Schlumberger

CYNARA

Acid gas removal membrane systems

Aligned with United Nations Sustainable Development Goals:
12—Responsible consumption and production,
13—Climate action

Embodied Carbon:
Reduce embodied carbon by up to 50%

Emissions Reduction:
Reduce CO_2 emissions by 30%–100% when combined with carbon capture and sequestration (CCS)

Applications

- CO_2 removal offshore
- Enhanced oil recovery (EOR)
- Midstream operations
- Stranded gas
- High-pressure CO_2 removal
- Fuel gas treatment
- Cryogenic plants
- Gas gathering or compressor stations

Benefits

- Reduced footprint and installation costs
- Improved HSE profile
- Enhanced operational and process flexibility
- Lower capex and opex

How it works

Industry-leading CYNARA* acid gas removal membrane systems are based on selective permeation. The technology takes advantage of the fact that gases dissolve and diffuse into polymeric materials. If a pressure differential is set up on opposing sides of a polymeric film (membrane), transport across the film (permeation) will occur. The product of a solubility coefficient and a diffusion coefficient determines the rate of permeation. Highly soluble molecules and small molecules (CO_2 and H_2S) permeate faster than large molecules (N_2, C_1, C_2, and heavier hydrocarbons).

When a natural gas stream containing CO_2 passes through the membrane, the CO_2 permeates at a faster rate than the natural gas components. The feed stream therefore separates into a CO_2-rich, low-pressure permeated stream and a CO_2-depleted, high-pressure natural gas stream. The system can handle varying feed gas composition and flow rates. Operation is fully automatic, and the modular system enables operators to add capacity incrementally.

CYNARA acid gas removal membrane system.

CYNARA system membranes consist of hundreds of thousands of hollow asymmetric fibers grouped in bundles, with epoxy tube sheets on each end. Pressurized gas flows into the membrane case, where it contacts the fiber bundles and flows radially inward. As the gas traverses the bundle, CO_2 selectively permeates into the low-pressure lumen of the fiber. The residual gas continues across the bundle into a central perforated tube.

How it improves performance

Inherent advantages of the CYNARA system's unique membrane element design include the following:

- Hollow fiber technology maximizes surface area per unit volume compared with competing membrane technology.
- Double-ended permeate flow minimizes pressure drop down the lumen of the fiber, maximizing CO_2 capacity as well as separation performance.
- Vertical orientation of the hollow fibers combined with the central collection tube enables recovery of hydrocarbon liquids—a valuable product for many operators.

Gas separation module performance depends on proper selection of the polymeric material comprising the membrane. Because cellulose acetate is very inert and stable in CO_2 and hydrocarbon environments, it is used as the base membrane material. The proprietary acetyl content of the CYNARA system membrane optimizes productivity and separation capability for EOR and natural gas cleanup applications while reducing capex and opex. Moreover, cellulose acetate has the unique ability to withstand condensing hydrocarbons, enabling efficient removal and recovery of hydrocarbon liquids.

CYNARA

How CYNARA systems support industry carbon intensity reduction goals

In FPSO applications, operators require a lighter topside structure to accommodate the skid-mounted CYNARA system. The large surface area of the hollow fibers results in a smaller overall system footprint, reducing the embodied carbon by up to 50%. Additionally, the lower quantity of hydrocarbons in the permeate stream environmental impact.

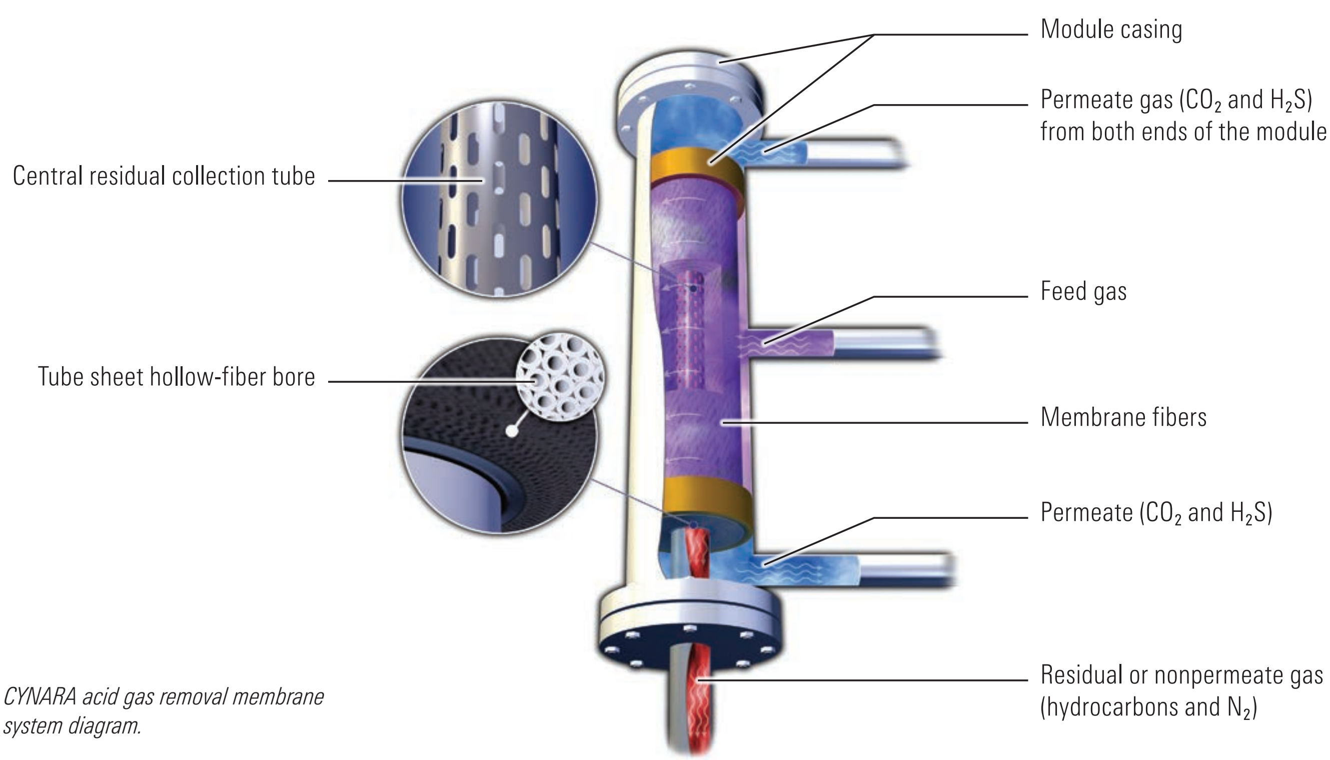
Replacing or reducing amine solvents usage for CO_2 removal eliminates or decreases greenhouse gas (GHG) emissions associated with pumping and heating solvents; CYNARA systems require no external energy or chemical storage and disposal facilities. When combining membranes for bulk removal of CO_2 with solvents for the final stage, a 30%–100% reduction in emissions can be achieved. Capturing and reinjecting the CO_2 into the subsurface leads to a 100% emissions reduction.

More than 35 years of experience

Since the first installation in 1983, CYNARA systems have established an impressive track record of reliability, operating with minimal downtime and average availabilities up to 99% since startup.

Schlumberger designs and provides custom membrane pretreatment equipment, membrane systems, and field operation and support services for major oil and gas companies worldwide. Solutions can address turnkey projects, gas dehydration, liquid hydrocarbons recovery, and CO_2 separation. High-capacity projects exceeding 1,200 MMcf/d, with inlet CO_2 concentrations from 5% to 85% and outlet concentrations from 50% to 1.5%, can also be engineered. Ongoing experience enables recommending the most economical and reliable solution, whether it is a stand-alone membrane system or a hybrid system with other separation technologies.

By centralizing related services, such as membrane manufacturing, R&D, testing, quality control, and engineering, Schlumberger achieves quality, product availability, economies of scale, and a level of product responsibility that are impossible through an outside supplier or multiple suppliers. Customers benefit from full control of scheduling, continuous quality upgrades, enhanced troubleshooting, rapid implementation of new designs, state-of-the-art-manufacturing facilities, and proven expertise.



CYNARA acid gas removal membrane system diagram.

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