

# Modular helium purification units

Reliable and proven helium recovery solutions for helium applications



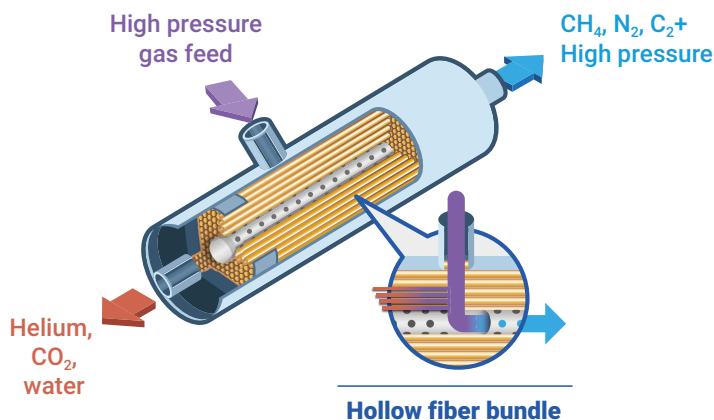
**A**ir Liquide's advanced Separations (ALaS) offers fully skidded and modularized factory built helium solutions, from small size to large scale, using a design approach that allows quick construction, predictable project schedule, lesser costs and superior quality. Our engineers and experts accompany you at every step of your project and ensure our customers' processing facilities are safe, cost-effective, efficient and reliable.

## Our technologies: the best in class combination of membrane and Pressure Swing Adsorption (PSA)

ALaS offers a combination of two key technologies to achieve the most effective yet compact helium purification system: membranes for bulk separation of helium followed by PSA to produce high purity helium (up to 99.999%). Air Liquide has partnered with Xebec Adsorption Inc to offer small scale PSA technology suitable for this market.

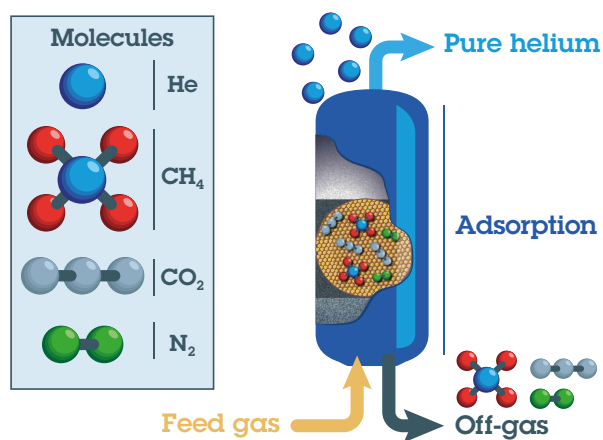
### Air Liquide hollow fiber membrane technology

This technology is a poly-imide based polymer membrane, where helium is separated by permeating from the high pressure side to the low pressure - permeate - side. Most of the other gases (methane and nitrogen in particular) are much less prone to permeation and will stay in the high pressure side. The membrane produces a stream with only the helium and a small amount of impurities going to the PSA.



### Compact Pressure Swing Adsorption technology (Xebec™ PSA)

Adsorbent layers are used to selectively adsorb all remaining impurities from the membranes to form the high purity helium product. This process is called the production / adsorption phase. Multiple vessels filled with adsorbent are used while some vessels are in production, others are regenerating by fluctuating the pressure (hence the name "pressure swing").



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#### Air Liquide's Membrane

- ✓ Proven and reliable for helium separation
- ✓ Minimum pretreatment needed
- ✓ Highest helium enrichment capabilities
- ✓ An exceptional chemical and thermal resistance

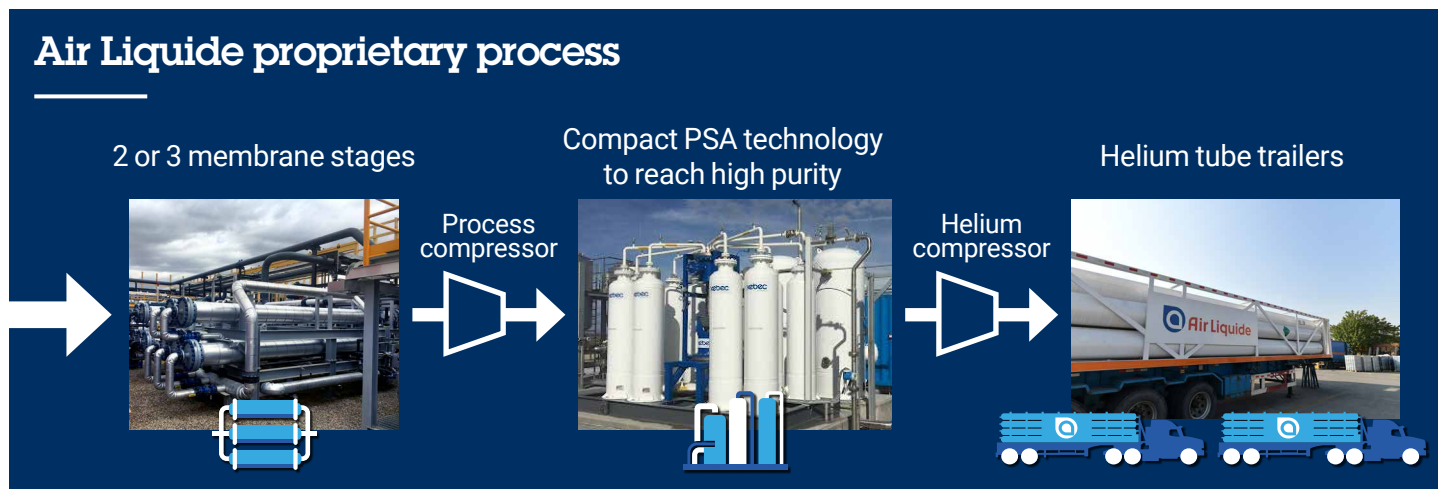
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#### Xebec™ PSA:

- ✓ High reliability: single rotary valve for control at constant speed vs. multiple on/off valves cycling on a regular basis
- ✓ High efficiency thanks to a 9-bed PSA cycle
- ✓ Proven technology
- ✓ Compact PSA technology using smaller beds thanks to fast cycle

# Our packaged helium purification solutions

**Our packaged Helium offering** is a simple way to monetize raw helium from the well and delivering a high purity product. It can be easily exported by tube trailers to the end users. We can deliver our membrane and PSA standard units with a shorter lead time. At the same time, we can also tailor your application with single stage membrane or multi-stage membrane using one or several PSAs depending on your specific needs.



## Advantages of our solutions

- Tailor made, modular, skidded and fully complete solutions including:
  - Feed gas pretreatment
  - Process compressors
  - Helium compressor
  - Membrane skids
  - PSA skids
- Very high helium recovery (up to 98% possible), with Air Liquide performance guarantee
- Most compact solution with small footprint
- Low capital costs and low construction cost (fully modularized)
- Easy to install
- Short lead time (<1 year from initial decision to first gas)
- Commissioning and start up support (training)
- On-going/continuous technical support
- Low maintenance requirements



## Modular helium purifier specifications

While being standardized and modularized, ALaS purifiers are highly flexible in what feed they can treat and performance they can achieve.

	Minimum	Maximum	Notes
<b>Feed flow rate</b>	0.5 MMSCFD (558 Nm <sup>3</sup> /h)	100 MMSCFD (111,589 Nm <sup>3</sup> /h)	Fully modular equipment: large range and easy turn down
<b>Helium feed content (mol%)</b>	0.05% mol	10% mol	
<b>Impurities management</b>	Base case: N <sub>2</sub> /CH <sub>4</sub> removal	Options: CO <sub>2</sub> / H <sub>2</sub> S / H <sub>2</sub> removal	
<b>Product purity (Helium %mol)</b>	70-95% mol	>99.999% mol	
<b>Helium recovery</b>	>85% (optimized CAPEX)	>98% (high recovery)	CAPEX optimization



## Project management

- Supporting you throughout the different phases of design, commissioning and operation of your project
- Faster project schedules and easy project coordination
- Global network of engineering and system fabrication partners
- Maintaining control over quality, minimizing risks and delivering on performance



## One of our success stories: North American Helium Battle Creek Facility

In April 2021, Air Liquide's Modular Helium Purifier technology was commissioned at Battle Creek facility near the hamlet of Consul, Saskatchewan, making it the largest helium purification plant in Canada.

The plant came online approximately 11 months after investment decision and produces helium with a purity from 99% up to 99.999%. It has been operating

at full capacity (up to 50 MMSCF per year expected production) successfully and meeting specifications. The time spent on construction was greatly reduced thanks to our fully skid-mounted solution (including all process packages: compressors, membranes, PSA, de-H<sub>2</sub> unit, glycol chiller for water removal).

## Contacts

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