

Membrane Separation Process

Membrane Separation performs on the principle of selective gas permeation. When gas mixture is introduced to the membrane, gas component dissolves into membrane material and diffuses through the membrane material. Solubility and diffusivity are different from gas component. Carbon dioxide, water vapor and hydrogen sulfide are easy permeable gas components, while methane, ethane and other hydrocarbons are very slow to permeate. This is why water and sour gas components in the natural gas are removed with the membrane. The driving force of gas separation is partial pressure difference of specific gas component between both sides of membrane.

How UBE Membrane Work

Our membrane is a hollow membrane made of aromatic polyimide. When a gas mixture is introduced to the outer side of hollow membrane at a pressure and the pressure of the other side of the membrane is maintained at a lower pressure, easy permeable gas components like CO₂, H₂O and H₂S permeate through the membrane, while gas components like hydrocarbons are remained in the outer side of the membrane.

Membrane Module for CO₂ and Hydrogen Separation

We provide four types of membrane module for CO₂ and Hydrogen separation for commercial use.

Dimensions	Max. Press. (psig)
8ind x 160inl	2200
8ind x 80inl	2200
4ind x 160inl	2200
4ind x 80inl	2200

Durability against Contaminants

Our membrane's compatibility against typical contaminants are summarized in the following Table.

Contaminants	Max. allowable content
Water vapor	Up to saturated
H ₂ S	3 vol%
NH ₃ & Amines	100 vppm
Methanol	5 vol%
Methyl Ether	5 vol%
Benzene	1 vol%
Toluene	2000 vppm
C ₅ + Hydrocarbons	Up to saturated

Features of CO₂ Membrane System

1. **Long lifetime of the membrane**

UBE's polyimide membrane is made of aromatic polyimide which is a strong material against compaction caused by CO₂, H₂S and hydrocarbons under high pressure. Also, because of high thermal resistance of polyimide, our membrane can be operated up to 100 °C. By applying higher operation temperature compaction can be minimized, also once declined permeability can be recovered.

2. **Compact & Simple System**

Because of high permeation flux and thin hollow fiber technology, our Membrane System applies only 1/2 to 1/4 membrane modules compared to the conventional relevant systems. Therefore our Membrane System is the most compact among available membrane systems. Also, because of excellent durability against contaminants, our Membrane System requires only a simple pretreatment.

3. **Applicable to CO₂ rich gas**

Because of chemical & mechanical stability in sour gas treatment, our membrane is the most reliable one in CO₂ separation from CO₂ rich gas as EOR (Enhanced Oil Recovery).

4. **H₂O and H₂S can be removed**

Water vapor and hydrogen sulfides are easy permeable gas components, accordingly our Membrane System requires no additional facility as glycol unit and H₂S absorber to get sales gas satisfies pipeline specification.

5. **Excellent selectivity**

Our excellent selective membrane can minimize hydrocarbon loss and recycle gas volume in multistage treatment.



Membrane System for natural gas treatment installed in Japan



Membrane System for EOR (Enhanced Oil Recovery) installed in Turkey

Performance Benefit

1. **Low Capital Investment**

Our Membrane System is low in cost compared with other alternatives.

2. **Compact and easy Installation**

Our Membrane System is a skid mounted with all necessary equipment and materials. Because of the largest permeability of CO₂ and simplest pretreatment facility, our Membrane System is the most compact and the lightest in weight compared with other alternatives.

3. **Easy Operation**

Our Membrane System is the simplest one, and therefore start up and shut down is almost instant as introducing process gas in a pipeline.

4. **Maintenance Free**

Long lifetime of our membrane and no moving part in the System promises maintenance free operation.

5. **Flexibility**

Our Membrane System can be operated in a flexible operation range: 30 - 100%, also the capacity of the System can be easily expanded by installing additional membrane modules.

6. **High Reliability**

Our Membrane's durability and our excellent design capability ensure high reliability of our Membrane System.

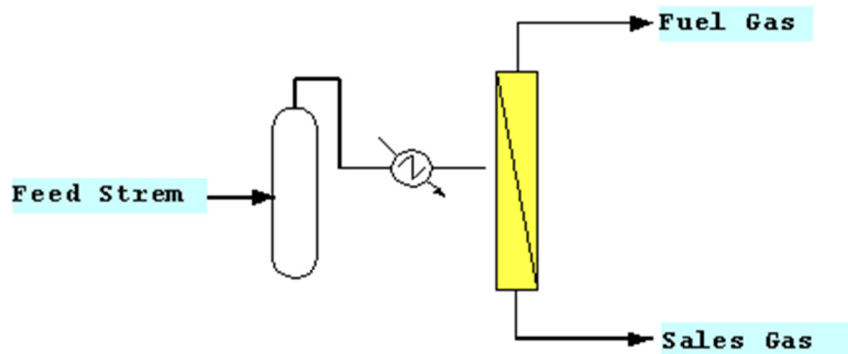
Applications

Our CO₂ Membrane System is applied ranging from a small wellhead to a large scale installation.

1. Natural gas treatment to satisfy pipeline specifications.
2. CO₂ for EOR (Enhanced Oil Recovery) injection.
3. Integration with absorption process.
4. Debottleneck an existing absorption plant.
5. Landfill gas/Biogas upgrading.

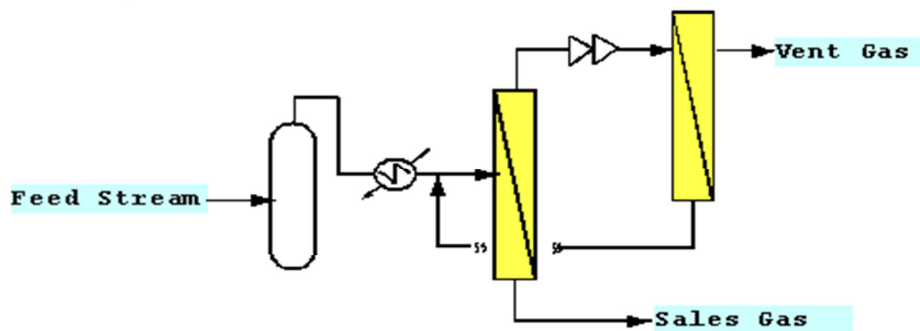
Typical Example

1. Natural gas treatment



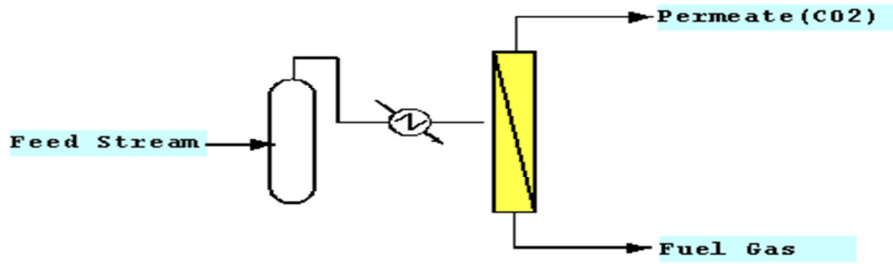
		Feed Stream	Sales Gas	Fuel Gas
Flow Rate, MMSCFD		20	16.1	3.9
Pressure, psig		950	940	75
Composition, mol%	CO ₂	6.1	1.8	23.9
	CH ₄	84	87	71.6
	C ₂₊	7.9	9.3	2.1
	N ₂	2	1.9	2.4

2. Natural gas treatment

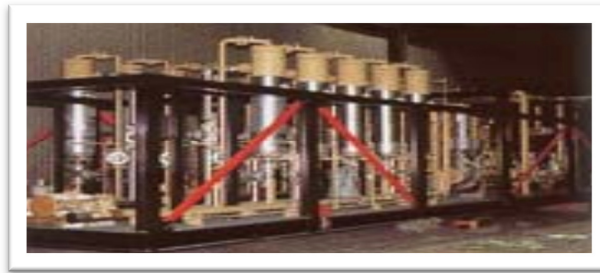


		Feed Stream	Sales Gas	Fuel Gas
Flow Rate, MMSCFD		100	87	13
Pressure, psig		850	840	5
Composition, mol%	CO ₂	9.6	1.9	61
	CH ₄	90	97.6	38.9
	C ₂₊	0.3	0.4	0
	N ₂	0.1	0.1	0.1

3. CO2 Enrichment



		Feed Stream	Permeate	Fuel Gas
Flow Rate, MMSCFD		14	7	7
Pressure, psig		750	150	740
Composition, mol%	CO ₂	73.1	93.5	52.7
	CH ₄	14.7	3.7	25.7
	C ₂₊	5.3	0.1	10.5
	N ₂	6.9	2.7	11.1



Membrane System for natural gas treatment supplied Canada

Technical Support

- 1. Engineering & Process Design**
 UBE Industries, Ltd. installed many membrane Systems world widely for H₂ and CO₂ separation. All Systems were designed and supplied by us. Our computer programs provide optimum Membrane System. Experienced project manager promises quick and timely delivery of the System.
- 2. Feasibility Study**
 We offer various services for Feasibility Study. Our experts propose you the best process.
- 3. Field Service**
 Our skillful personnel helps you with operator training, start-up and replacement of the membrane. Also we provide you with installation service.
- 4. Check-up Service**
 We report you how long membrane will be used on if you would send us operation data.

