiber production facilities spend hundreds of thousands of euros on helium annually. Nextrom, a leading global plant engineering firm for the glass fiber industry, has now developed a solution for fiber producers that is based on SEPURAN® Noble. It offers a system in which the used helium is collected, cleaned, and re-used for cooling. As much as 90 percent of the helium can be recovered in this way.

A mere two years after market launch, SEPURAN® Noble has now become established in the glass fiber industry; the SEPURAN® team owes this success partly to the support of their coleagues from Silanes, who are familiar with this sector. Moreover, membrane technology can be very easily integrated into glass fiber production because the upgraded helium need not be liquid nor ultrapure. In many applications Helium is mixed with air, nitrogen or argon. By recovering the very valuable helium from these gas mixtures, high cost savings can be realized. The highly selective SEPURAN® Noble Membrane developed by Evonik, together with the clever membrane configuration of Evonik, enables both a high product gas purity and a high helium yield.

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Evonik Fibres GmbH
Gewerbepark 4
4861 Schörfling
Austria

PHONE +43 7672 6006-0
sepuran@evonik.com

www.sepuran.com
www.evonik.com

Evonik Corporation
High Performance Polymers
299 Jefferson Road
Parsippany, NJ 07054
United States

PHONE +1 973 929-8000

Evonik Specialty Chemicals (Shanghai) Co., Ltd.
55 Chundong Road
Xinzhuang Industry Park
Shanghai 201108

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