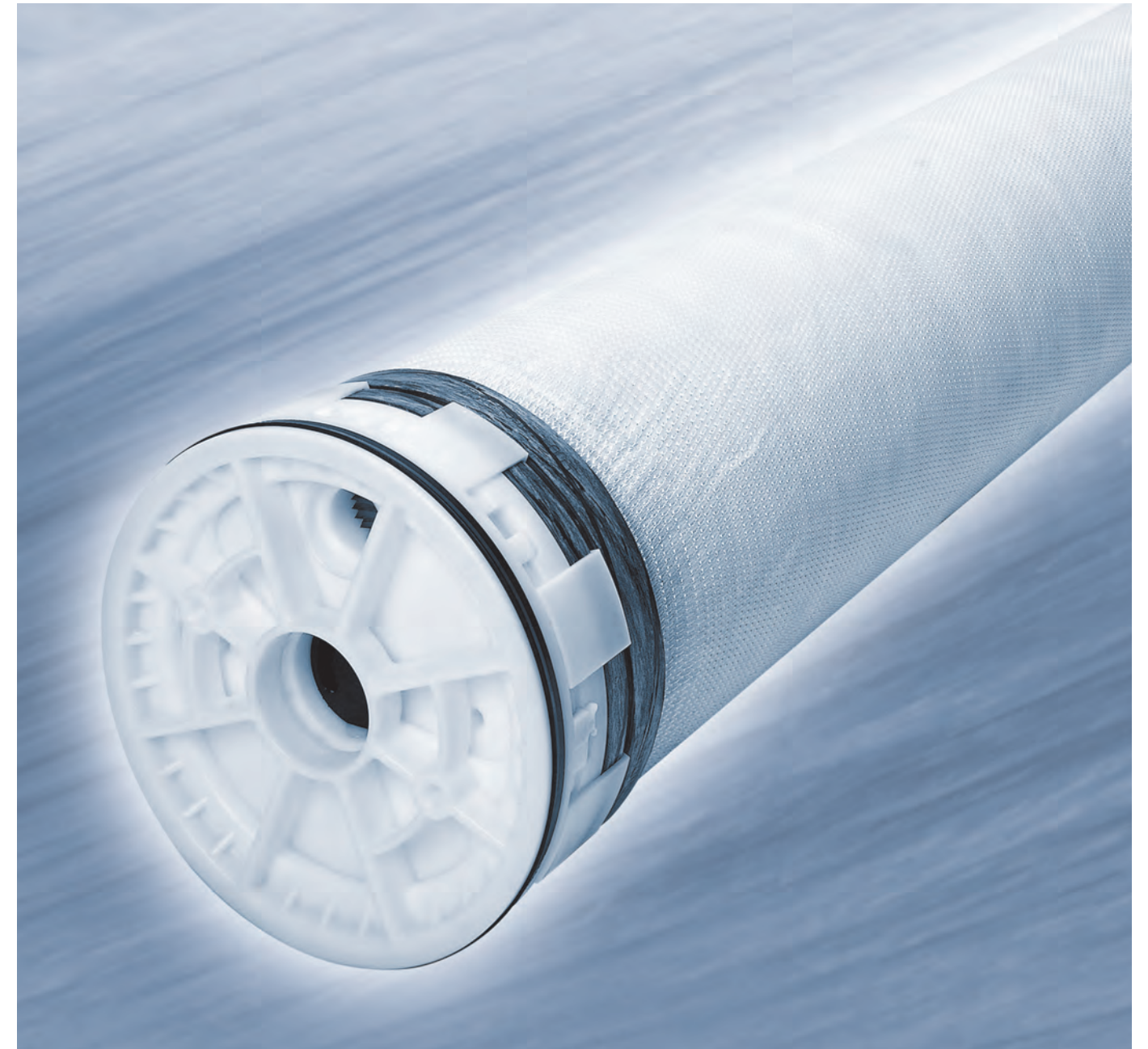


HOLLOSEP®



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The Best Solution
for Desalination

Toyobo MC RO Module "HOLLOSEP®"

Toyobo MC, a leader in fibers, textiles and polymer chemistry over more than century of operations and now, the leader in the world of Seawater RO based on hollow fiber membrane technology.

Toyobo MC "HOLLOSEP®" has unique characteristics that eliminate biofouling, provides higher availability, delivers excellent reliability, and allows the highest recovery of product water. Toyobo MC "HOLLOSEP®" has proven its higher quality in performance and cost competitiveness in the Middle East and around the world in large commercial desalination plants.



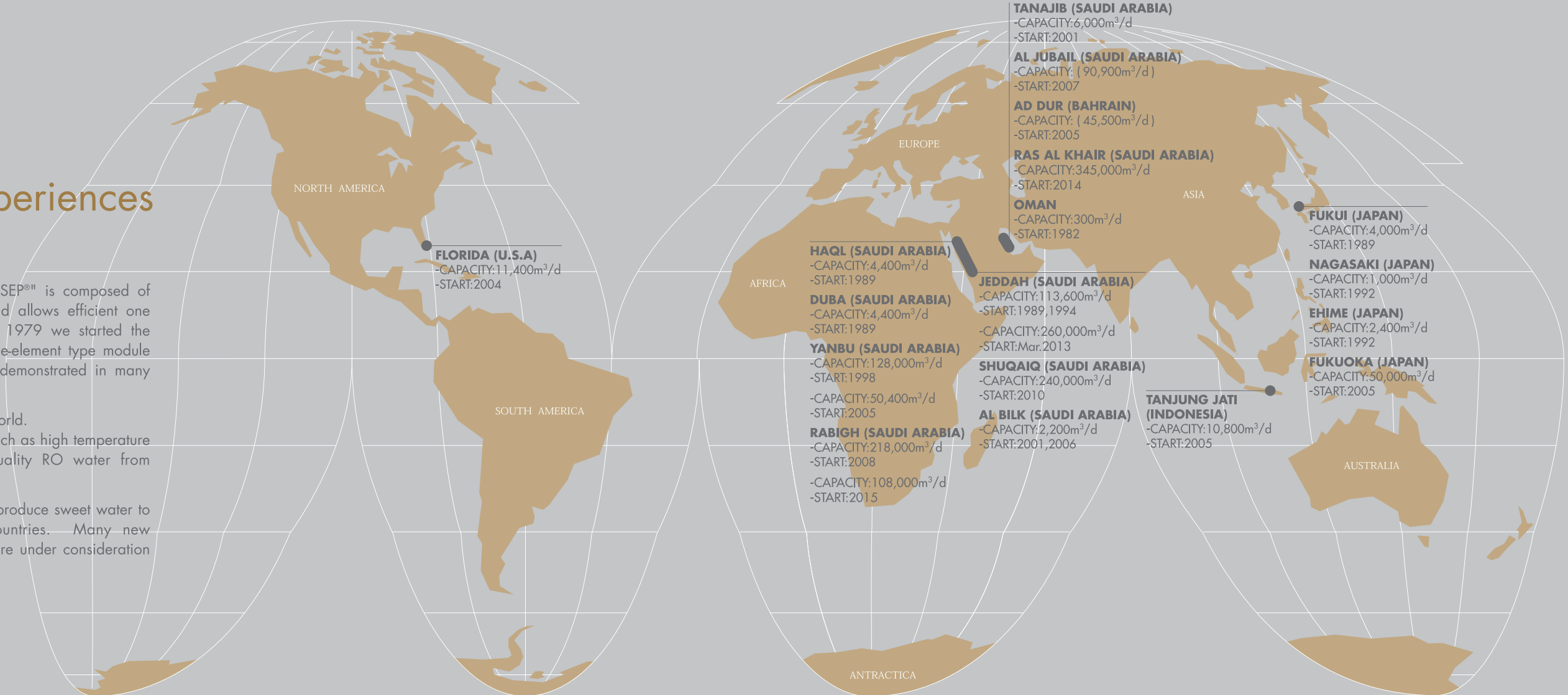
Many Years of Experiences for Desalination

Toyobo MC's RO membrane module "HOLLOSEP" is composed of cellulose triacetate hollow fiber membrane and allows efficient one stage, one pass desalination of seawater. In 1979 we started the world's first commercial production of a double-element type module and over many years this product has been demonstrated in many desalination plants.

"HOLLOSEP" is successfully used all over the world.

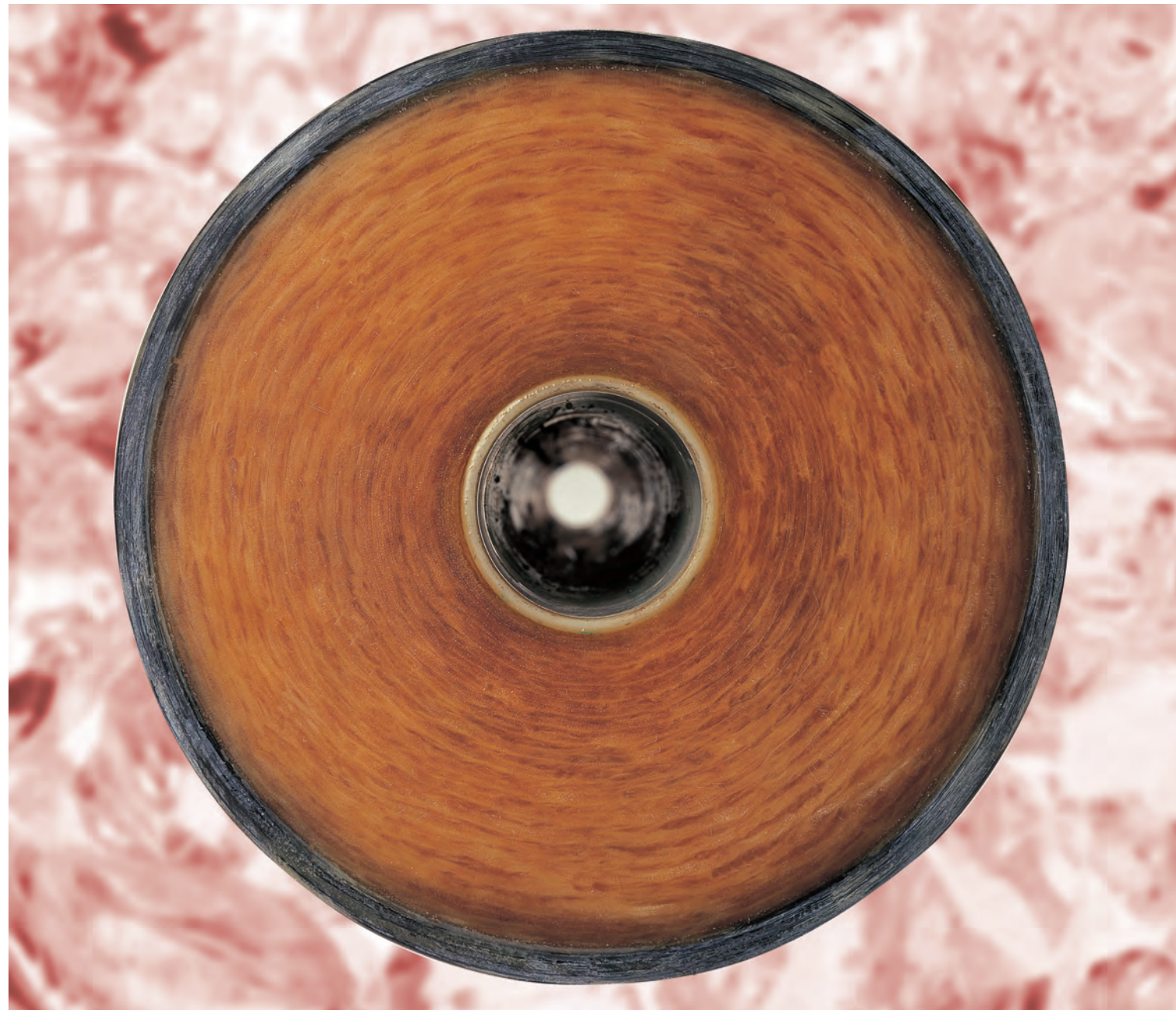
In the Middle East where harshest conditions, such as high temperature and high salinity, exist for making high quality RO water from seawater.

All over the world, "HOLLOSEP" continues to produce sweet water to contribute and meet demands in many countries. Many new "HOLLOSEP" seawater desalination projects are under consideration to further capture these proven benefits.

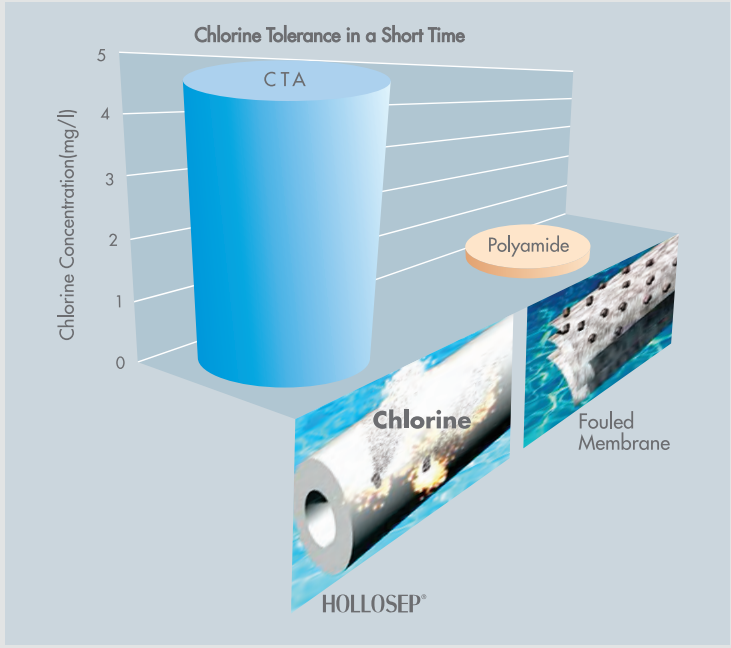


Reliability

"HOLLOSEP®" RO modules provide an opportunity for the least complicated engineering design, unique bio-fouling prevention by the use of chlorine disinfectant, and superior fouling resistance by greater surface area. These benefits deliver the highest availability and lowest cost to produce high quality product water.




Eliminate Biofouling



Toyobo MC hollow fiber membrane produced from cellulose triacetate (CTA) chemistry offers superior chlorine tolerance compared with polyamide chemistry membranes. This unique chlorine tolerance allows effective, low cost chlorine injection to the RO system as the most superior disinfectant to prevent biofouling. Toyobo MC has demonstrated long term, successful experience in chlorine sterilization at the large RO seawater desalination plants. Chlorine injection techniques including quantity and duration can be easily adjusted to meet specific seawater conditions.

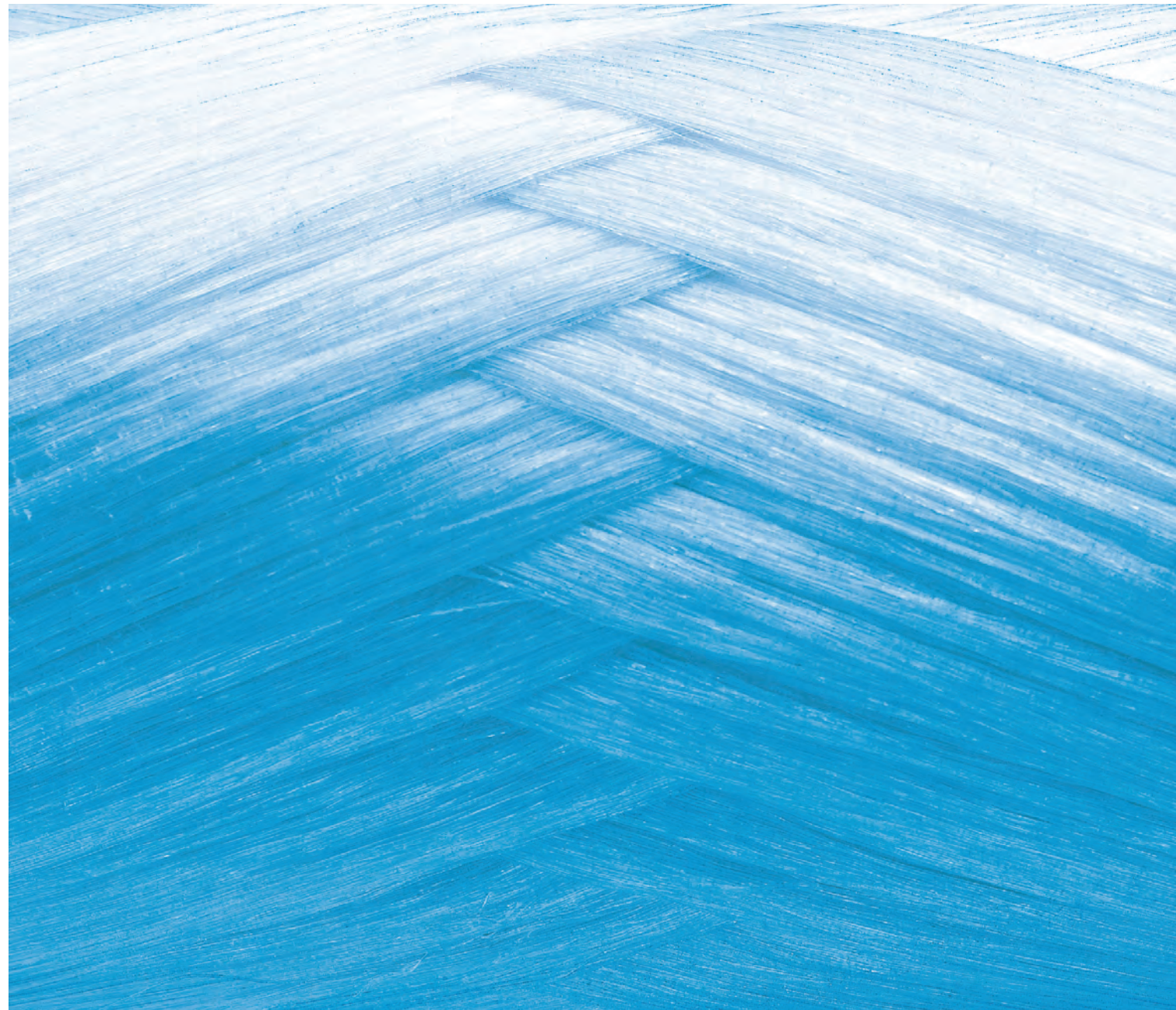
Superior Fouling Resistance

Millions of hollow fibers are wound into the module construction by a cross winding technique to achieve minimum pressure loss and uniform water flow. Compared to spiral wound type membranes, hollow fiber membrane has about 10 times the surface area. This greater surface is a key factor to better tolerate potential fouling in the RO module. If the same amount of fouling material is present in the feed water, the much larger surface area of hollow fiber type membrane will be subjected to much less surface fouling than the spiral wound type membrane.



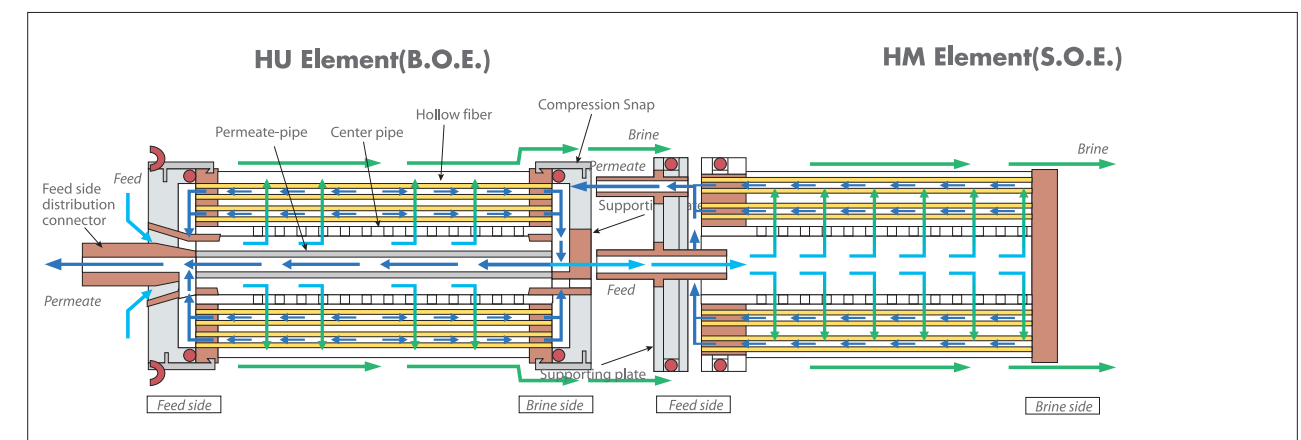
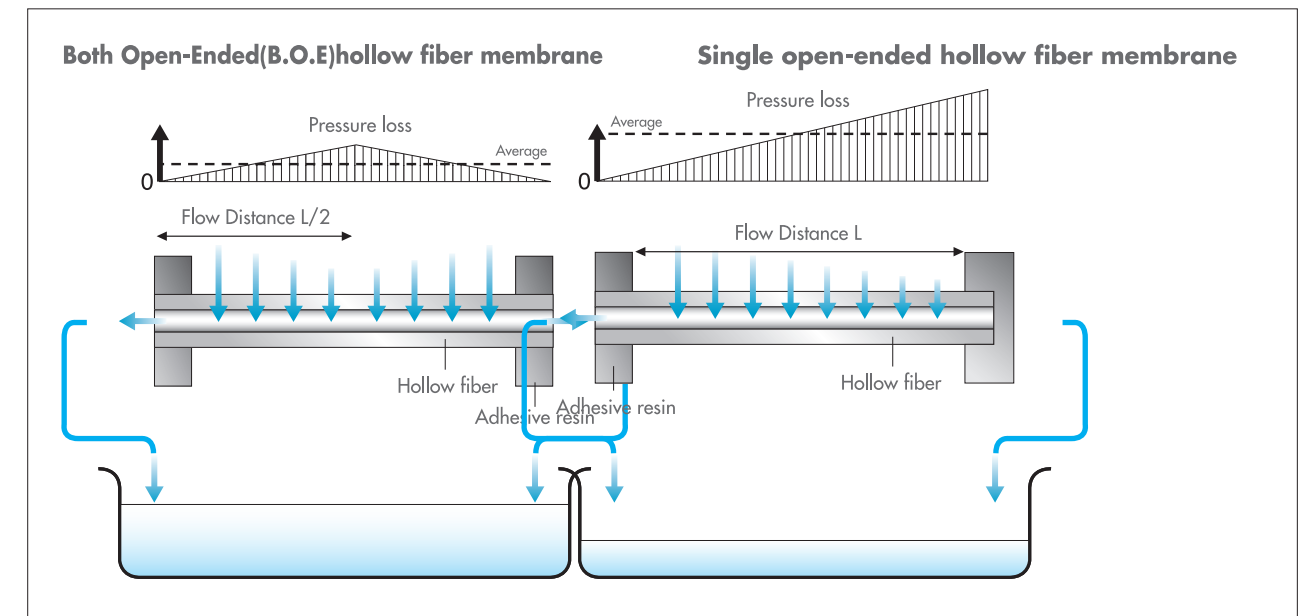
Ultimate Design and Structure

We have succeeded in development of a new type of RO membrane designated the "HOLLOSEP®" "HU-Series". The HU-series has double the production of the conventional module so that the RO design only requires half the number of modules. The HU-series also makes a very compact RO building because for a given capacity, it requires only half the volume of RO rack space.

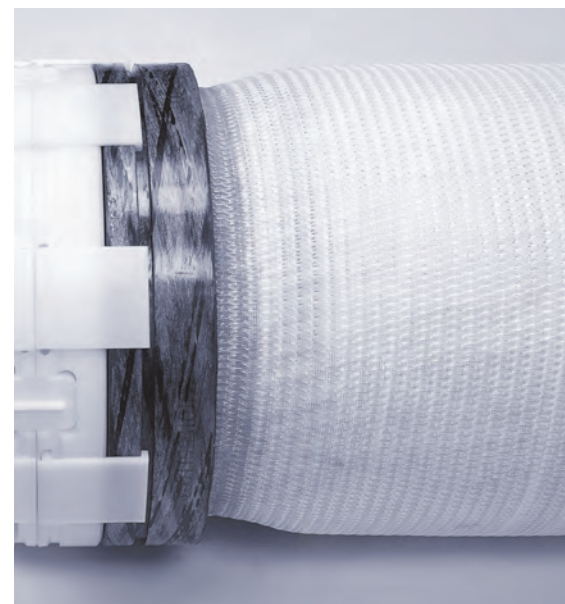
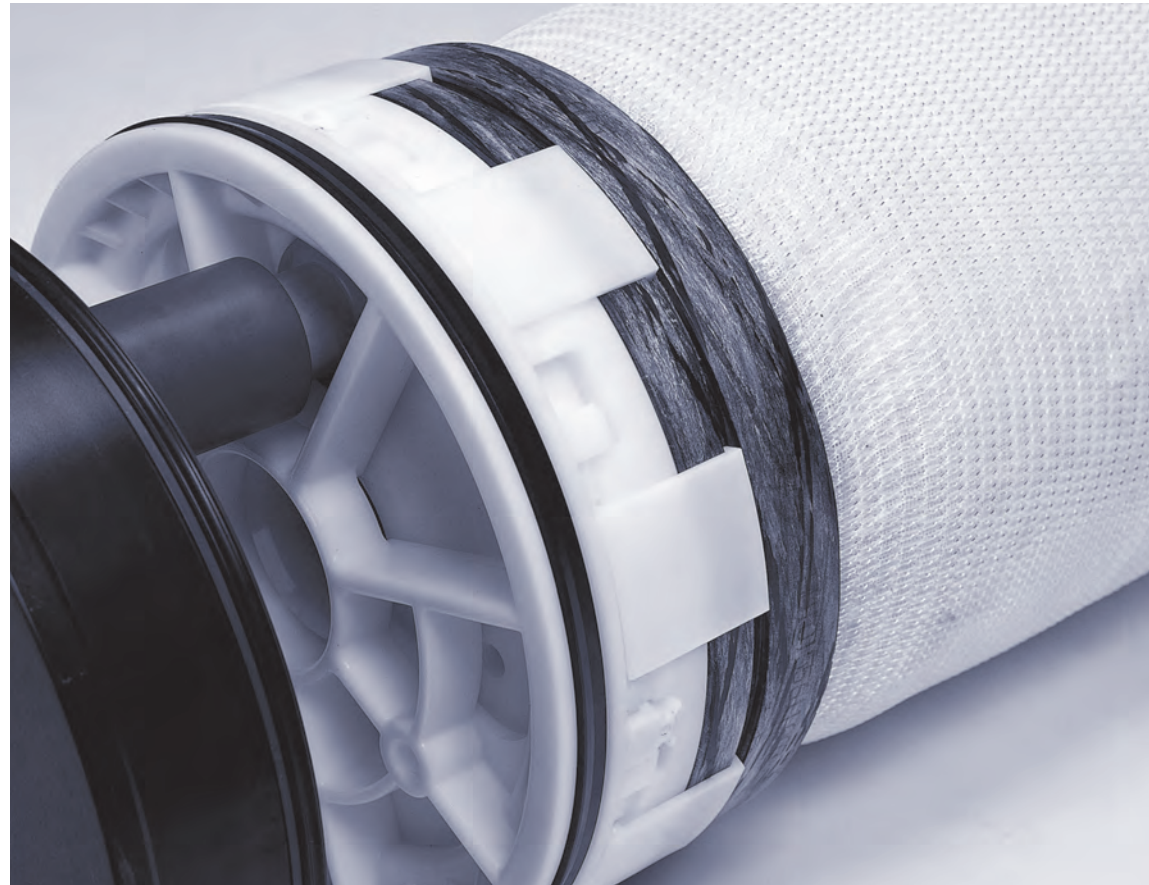


Both Open-Ended

A conventional RO element has hollow fibers with a single open-ended structure. The new HU-series element has a structure of hollow fibers with both open-ended, so called B.O.E. structure. The B.O.E. type minimizes pressure loss in the hollow fiber by creating a shorter flow distance along the fiber bore. This unique design leads to greater efficiency to achieve much higher production than conventional design of an element.



"HOLLOSEP®" for Large RO Desalination Plants



Specifications

RO module

Model		HU10255	HJ9155	HB9155
Product Flow Rate (Nominal) *1	m ³ /day	95	34	15
Salt Rejection (Nominal) *1,*2	%	99.6 (99.8)*3	99.6 (99.8)*3	99.6 (99.8)*3
Operating Conditions -Pressure (Max) -Temperature -Brine Flow Rate *4	MPa °C m ³ /day	6.86 5-40 70-350	8.23 5-40 25-120	8.23 5-40 15-100
Feed Water Qualities -FI (SDI ₁₅) (Max) -pH *5 -Residual Chlorine *5	- - mg/l	4.0 3-8 1.0	4.0 3-8 1.0	4.0 3-8 1.0
Module Dimension -Number of Element -Vessel Size Outer Diameter Inner Diameter Length -Weight, Filled with Water -Connection Feed Brine Product	 mm mm mm kg inch inch inch	2 396 280 4,720 530 approx. Victaulic 3 Victaulic 3 Victaulic 1	1 302 240 1,963 160 approx. NPT 1 NPT 1 NPT 1/2	1 278 216 1,498 100 approx. NPT 3/4 NPT 3/4 NPT 3/4

RO element

Model		HE10155	HL10155	HB10155	HM10155
Product Flow Rate (Nominal) *1	m ³ /day	59.5	47.5	31	22.5
Salt Rejection (Nominal) *1	%	99.6 (99.8)*3	99.6 (99.8)*3	99.6 (99.8)*3	99.6 (99.8)*3
Operating Conditions -Pressure (Max) -Temperature	MPa °C	6.86 5-40	6.86 5-40	8.23 5-40	6.86 5-40
Feed Water Qualities -FI (SDI ₁₅) (Max) -pH *5 -Residual Chlorine *5	- - mg/l	4.0 3-8 1.0	4.0 3-8 1.0	4.0 3-8 1.0	4.0 3-8 1.0
Element Dimension -Element Size Outer Diameter Length	mm mm	280 2,068	280 2,078	280 1,350	280 1,350

Notes

*1: Based on operation with a feed of 35,000mg/l NaCl, 5.39MPa, 25°C, and 30% recovery.

*2: The salt rejection defines the product quality, being indicated in the following formula under Toyobo MC standard condition.

$$(1 - (\text{salt concentration in product water}) / (\text{salt concentration in feed water})) \times 100$$

*3: The salt rejection defines the product quality, being indicated in the following formula under spiral wound membrane condition.

$$(1 - (\text{salt concentration in product water}) / ((\text{salt concentration in feed water} + \text{salt concentration in brine water}) / 2)) \times 100$$

*4: The brine flow rate range is limited by the quality and the temperature of feed water.

*5: The pH and residual chlorine are limited by the quality and the temperature of feed water.

The above specifications are understood to be subject to change without prior announcement. For the detail design, consult Toyobo MC.