

01_COMPANY Introduction

02_BUSINESS Model & Strengths

03_FEATURES of Products



- Total solution for membrane technology
- Organization
- PHILOS Introduction
- History
- Total solution for membrane & application
- R&D oriented company that produces various type of membranes & total solution
- Global partnership
- · Government-aided research
- Intellectual property rights
- Membrane applications
- Membrane & Modules
- Membrane system & membrane manufacturing system, evaluation system & raw material
- $\bullet \ \ \mathsf{RCM}(\mathsf{Reinforced\ capillary\ membrane})\ features.$
- Megaflux-MBR Submerged MF Module for MBR Process
- Megaflux-CUF Pressure-driven UF Module for water Treatment Process
- SCAF Pressure-driven UF Module for water Treatment Process
- Master Pressure-driven UF Module for Food/Bio Process
- i-MBR in vitro(side-stream filtration) MBR Process

01_COMPANY

Vision & Introduction

Organization

Introduction of department

History



Gveonggi-do Province-Algal bloom

2008

removal : Korea Industrial Complex Corp, - Seawater Purification

Ministry of Environment - International Co-development

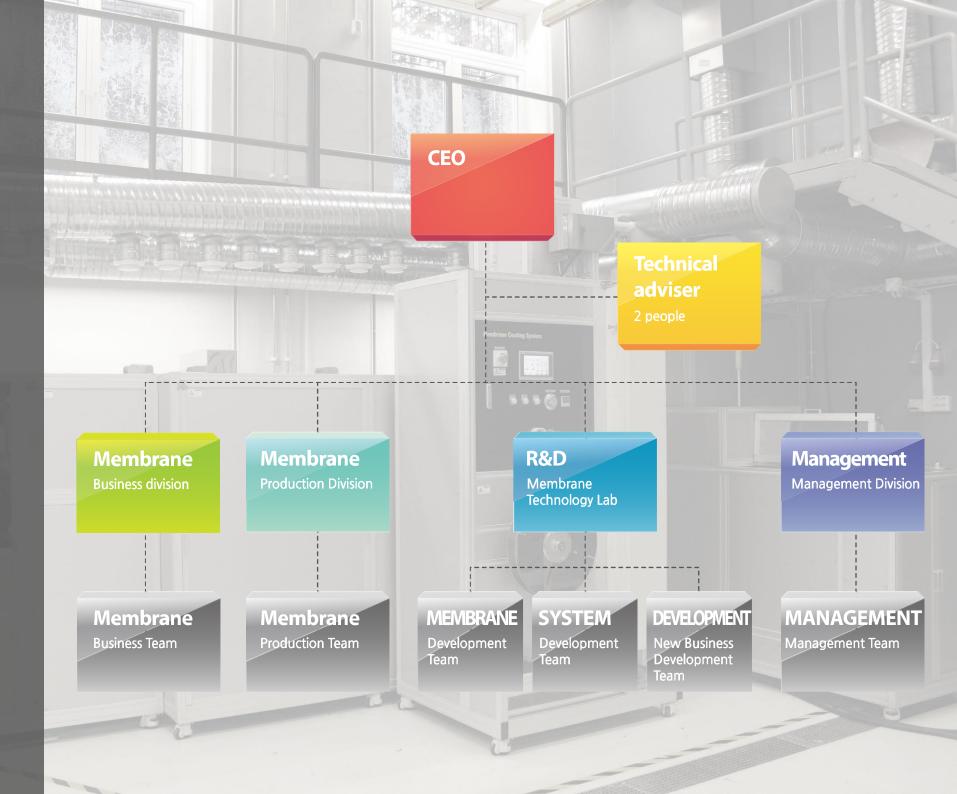
01_COMPANY

Vision & Introduction

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Histor



01 COMPANY

Introduction of department

INTRODUCTION OF DEPARTMENT

Head office, Research center and Production plant introduction

HFAD OFFICE 본사





- **CENTER OF PHILOS** Membrane manufacturing know-how for 30 years
- **MEMBRANE BUSINESS** Production of various type of membranes and materials
 - Membrane Engineering, Technical Services and Consulting
 - Domestic & overseas global network construction and business cooperation

 - ADDRESS #B-1210, 60, Haan-ro, Gwangmyeong-si, Gyeonggi-do, Republic of Korea
- CORPORATE REGISTRATION NO. 135-81-71800

 - MAIN PRODUCTS Membranes and modules, membrane systems, research equipment, etc.



Membrane Technology Research center



MAIN TECHNOLOGY

MEMBRANE RELATED • Membrane basis performance evaluation

- RESEACH & DEVELOPMENT New technology research and development for FO/PRO/MD etc
 - Government project

New product development

- VARIOUS MEMBRANE Performance evaluation system for MBR, UF/MF, NF/RO
- **PERFORMANCE & EVALUATION** Membrane application field process R&D and performance evaluation.
 - **SYSTEMS** Open Laboratory

FACTORY Production plant





MEMBRANE · Reinforced capillary ; 430,000m2/year

MANUFACTURING FACILITY

(200,000m3/day capacity of sewage treatment)

- Prodution of hollow fiber membrane and Specialty membrane
- PRODUTION OF VARIOUS UF/MF,MF/RO,GS,etc
- MEMBRANE & MODULES Pressure-driven, Submersible, in-vitro suction, etc.
 - Specialty(Dehumidify membrane, Degasifier, Bioreactor, etc)

- MEMBRANE SYSTEM Water treatment equipment and package(Containerized) system
- MEMBRANE MANUFACTURING SYSTEM Membrane system, Performance evaluation system, R&D system

01_COMPANY

Vision & Introduction

Organization

Introduction of department

History

		1					
Initial stage	2002	9	06	Foundatio	n		
	2004		07	Establishm Adopted h	ent o ollow	echnology Innovation Company" by the government of PHILOS Corporation with fiber membrane spinning equipment, Braid reinforcement film coating equipment, Dry wet-type flat membrane facility, Company certification "Frontier" by government, Awarded the bronze prize of the Korea Venture Company	
	2005	0	03	Established	d mer	a government certified venture company embrane R&D center ation of RCM, Reinforced Capillary Membrane	2
Take-off Stage	2006	0	01	Registered	facto	tory and extension of business at Si-wha industrial complex.	
	2007	0	80	Adopted h	ollov	ation of Megaflux-MBR for Submersible module ow fiber membrane production facility of i-MBR module that external circulation for water and water recycling	
	2010	0	06	Signed wi	ith Ni	Nitto-Denko company (Hydranautics U.S.A) as official agent	
	Growth	Sta	ge	2011 2012 2013		07 Relocated Gwangmyeong head office and R&D center 01 Established 1st factory in An-san 06 Selected the best assessment company by Technical Assurance Fund (A Members) 07 Registeration of public procurement service 10 Business agreement with KISTI as "Knowledge-mentoring" 02 Certificated quality management (ISO:9001, ISO:14001)	
				2013		Development and Commercialization of MF module Super-M of big hollow fiber Braid Awarded the grand prize of Appropriate technology social enterprise festival by SK Happiness share foundatio Awarded the excellence award of development project by Gstep	n
				2014		01 Established 2nd factory in An-san 08 Commercialization of Wellspring for portable water purifier	
				2015	0	01 Development and Commercialization UF module Megaflux-CUF for big storage water treatment	
	Globaliz	zatio	on	2016	0	01 Development and Commercialization of wellspring	
				2017	1	07 Development of Dehumidify membrane and module 12 Relocation and extention of membrane factory at Dongtan	

02_PHILOS STRENGTH

Membrane & Application

Various membrane

Global partne

Government-aideoresearch

Intellectual property righ

01

Reinforced Membrane, Hollow Fiber Membrane, Flat Sheet Membrane Producing Technology

MF, UF, RO, GS membranes 10K, 30K, 60K, 0.05 \(\mu \), 0.1 \(\mu \), 0.4 \(\mu \), 5 \(\mu \)

World-class membrane performance Stable flux maintenance

30 years of membrane production know how Membrane manufacturing core technology

MEMBRAN MANUE UZ Lligh

High Quality / Efficiency Membrane System Design Production

Optimized water treatment system design MBR, UF/MF, NF/RO, EDI system

Specialty membrane system production Food / bio separation concentration

Lab system / performance evaluation system Lab/Pilot scale evaluation system

PHILOS Total solution for

Total solution for membrane & application

ONSULING & SER

MANUFACIO

Technical Service for Customer

Membrane technology development support Highly efficient water treatment technology co development

Membrane engineering technology support Core technology training and technological marketing cooperation Membrane Manufacturing
System & Application Technology

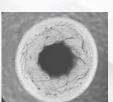
Worldwide membrane researcher network
Over 20 companies from more than 10 countries

Membrane manufacturing technology R&D Provision of raw materials for membrane production Security maintenance through NDA Provision of braid, non woven fabric, adhesive etc., 02 PHILOS STRENGTH

Various membrane

 Various membrane manufaturing technology & system design

 Strengthen material business & domestic and overseas business cooperation



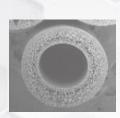
Highly Durable Braid Reinforced Membrane

 $MF(0.1 \mu m, 0.4 \mu m, 5 \mu m) / UF(0.05 \mu m)$ Functional polymer pore filling membrane Patent technology



Various Membrane Company Alliance

OEM products, patents/ new technology Cooperation with leading companies Customized products according to customer needs



Hollow fiber Membrane for water treatment & Concentration & Separation UF(10K,30K,60K,150K)Sponge-like/Finger-like, Patent technology



Membrane Raw Material Sales

Non woven fabric, chemicals etc.



Membrane System design

MBR, UF/MF, NF/RO, EDI system Specialty separation system



Overseas Joint Venture

Establishment of overseas production plant



Design technology of experiment and research equipment

Flat sheet, Hollow fiber membrane & module evaluation system



Membrane Manufacturing system / Technology Transfer

Co development with customer International network of experts

02_PHILOS STRENGTH

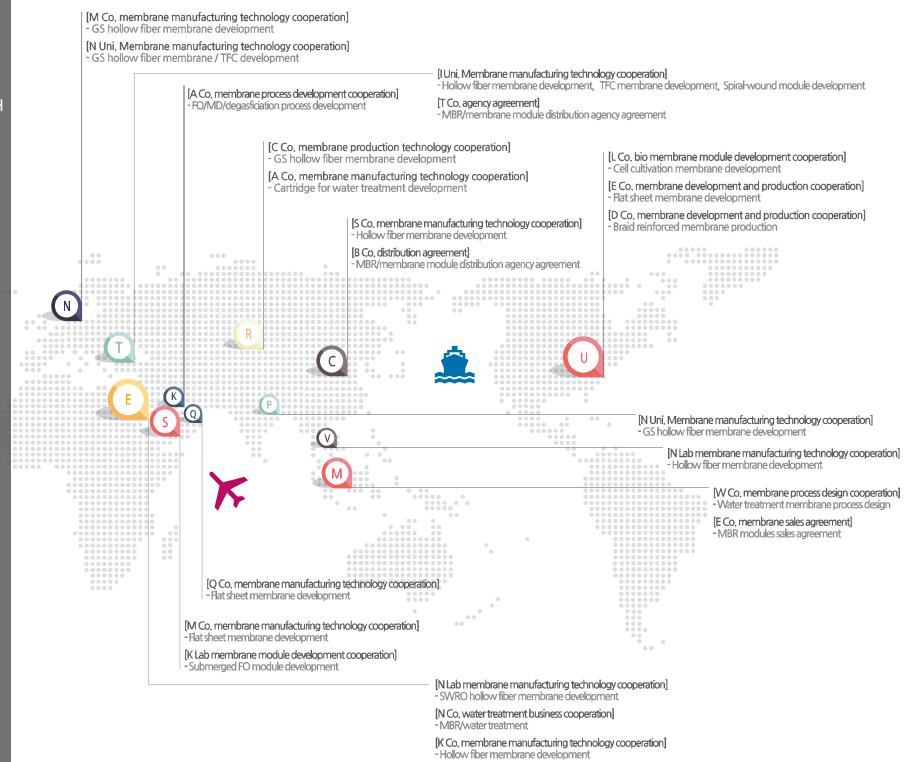
Membrane & Application

Various membrane

Global partner

Government-aided research

Intellectual property righ



www.philosmembrane.com www.pmbr.com		
		Development of self clean supporter reinforced capillary filtration membrane module water treatment system technology and completing commercialization report
	2004	Development of pressurized capillary filtration membrane module, submerged MBR module and system technology
02_PHILOS STRENGTH		Development of degasification system with membrane
	2006	Development of degasifier and degasification system for removing gas in water
Membrane & Application	2006	Development of various pore sizes of membrane with hydrophilic material
	2007	Development of membrane by gaining excellent membrane materials of Hydrophilic PVDF
Various membrane		Research on synthesis of membrane manufacturing solutions and technical development for improvement in dope formulating process
	2011	 Manufacture automatic systems, reduce the workload and improve the working environment by developing optimum material synthesis condition
Global partner	2011	Development of packaged high efficiency water reuse processing facility Development of package water reuse processing system with use of an external cyclic membrane system which is easy to maintain and make better
		use of a space
Government-aided	2012	Development of suppression technology for lake eutrophication with use of electrolysis, elector-coagulation and fiber supported hollow fiber
research		• Development of low-energy/high-efficient eutrophication suppression technology by applying membrane which is gravity-filterable.
Intellectual	2014	Development of by-product application technology and production of herbaceous bio-ethanol by enzyme hydrolysate
property right		 Development of SPUF membrane and process which makes possible to reuse sodium hydroxide waste solution after eliminating foreign body and recovering high value by-product
	2015	Development of reclaimed wastewater reuse process with membrane hybrid process
		• 3,000ton/d wastewater reuse system buildup in Jeju Island by applying hydrophilic PVDF UF reinforced membrane and high capacity frame
		Development of hybrid eco-fresh water generator unit system
		• Improve efficiency of fresh water generator by perfectly eliminating mud and float substances in inflow into the seawater fresh water generator.
	2016	Investigation and control biofouling and development of cleansing technology in forward osmosis-reverse osmosis process
	2010	 Deriving water quality control operation factors, predicting and controlling membrane fouling phenomena in FO-RO integrated process
	2017	Development of PRO(Pressure Retarded Osmosis) module for Salinity gradient power
		 Development of hollow fiber membrane and pressure-resistant module for PRO (Salinity gradient power with membrane)

02_PHILOS STRENGTH

Membrane & Application

Various membrane

Global partner

Government-aided research

Intellectual property right

PATEN1

Membrane module

15 case

Membrane manufaturing

7 case

Membrane process

24 case

Total: 46

Water treatment system with hollow fiber membrane

Submerged type treatment system with hollow fiber membrane

Membrane manufacturing technology and water treatment filter module, equipment, and system

Hollow fiber membrane module

Membrane module and submergible type water treatment system

Disk type membrane module

Membrane module and manufacturing technology

Hollow fiber membrane manufacturing technology and water treatment system

Detachable membrane module and anti-contamination membrane module unit

Membrane module

Anti-contamination submergible membrane system

Air diffuser and water treatment device including it

Water purification patches, water cartridges, and portable water purifier using these

Air filters and air purifiers

Water treatment device

Braided coated membrane manufacturing technology

Capillary membrane support and coating technology

Functional braid membrane and manufacturing technology

Micro filter manufacturing technology and the system

Membrane and its manufacturing methods

Hollow fiber membrane for Dehumidification and Its Manufacturing Method

Hollow fiber membrane for dehumidification, using of dehumidification module

and manufacturing method of dehumidification membrane module

Hollow fiber membrane and cultivation system

Algae and microorganism concentration system (marine-bio co-patent)

Gray water and rain water treatment system by side stream membrane (Samsung co-patent)

Operation process to increase membrane bio-reactor efficiency

Small scale automation water treatment system

MBR system and operating process for load variation

MBR system with gas collection unit

MBR waste water treatment for load variation

Submergible type membrane system and operating process

Waste water treatment process

Membrane cleaning process

Submergible membrane system

Membrane water treatment system

Water treatment system with submergible membrane

Water treatment system and process

Potassium iodide recovery technology and the system

Caustic soda solvent and by-product recovery device and recovery method of biomass

Hollow fiber membrane immobilization module and water purification device including it

Water treatment facility and water treatment method

Emergency portable water purifier

Membrane module for water purifier and using it Water treatment equipment

Membrane in high-efficiency cooling tower

Membrane in plume abatement cooling tower

Emergency portable membrane water purifier

UTILITY MODEL

Submersible type flat membrane filtration device

Flat sheet plate module

Potable water purifier

REGISTERED TRADEMARK

Trademark registration application of PHILOS CO, LTD

Trademark application of wellspring

REGISTERED DESIGN

Design application of wellspring

UTILITY MODEL

TRADEMARK & DESIGN

PATENT

Membrane -Application

Membrane module

Membrane system

RCM

Megaflux-MBR

Megaflux-CUF

SCAF pressure

Master pressure

i-MBF

PHILOS MEMBRANE APPLICATIONS

Widely used in many industrial fields by various membrane material and pore size of PHILOS product









Wastewater treatment Water reclamation

Membrane bioreactor(MBR)









Water treatment

Drinking water Industrial or ultrapure water Desalination







Food/Bio Applications

Concentration / Separation Fermentation / Cell culture







04

Chemical applications

Pervaporation
Solvent separation / Bio refinery





05 Specialty

Membrane dryer Fuel cell membrane (Humidifier)

Membrane -Application

Membrane module

Membrane system

RCM

Megaflux-MBR

Megaflux-CUF

SCAF pressure

Master pressure

i-MBF

PHILOS MEMBRANE & MODULE

Membrane own manufaturing of various membrane material and pore size

Submesiable module for MBR to use sewage/ waste water treatment,

Pressure-driven module for watertreatment, Production of in-vitro module for concentration and separation



01

Water treatment

Braid UF 0.05 µm: Megaflux-CUF(Pressure-drive)

Braid UF 0.1 µm: SCAF(same as above)

Braid MF 5 um+Functional Polymer pore filling: SCAF(same as above)



02

RO

- * Biz. Alliance(Nitto Denko)
- Φ4", Φ8" NF/RO
- Final UF(MWCO 6K)



03

MBR

Braid UF 0.1 m

: Megaflux-superMBR(Submersible, Suction)

Braid UF 0.4 µm

: Megaflux-MBR(Submersible, Suction)



04

Concentration/ Separation

Hollow fiber UF 10K, 30K, 60K, 150K

: Master(Pressure-drive, Internal pressure-driven)

Braid UF 0.1/0.4

m

: i-MBR(in-vitro, 감압흡입)



05

Home

Hollow fiber MF 0.1

m, Braid UF 0.1

m

: Wellspring(Gravity filtration, Suction)



06

Specialty

All kinds of membrane

: Labio (Φ1", Φ2" Module for test)

Membrane system

Membrane System, Membrane Manufacturing System, **Evaluation System & Raw Material**

Provide total solution from membrane matrial to application technology, Membrane system, Membrane manufaturing facilities and research equipments, Provide from base material to subsidiary material inclusive.



Membrane system

Water treatment UF/MF block(skid)+BWRO system UF/MF submerged / in vitro system MBR process

Pressure-driven / Submerged UF/MF(+ BWRO system) Water reuse Pressure-driven / Submerged UF/MF+ SWRO system Desalination

UF/MF+RO+EDI+IX system DI water

Containerized package system(WT, MBR) Specialty



Membrane manufaturing facilities & research equipment

Flat sheet membrane manufacturing Performance/Evaluation

Hollow fiber membrane manufacturing UF/MF/RO/GS membrane, Lab / Pilot / Commercial scale TFC membrane, Lab / Pilot / Commercial scale UF/MF/RO/SDI/GS/FO/MD/PRO/PV



O3 Chemicals & Materials

Raw materials Non-woven fabric, Braid, Adhesive, Polymer, Solvent, Additives

Membrane -Application

Membrane module

Membrane system

RCM

Megaflux-MBF

Megaflux-CUF

SCAF pressure

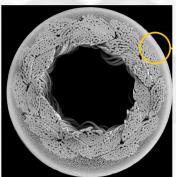
Master pressure

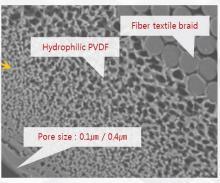
i-MBF

PHILOSEP RCM Features

(Reinforced Capillary Membrane)

- Used reinforced fiber braid membrane, non-breakage of membrane and highly durability,
- No turbidity spilled due to coating system that impregnating Braid with hydrophilic PVDF with excellent chemical resistance.
- Membrane performance does not deteriorate even with frequent chemical deaning, and it is excellent performance over a long time period.
- Applicated to wastewater treatment MBR, water treatment and supply water, water recycling



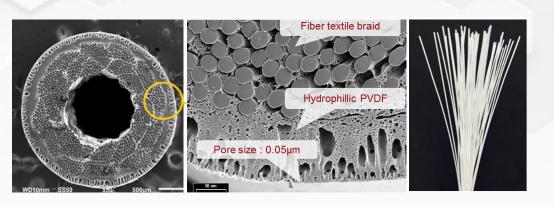




01 RCM MF SPECIFICATION

Membrane Material
Support Material
Inner / Outer Diameter
Pore Size
Designed Flux(for MBR)
Tensile Strength

Hydrophilic PVDF Polyester 0.7 / 1.65mm 0.1 \(\nu\) / 0.4 \(\nu\) 5~40 LMH(L/m²·hr) 40~50 kgf / fiber



02 RCM UF SPECIFICATION

Membrane Material
Support Material
Inner / Outer Diameter
Pore Size
Designed Flux(for MBR)

Designed Flux(for MBR)
Tensile Strength

Hydrophilic PVDF Polyester 0.7 / 1.65mm 0.5 m

40~100 LMH(L/m²·hr) 40~50 kgf / fiber

Megaflux-MBR

Megaflux-MBR Submerged MF Module for MBR Process

MBR Membrane module for wastewater treatment After wastewater treatment or water recycling by MBR

Megaflux-MBR Special Features

Easy to set up in site, simply assembly and disassembly as block structure

: Possible to order-made when replacement no need to special work.

Application of hydrophilic PVDF braid reinforced memnbrane

: Excellent mechanical strength, perfectly treatment water and maintain without breakage of membrane when operating.

Application for membrane of submersible matrial with optimal sponge structure

: Excellent restoration, keep a stably capacity of channel when long term use.

Diffuser installation for effective aeration

: Minimized membrane pollution when operating by element structure that individual air diffuser included.

Sludge discharging diffuser structure

: Solution for blockage by possible to sludge discharging open structure.

2 Megaflux-MBR Features



Membrane

RCM 0.1 \(\mu\mathrm{m}\) / 0.4 \(\mu\mathrm{m}\)

Element

Air diffuser all-in-one type

Frame

Block assembly for easy to expand and assemble



Selection / production at various heights accoding to site condition

R4 - Applicable to small size MBR site(Under 100m³/d)

R3 - Applicable to medium size MBR site (Under 500m³/d)

R2 - Applicable to large scale MBR site (Over500m³/d)



Various element composition as customer's need

Module production using height-specific elements Possible to manufacture that customer's need and site condition



Expandability by capacity of treatment

Frame production by various size and combined module Possible to customize without any special work when existing submersible membrane replacement

> Membrane -Application

Membrane module

Membrane system

RCM

Megaflux-MBR

Megaflux-CUF

SCAF pressure

Master pressure

i-MBR

Megaflux-CUF Pressure-driven UF Module for water Treatment Process

Large scale of water treatment / RO pre-treatment / Sewage & effluent recycleing / Seawater desalination / Wastewater treatment / Manufacture ultrapure water/ Wastewater Reclamation / Supply water for boiler / Polished waste water recycling

01

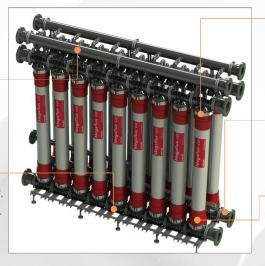
Megaflux-CUF Features

COMPACT and All in one UF SKID

- UF module and skid pipes are formed of a single block.
- Skid production cost reduction and footprint more than 50% reduction.

SAFE TRANSPORTATION

- CUF modules and skid components are transported separately.
- Reduce transportation costs and minimize transportation damage.
- Reduced equipment costs on site installation.



HIGH EFFICIENT UF MODULE

- No breakage of fiber due to application of RCM UF. (Stable particle removal)
- Integrated aerator installation. (Effective aeration)

EXCELLENT EXPANDABILITY

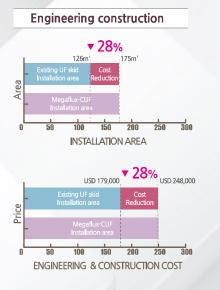
- Series connection and parallel array arrangement.
- Reduction in installation costs.

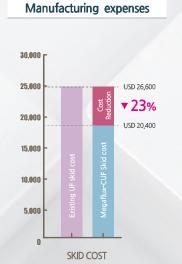
EASY MAINTENANCE

- CUF module and pipe connection using grooved joints.
- Easy assembly and disassembly when repairing and replacing modules.

Comparison of conventional skid and Megaflux-CUF skid installed area(3,000m3/d Water Reuse for sewage treatment)

Items	Megaflux-CUF skid	Conventional skid
Туре	Frame Type	Frame Type
Module Diameter	8 inch	6 inch
Footprint size(WxL)m	1.4x2.8(4.5m²)	1.6xL5.5(9.0m²)
Skid Volume	11,56m²	25.41m ³
Amount of module	18modules(990m)	36modules (990m²)
Picture &		THE REAL PROPERTY OF THE PARTY
footprint area		





Membrane -Application

Membrane module

Membrane system

RCM

Megaflux-MBF

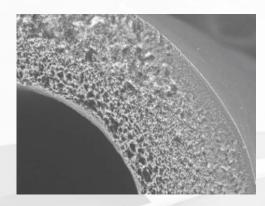
Megaflux-CUF

SCAF pressure

Master pressure

i-MBR

SCAF Pressure-driven UF Module for water Treatment Process



SCAF Hollow fiber UF membrane module Features

UF Membrane Module

Specialization for water recycling and industrial water treatment

Filtration: External pressure-driven

Back washing: Back washing of water and chemical at the same time **Application**: Water treatment, RO pretreatment, Recycling wastewater

O2 SCAF6 Specification



	Items	SCAF 6
Мо	dule dimension	Ø 6" x L70(inch)
Membran	e area (outer surface)	30m²
Designed	flow rate per module	1.2 ~ 3 m3/hr
Ma	jor application	Water purification, Pretreatment of RO (Seawater, Surface water, Water Recycle)
Membrane	Pore size	MWCO 150,000
dimension	OD/ID	1.15 / 0.65
Material	Membrane	Polyethersulfone
	Housing	PVC / ABS
	Sealing	Polyurethane
	Filtration type	Outside-in
Operating condition	Max, TMP	< 3 kg/m²
	Normal operating pressure	< 1 kg/m²
	Max. temperature	40℃
	pH range	2 ~ 12

Membrane -Application

Membrane module

Membrane system

RCM

Megaflux-MBF

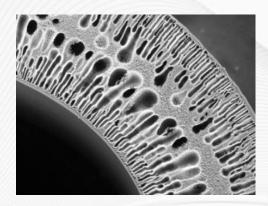
Megaflux-CUF

SCAF pressure

Master pressure

i-MBF

Master Pressure-driven UF Module for Separation/Concentration Process



Master Hollow fiber UF membrane modules Features

UF Membrane Module
Specialization for water recycling and industrial water treatment

Filtration: External pressure-driven

Back washing: Back washing of water and chemical at the same time

Application: Food/ Bio separation/ Concentration/ Purification

O2 MASTER6 Specification



	Items	MASTER 6
M	Iodule dimension	Ø 6" x L50(inch)
Membra	ane area (outer surface)	10m²
N	Major application	Food & Bio process, Water purification
Membrane	Pore size	MWCO 10K, 30K, 100K, 150K
dimension	OD/ID	1.3 / 0.7
Material	Membrane	Polyethersulfone
	Housing	PVC / ABS
	Sealing	Polyurethane
Operating condition	Filtration type	Inside-out
	Max. TMP	< 3 kg/m²
	Normal operating pressure	< 1 kg/m²
	Max. temperature	40℃
	pH range	2 ~ 12

i-MBR

i-MBR in vitro MBR Process





i -MBR in vitro suction MBR module Features

MBR Membrane Module of in vitro circulatory system

Installation: Installation outside of plant MBR (* Odor air emissions obstruction)

Chemical treatment: in-site (* No need special treatment tank)

Applications: Water reuse treatment for a luxury building,

Processing of concentration, separation and refining for food / bio



02i -MBR Module Specification

	Items	MASTER 6
Module dimension (inch)		Ø 14" x L 80
MBR 7	Treatment Capacity	5 ~ 15 m3/d
М	ajor application	In vitro circulation suction type MBR Process Wastewater treatment
	Pore size	0.4 µm
Membrane	Material	Hydrophilic PVDF
	Max, Pressure	<400 mmHg
	Normal Pressure	100 ~ 200 mmHg
Operating	Circulation Flow	24 ~ 30 Nm3 / Hr module
condition	Aeration	4m3/hr·module
	Max. temp.	40 ℃
	pH range	2~13

Products & Technologies Hollow Fiber Membrane Manufacturing System Dope Formulation TIPS, NIPS Spinning TechnologyTransfer Potting & Cutting Flat Sheet Membrane Manufacturing System Spiral-wound Coating & Casting Membrane Manufacturing System Systems for Feasibility Tests & Scale-up study Membrane Performance Evaluation **Pilot Test** Happiness **Membrane Permeation Cell** Laboratory and evaluation System OEM Materials Non-woven Fabric Filters Chemicals Solvents Additives Polymer Materials



Total Solution