

기체 분리막을 이용한 수소분리/정제: RHDS/VRDS에의 분리막 적용

Separation and Purification of Hydrogen Using Gas Separation Membranes

: Application of Membrane Unit in RHDS/VRDS

SK 중질유분해팀



1. VRDS/RHDS Unit History

	VRDS	RHDS
Initial S/U	1992年	1996年
Design Capacity	30,000 B/D	60,000 B/D
Current Capacity	38,000 B/D	71,000 B/D
Feed Type	AR/VR	AR
Product Usage	Fuel Oil	RFCC
Product Spec.		
Sulfur (wt%)	0.5 → 0.3	0.4
Metal (wtppm)	-	10
CCR (wt%)	-	4.65
N2(wtppm)	-	1800

2. Typical Feed Properties & Yields

◆ Typical Feed Properties

Property	AR		VR	
	Typical	Max.	Typical	Max.
API	13	-	4.8	-
Sulfur (wt%)	3.7	4	5.2	5.5
Metal (wtppm)				
Ni	26	31	60	80
V	74	89	160	200
Ni + V	100	120	220	280
CCR (wt%)	12	13.5	24	27
Viscosity (@100 °C)	65	-	3100	-
Fe (wtppm)	15	40	20	50
Nitrogen (wtppm)	2800	3400	-	-

◆ 2000年 平均 Yields

Yield	VRDS	RHDS
LPG	0.45	0.27
Naphtha	2.31	2.16
Diesel	14.41	18.56
B-C	87.04	81.91
Total	104.21	102.9

3. RHDS Membrane Unit Design Data

가. Feed Properties

Feed Properties	SOR		EOR	
	Kmol/hr	Mole%	Kmol/hr	Mole%
Pressure	163 kg/cm ² g		159 kg/cm ² g	
Temperature	55 °C		55 °C	
Flow Rate	33,454 Nm ³ /hr		33,440 Nm ³ /hr	
Components	Kmol/hr	Mole%	Kmol/hr	Mole%
H ₂	1,413	94.65	1,295	86.79
CH ₄	42.88	2.87	119.74	8.02
C ₂ H ₆	19.65	1.32	44.6	2.99
C ₃ H ₈	11.0	0.74	21.16	1.42
iC ₄ H ₁₀	0.71	0.05	2.37	0.16
nC ₄ H ₁₀	1.88	0.13	4.68	0.31
C ₅ +	0.78	0.15	1.01	0.22
H ₂ O	1.22	0.08	1.22	0.08
H ₂ S	0.10	0.01	0.10	0.01
Total	1,492.82	100	1,492.18	100
M.W	3.38		5.09	

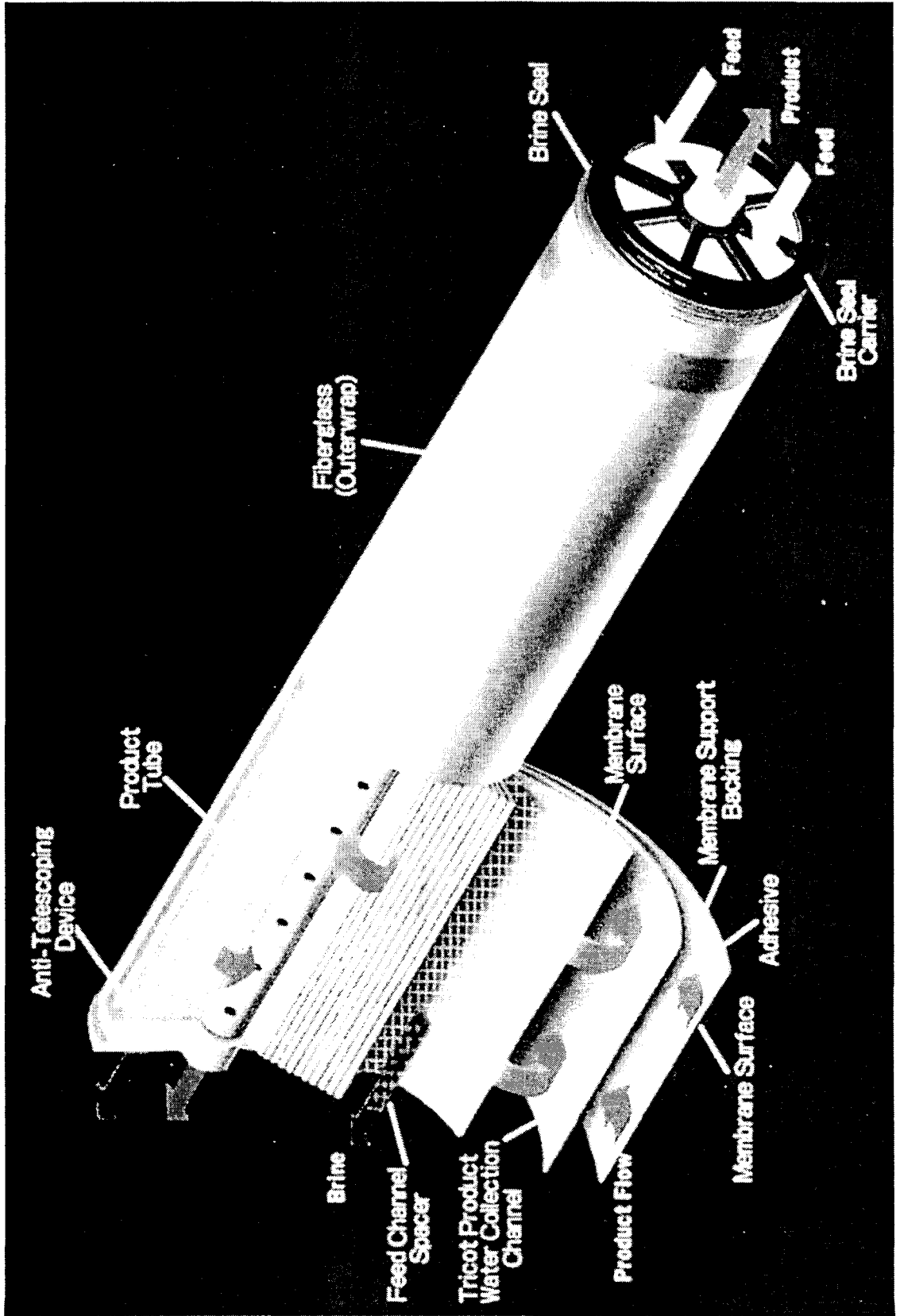
Lt. Feed Condition Range

Feed Condition	Minimum	Normal	Maximum
Pressure, kg/cm ² g	120	164 / 159	-
Temperature, °C	-	55	
Flow Rate, %	50	100	120
Flow, Nm ³ /hr	8,500	33,340 / 33,454	40,055
H ₂ Recovery, %	-	95	-
H ₂ Purity, %	-	98.47	-

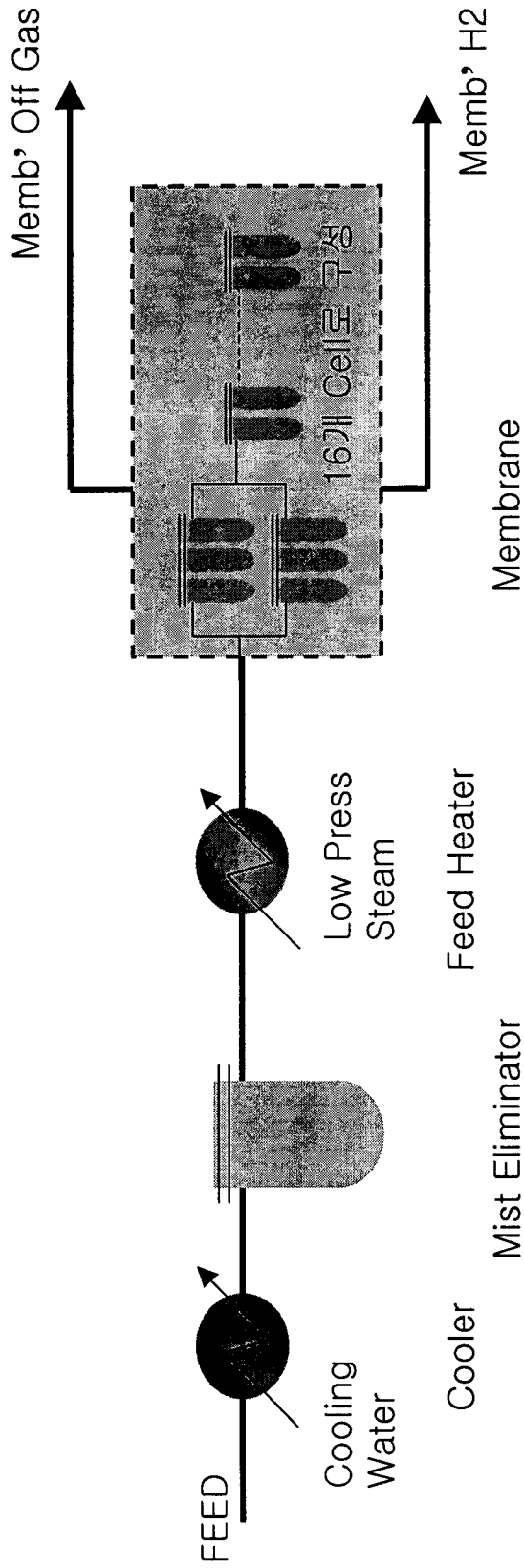
Lt. Product Condition Range

Product Condition	H ₂ Product	Off Gas
Pressure, kg/cm ² g	45	20
Temperature, °C	80	80
Flow, Nm ³ /hr	31,984 / 28,593	2,200 / 4,847
H ₂ Recovery, %	95	-
H ₂ Purity, %	98.47	-
Next User	H ₂ Plant M/U Gas Comp. 2 nd Stage	Deethanizer Feed / H ₂ Plant Feed Vaporizer

4. Membrane Fiber 구조도



“A”사 Membrane Process Flow Diagram



Material Balance		F, Nm ³ /h	P, kg/cm ²	T, °C	Purity, %	Recovery, %
Design	FEED	19,100	135.5	55	87.7	97.6
	Memb' H2	17,200	44.0	80	Min.95	
	Memb' O/G	1,900	21	80	21.3	
Actual	FEED	12,007	141.0	65.6	92.8	97.3
	Memb' H2	10,915	43.4	80	99.3	
	Memb' O/G	1,221	15	80	-	