Schlumberger

CYNARA

Acid gas removal membrane systems

APPLICATIONS

- Offshore carbon dioxide (CO_2) removal
- 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 installation and operating costs
- Improved HSE profile
- Enhanced operational and process flexibility
- Lower capex and opex

FEATURES

- Skid-mounted packages with small, lightweight footprint
- No external energy supplied
- No requirement for chemicals nor their storage or disposal
- Flexibility to operate with variations in feedgas composition and flowrate
- Large turndown capability
- Ability to incrementally add capacity
- Fully automatic operation

From the world's first commercial CO_2 membrane plant for CO_2 recovery in EOR applications (Scurry Area Canyon Reef Operators [SACROC] oil field) to the world's largest CO_2 membrane plant for natural gas cleanup (1.28 Bcf/d, Cakerawala Gas Field Development—Petronas Carigali Hess Operating Company), Schlumberger continues to lead the industry with state-of-the-art CYNARA* acid gas removal membrane systems.

Since the first installation in 1983, CYNARA systems have established an impressive track record for the industry. Schlumberger-owned and -operated SACROC facilities continue working every day with minimal downtime. The average availability maintained since startup is 99%. This experience assures customers that they can depend on Schlumberger to provide the performance and efficiency that they demand in a separation system. It also allows Schlumberger to anticipate and deliver the customized solutions required to enhance the customer's ability to compete.

Schlumberger designs and provides custom membrane pretreatment equipment, membrane systems, field operations, and support services for major oil and gas companies worldwide. We provide solutions for turnkey projects, dehydrating gas, recovering liquid hydrocarbons, and separating CO_2. Additionally, we accommodate high-capacity projects of 1,200 MMcf/d and higher, CO_2 inlets from 5% to 85%, and CO_2 outlets from 1.5% to 50%.

Schlumberger CYNARA systems have established themselves as the industry leader, with operating facilities in the US, Canada, Southeast Asia and Argentina. Onshore and offshore, Schlumberger has the largest installed base of equipment by volume worldwide. It also is the world leader in membrane technology for EOR applications. With ongoing experience in owned and operated plants, customer facilities operation, and field service support, Schlumberger can recommend the most economical and reliable solution, whether it is a stand-alone membrane system or a hybrid system with other separation technologies.

CYNARA acid gas removal membrane system.

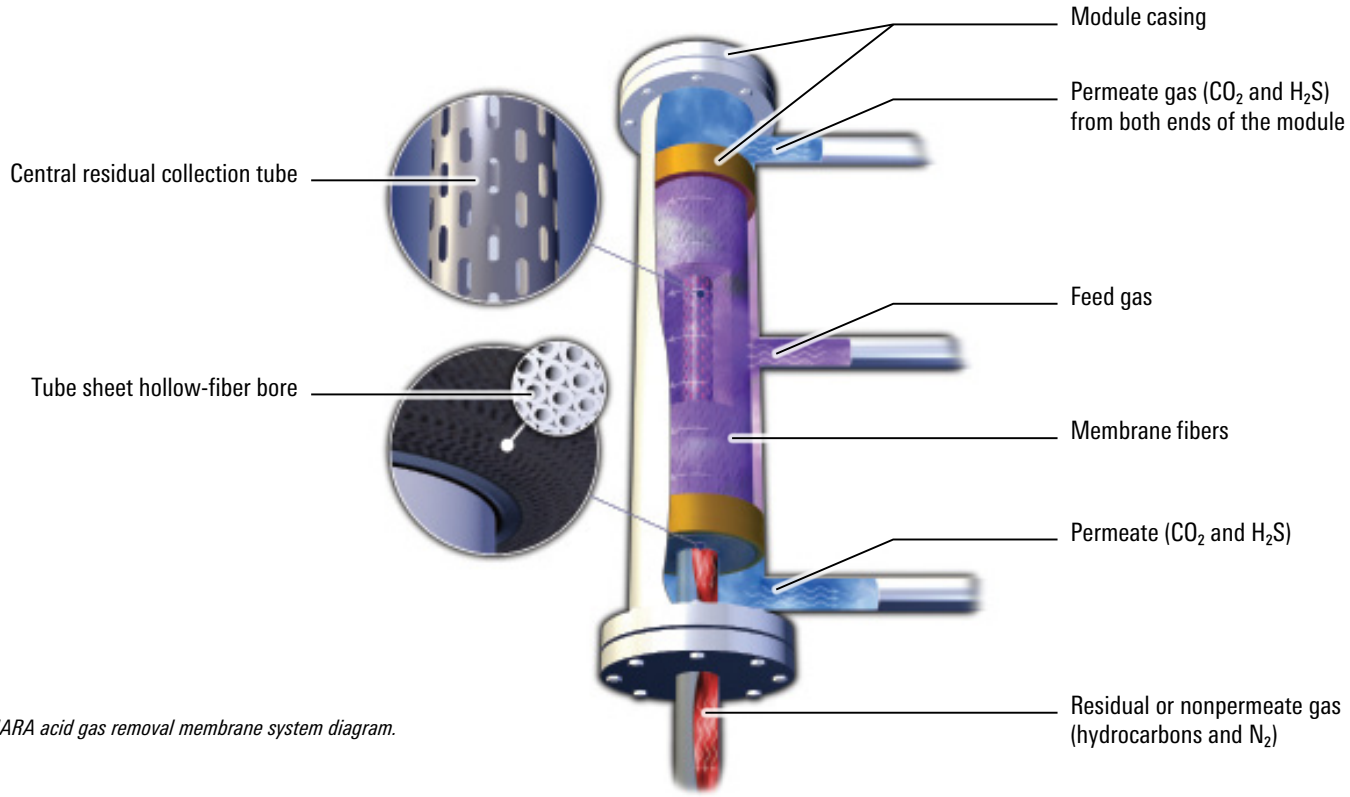
How it works

CYNARA systems operate on the basis of 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).

For example, most oil and gas applications involve CO_2 removal from natural gas components. When a natural gas stream containing CO_2 is fed to a membrane, the CO_2 will permeate the membrane at a faster rate than the natural gas components. Thus, the feed stream is separated into a CO_2-rich, low-pressure permeated stream and a CO_2-depleted, high-pressure natural gas stream.

Proper selection of the polymeric material comprising the membrane is extremely important. It determines the ultimate performance of the gas separation module. Cellulose acetate was selected as a base membrane material. Cellulose acetate is very inert and stable in CO_2 or hydrocarbon environments. Furthermore, the proprietary acetyl content of the CYNARA system optimizes membrane productivity and separation capability for EOR and natural gas cleanup applications.or the customer, this means lower capital and operating costs.

CYNARA



CYNARA acid gas removal membrane system diagram.

Module productivity for a given base material is determined by three factors: partial pressure difference across the membrane, membrane thickness, and membrane surface area. The partial pressure difference is typically determined by the specifics of the application. The membrane manufacturer can address the other factors determining membrane productivity. With in-house membrane manufacturing and R&D capability, Schlumberger directly controls and is solely responsible for quality control and performance of the membrane product. In-house R&D efforts continue to evolve the membrane technology to new levels of performance. This combination allows Schlumberger to customize fibers and membranes for specific applications.

CYNARA system membranes consist of hundreds of thousands of asymmetric hollow fibers. Epoxy tube sheets on each end of the fiber bundle and O-rings are used to separate feed and permeate gas. Pressurized gas flows into the membrane case, where it contacts the fiber bundle. Gas flows radially inward.

As the gas traverses the bundle, CO_2 selectively permeates the fiber into the low-pressure lumen of the fiber. The residual gas continues across the bundle and is collected in a central perforated tube. There are many inherent advantages of this design. The hollow fiber technology maximizes surface area per unit volume relative to competing membrane technology.

Double-ended permeate flow minimizes pressure drop down the lumen of the fiber, maximizing separation performance. The vertical orientation of the hollow fibers, combined with the central collection tube and the unique ability of cellulose acetate to withstand condensing hydrocarbons, enable efficient handling of hydrocarbon liquids, as hydrocarbon liquids are a valuable product for many operators. The CYNARA system has the only membrane element that combines all of these features into a single device.

By centralizing related services-membrane manufacturing, R&D, testing, quality control, engineering, and manufacturing capabilities, Schlumberger achieves economies of scale, quality control, product availability, and a level of product responsibility not possible through an outside supplier or multiple suppliers.

These capabilities mean that Schlumberger provides customers with

- full control of scheduling
- constant quality upgrades by working with customers to optimize membrane systems for specific applications
- enhanced troubleshooting
- rapid implementation of new fiber or element design
- more than 25 years of membrane application and operation experience.

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