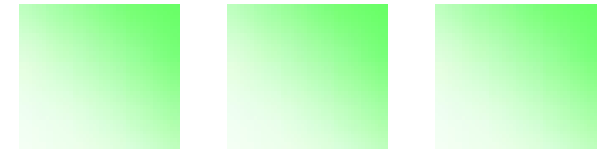


<5th IT-2010 IR Seminar>

TORAY

Innovation by Chemistry



Expansion Strategy of Water Treatment Business

19th December 2008

Toray Industries, Inc

Executive Vice President and
General Manager of Water Treatment & Environment Div.
Akihiro Nikkaku

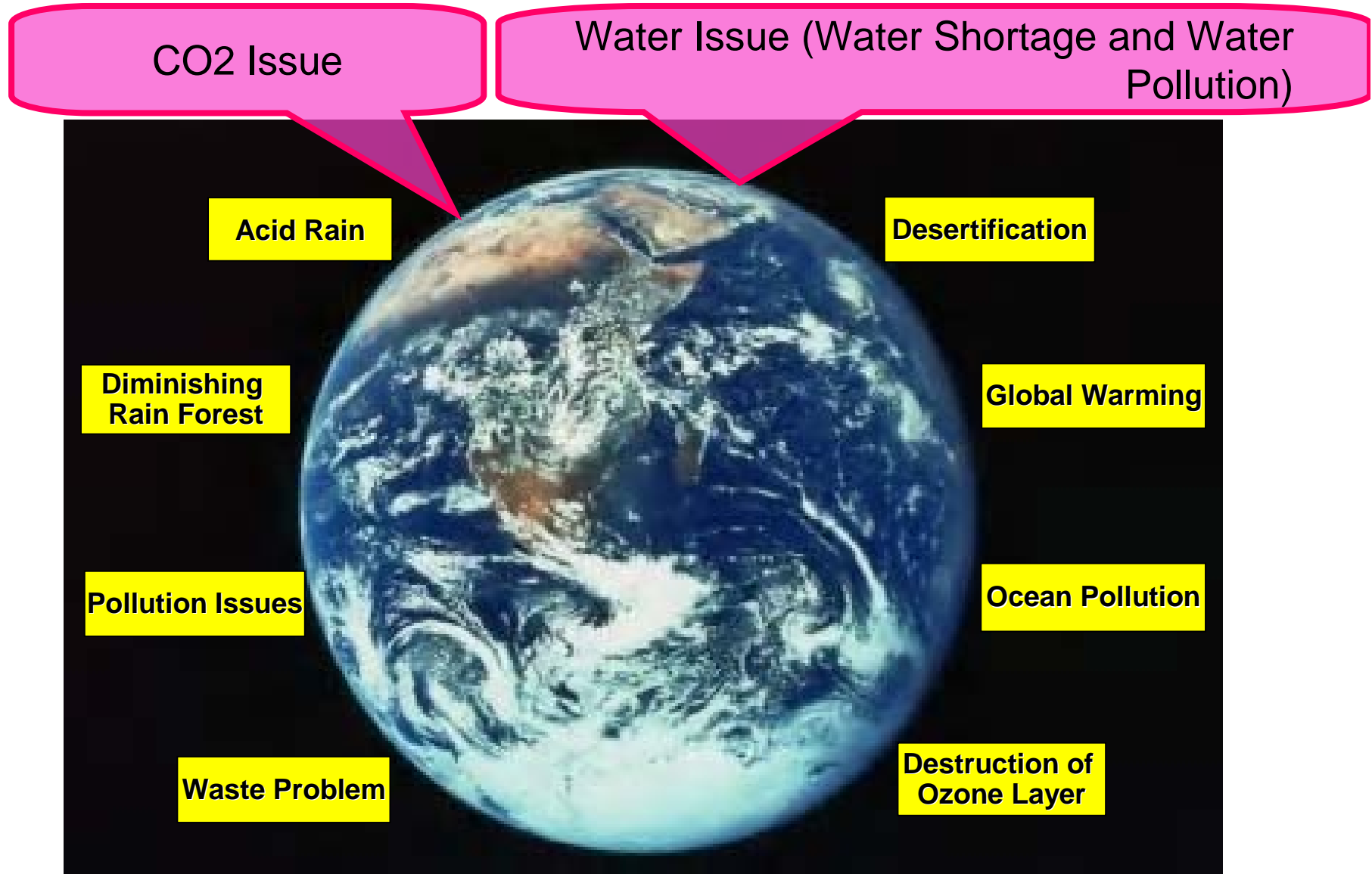
General Manager of Water Treatment Div.
Hideo Sato



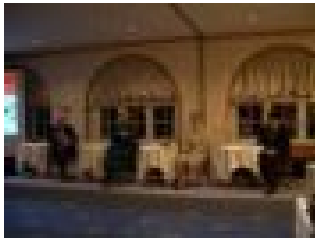
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Global Environmental Issues: Co2 and Water



Toray's Approach toward Global Water Environment Issue



Global Environmental Issue: Water became a focus at World Economic Forum 2007 (Commonly known as: Davos Conference)

Jan 25, 2007, Davos: Toray co-sponsored Special Japanese Sushi Reception 2007, which was hosted by Japan Water Forum (JWF)



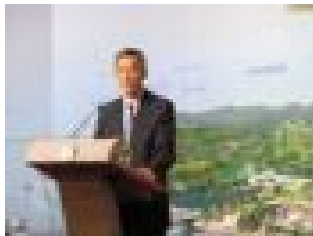
The 1st Asia Pacific Water Summit (Beppu, Japan): Organizer: APWF(JWF)

Dec. 3-4, 2007, Beppu: Toray attended at CEO PANEL and made the presentation titled "Membrane Technologies meet to the Solution of the Subjects on the Global Water Environment"



Toray attended the Liberal Democratic Party research group on water security

Mar. 23, 2008, Toray made a report on "Approach to Rapidly Growing Global Water Business Market" as one of the major members of Council on Competitiveness-Nippon (COCN)'s "Technologies for Effective Utilization of Water Treatment and Water Resource Project"



Toray participated in Singapore International Water Week

June 23-27, 2008, Singapore: Toray gave a keynote speech at Japan Business Forum. Theme: "Global Market Trend on Advanced Water Treatment and Japanese Contribution by Technology"

Present Situation of Water Resource

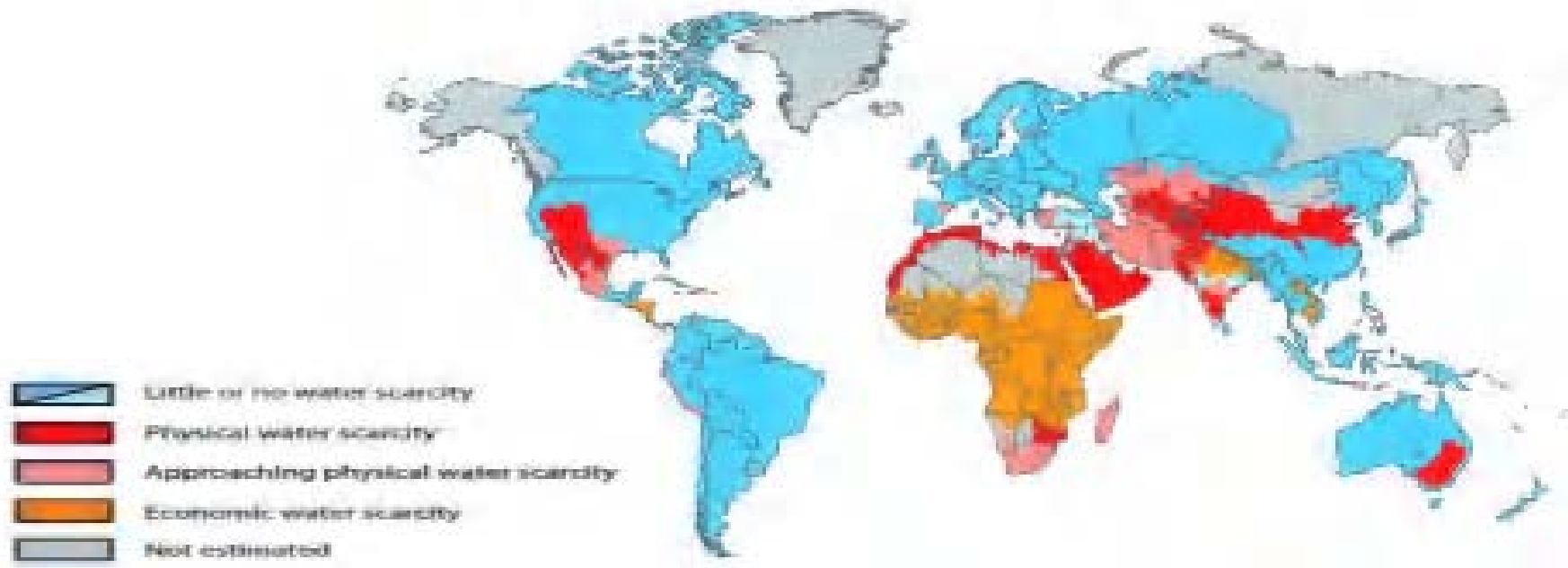
*World population is **6.5 billion**

1.1 billion people cannot access to good drinking water
(including water for daily life)

2.4 billion people do not have sanitary accommodations
(wastewater and human waste treatment)

Present water situation in the world (Source : IWMI Report 2006)

Areas of physical and economic water scarcity

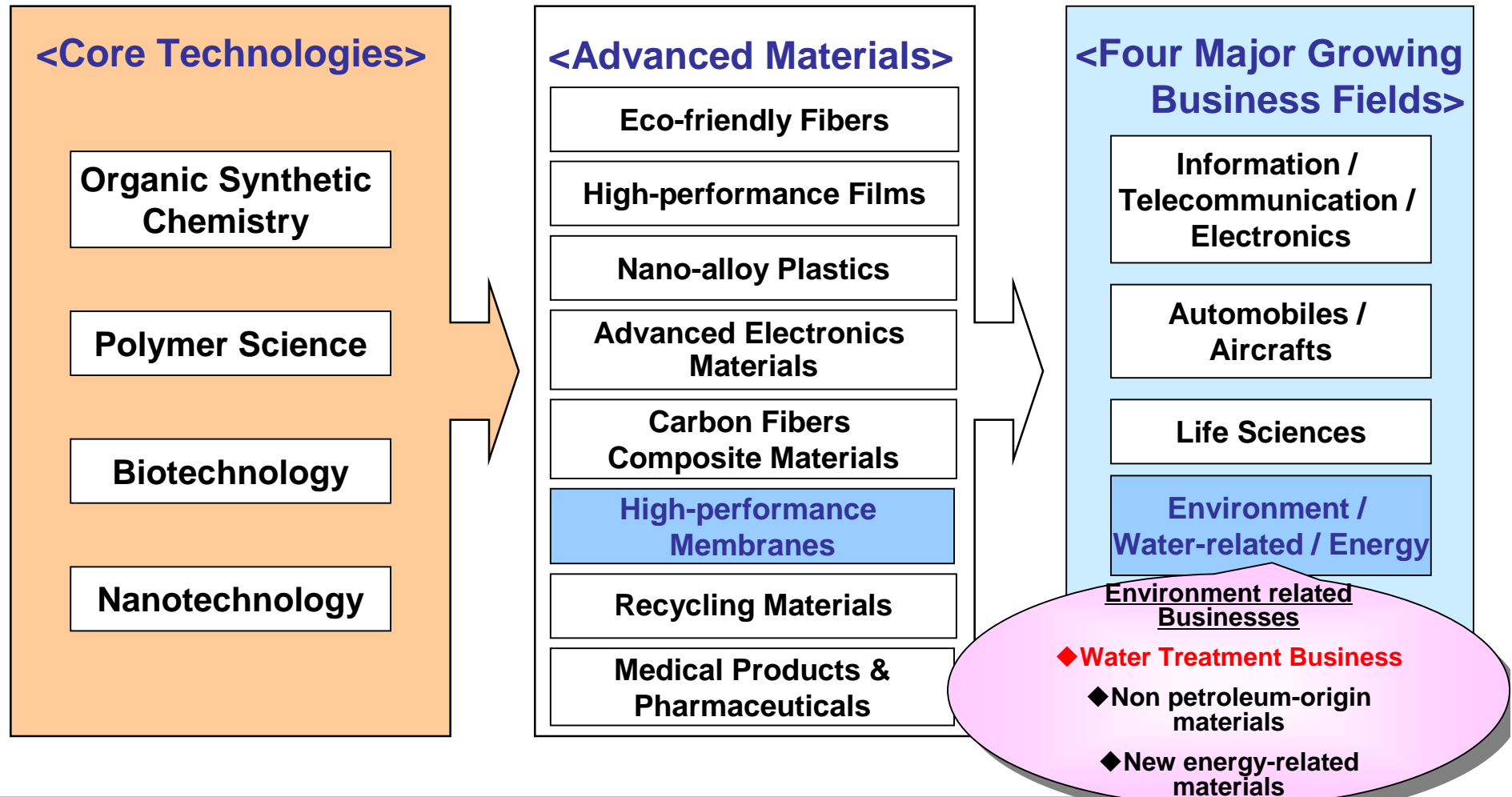


Global "Water shortage" is the keenest issue,
it is expected to become even more serious.

Contents:

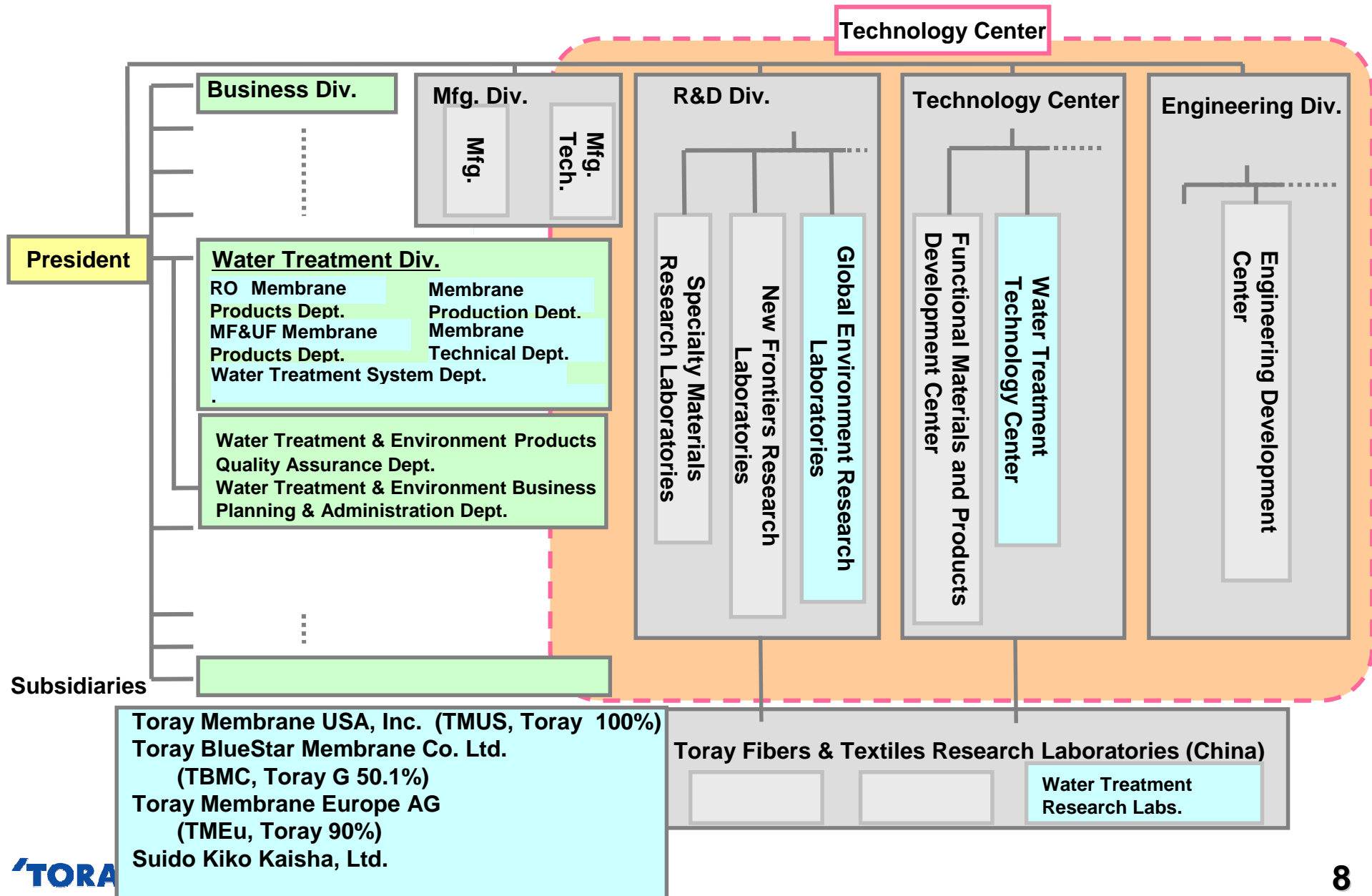
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Position of Water Treatment Business in Toray

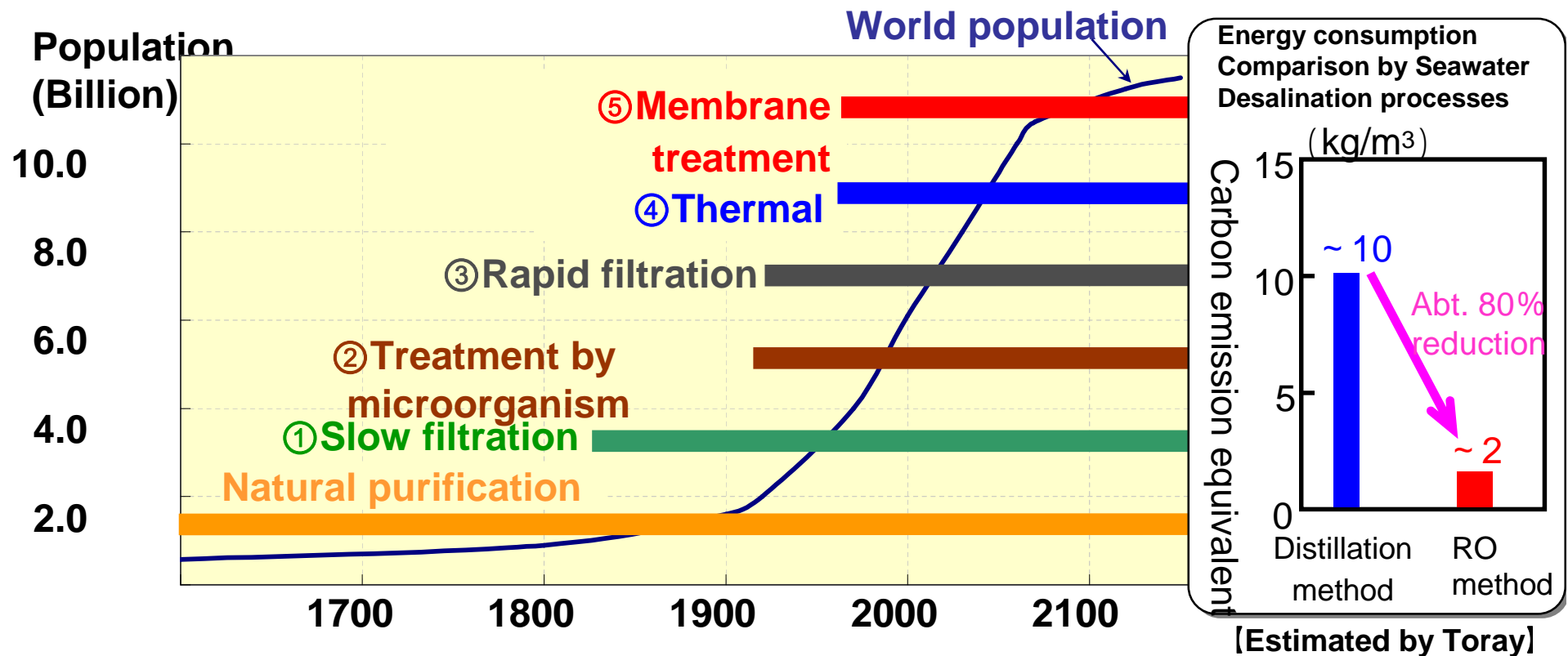


**Develop Water Treatment Business as a “Strategically Developing Business”
to a core of Environment related Businesses**

Organization of Toray's Water Treatment Business



Increase of World Population and Development of Water Treatment Technologies



Difficult to secure quantity and quality of water **only by natural purification** due to the rapid increase of population

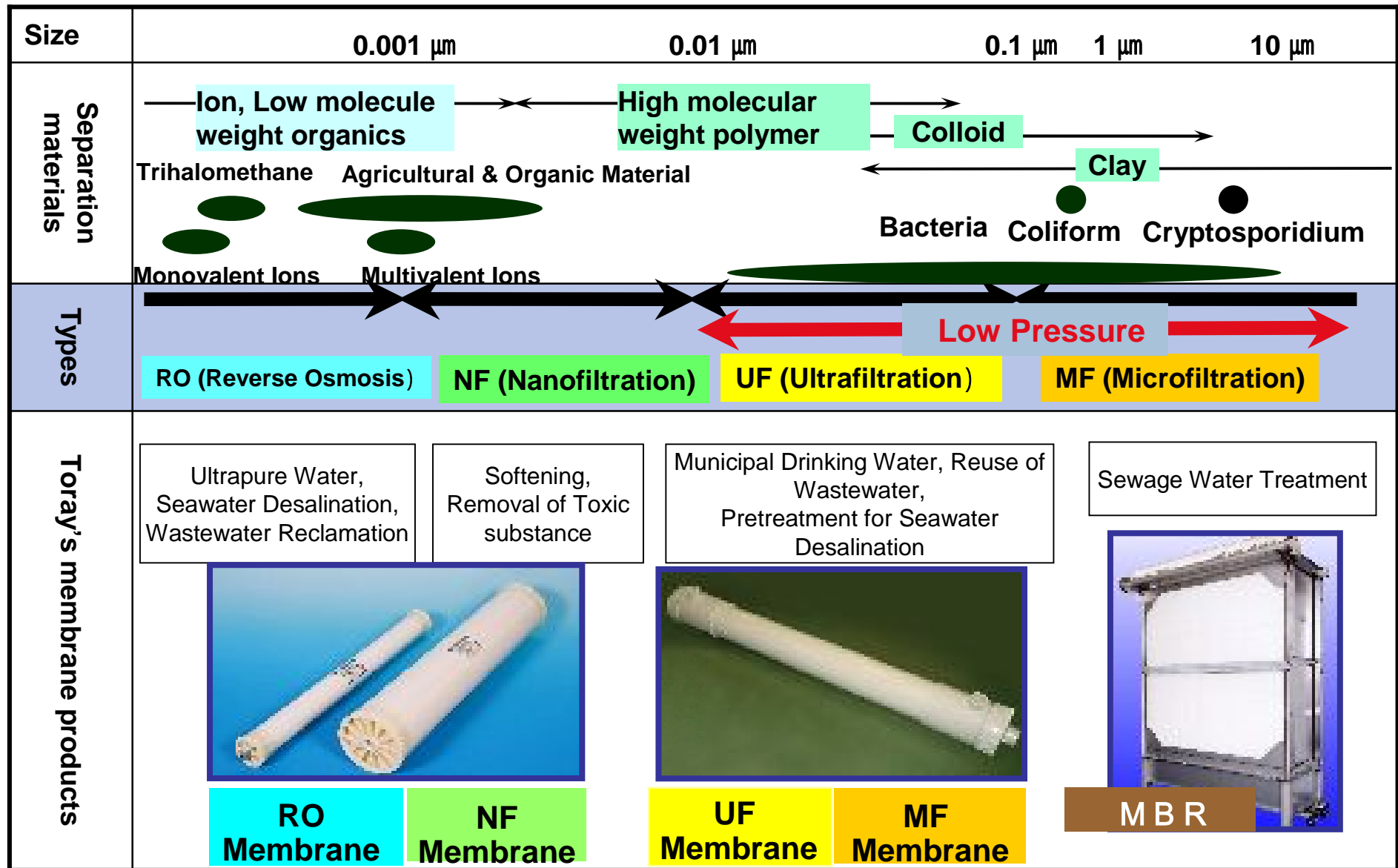


Membrane technology, which **enables precise control of water quality and high speed treatment**, is essential in 21st century

History of Toray Membrane Technology & Water Treatment Business

Period	~ 1960	~ 1970	~ 1980	~ 1990	~ 2000	2001 ~
RO/NF Membrane	<p>◆1953 USA launched RO concept.</p>	<p>◆1960 J.F. Kennedy made a speech on a seawater desalination. *Next year, in 1961, he decided to approve a seawater desalination as a national undertaking as the President.</p>	<p>◆1968 Started Research on RO Membrane</p>	<p>◆1980 Started marketing RO Membrane for ultra pure water plants</p>	<p>◆1996 Installed in a large brackish water desalination plant</p>	<p>◆2001 Installed in a large seawater desalination plant</p> <p>◆2003 Installed in the world's largest wastewater reuse plant</p>
Hollow Fiber UF/MF Membrane				<p>◆1990 Started research on UF membrane</p>	<p>◆2000 Started research on MF membrane</p>	<p>◆2002 Started trial marketing on MF membrane</p> <p>◆2007 Installed in the largest membrane plant in Japan</p>
Submerged Membrane for MBR				<p>◆1996 Started research on MBR</p>	<p>◆2003 Started trial marketing</p>	<p>◆2008 Installed in a large plant in Middle East</p>

Types of Membranes and Toray's Membrane Products



Membrane Manufacturers in the World

【Investigated by Toray】

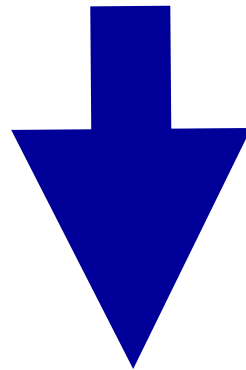
		RO	NF	UF	MF	MBR
Overseas	DOW (US)	⊙ Filmtec	⊙ Filmtec		○ Omex	○ Omex
	Koch (US)	○ UOP	△ UOP	○ Abcor	○ Abcor	○ Puron
	General Electric (US)	○ Osmonics	○ Osmonics	⊙ Zenon		⊙ Zenon
	Siemens (Germany)				⊙ Memcor	○ Memcor
	Norit (Netherlands)			⊙ X-Flow		○
	Woongjin Chemical (Korea)	○ Saehan	○ Saehan			
	MOTIMO (China)			○	○	○
	Vontron (China)	○	○			
Japanese	Toray	⊙	○	○	○	○
	Nitto Denko	(Hydranautics) ⊙	(Hydranautics) ⊙	(Hydranautics) ○	(Hydranautics) ○	
	Mitsubishi Rayon				○	○
	Toyobo	○		○	△	
	Daicel Chemical	○		○		
	Asahi Chemical			○	⊙	○
	Kubota					⊙

⊙ :High share product ○:product in the market △:under development

Policy of Toray's Water Treatment Business

By utilizing **superior membrane technologies**
and all variety of membrane products,

- Expand and Strengthen global sales system
- Strengthen profit structure by arrangement of production systems and increasing production capacity



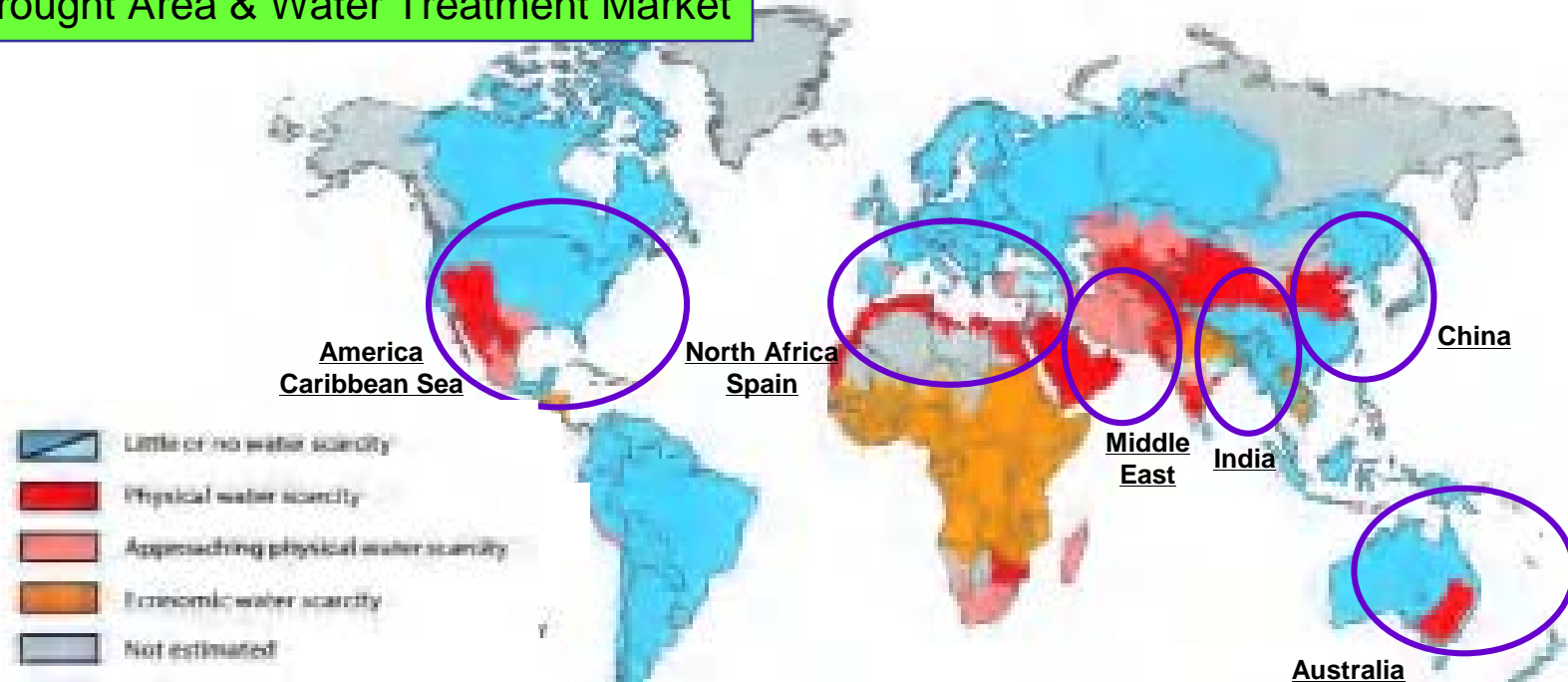
Become “Number One” of the Membrane Business by 2010.

Rapid Expansion of Global Water Issue and Water Treatment Market

Areas of physical and economic water scarcity

Drought Area & Water Treatment Market

Source: IWMI Report 2006



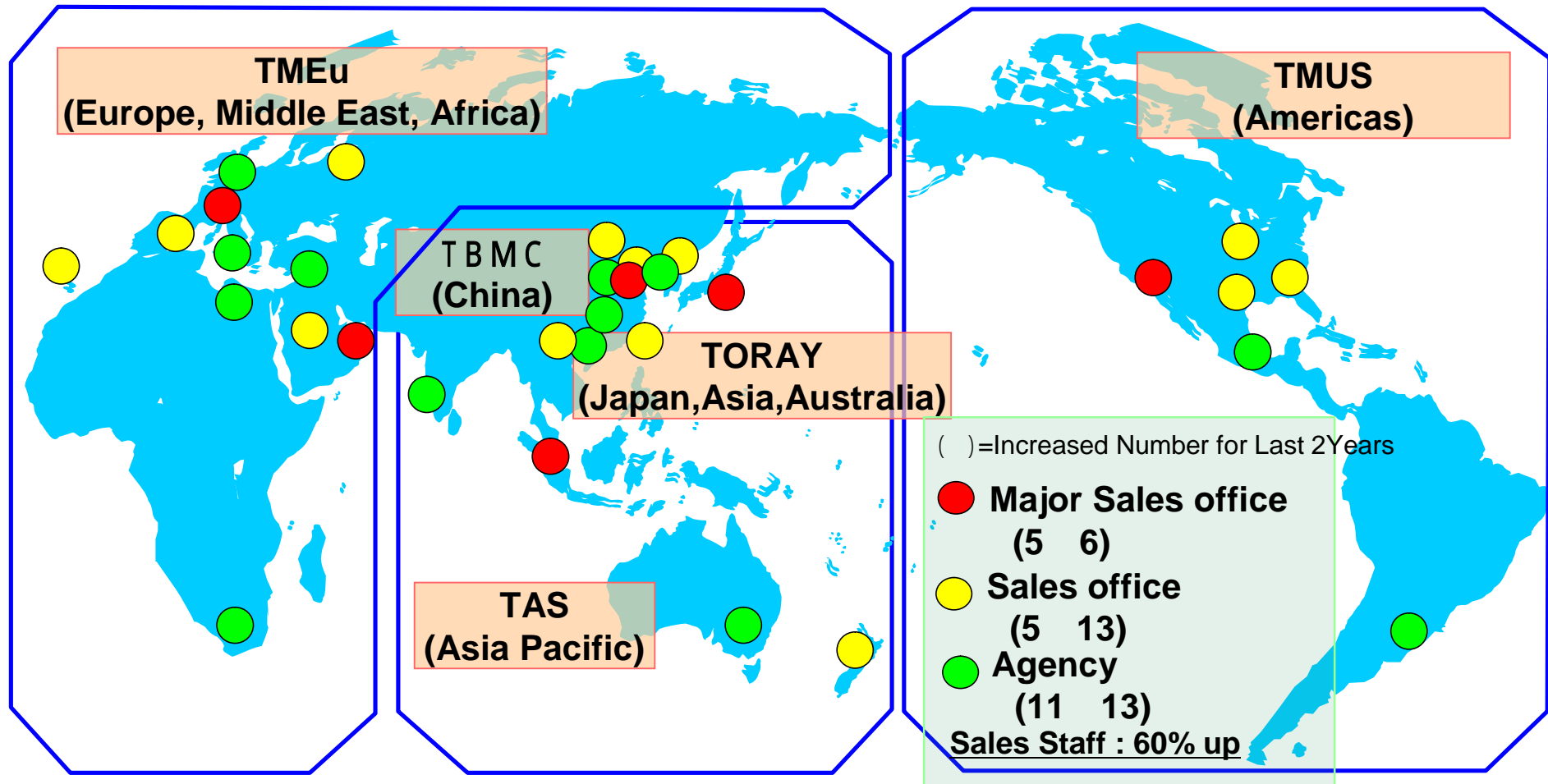
Toray's
Business
Expansion
Strategy

Solution of both water quantity and quality (Boron and Arsenics) is necessary for countermeasure of Global Water Issue. Our targets are drought areas of the world.

- 1 . Middle East/North Africa region is the most expanding market. Toray has a good track record and continue to focus the market.
- 2 . As for the USA, Toray has established local production facility already. Toray attacks this World's 2nd largest market
- 3 . Australian market has just taken off. Toray started strategic sales in this market.
- 4 . China is the largest potential market in the world, and Toray will expand the business in the country by new business structure.

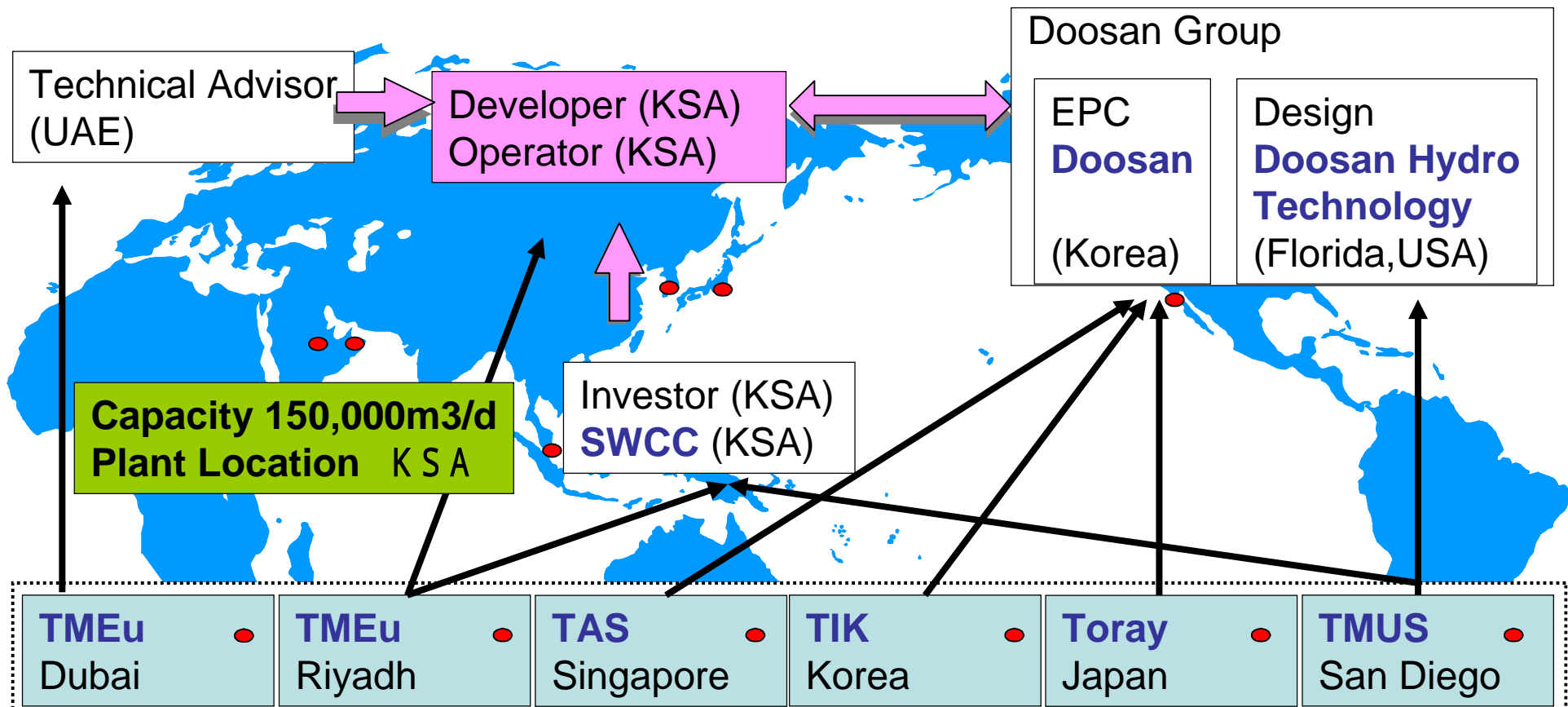
For achievement of above, Toray strengthens Global Sales Team and production capacity.

Toray Water Treatment Global Sales Team



- Japan is in charge of sales for Asia and Oceania together with TAS
- TBM C: China
- TMEu: Europe, ME, Africa, TMUS: Americas

Global Network Led Success at Shoaibah Project



In case of large scale project, the operation is proceeded in the form of combining multiple companies playing their role, therefore it is essential to approach to each one of them.

Even though the location of this project was KSA, the related companies were operating world wide: (a) Technical advisor (UAE), (b) Developer & Operator (KSA), (c) Investor (KSA), (d) EPC & Design (Korea and USA) and others.

Toray's Global Sales Team reacted well to this circumstance, and played their part in their region keeping good mutual coordination, which resulted in winning this project.

Establishment of Joint Venture in China-1

日中協力案件調印式
中日合作项目签约仪式



28th November, 2008
Signing Ceremony of
TBMC JV Agreement

Establishment of Joint Venture in China-2

Outline of Toray BlueStar Membrane Co., LTD. (TMBC)

1. Main businesses: Manufacturing, sales, application development and technical service of the following water treatment membranes as well as their export and import.
 - (1) RO membrane and RO membrane element
 - (2) NF membrane and NF membrane element
 - (3) Submerged MF/UF membrane element
 - (4) Submerged module of MF flat sheet for MBR
2. Location: Beijing, China
3. Established: May 2009 (scheduled)
4. Capital: 35 million USD (about 3.5 billion yen)
5. Investment ratio:

Toray Industries, Inc. –	40.1%
Toray Industries (China) Co., Ltd. (a Toray subsidiary)-	10.0%
China BlueStar & BC group Co., Ltd-	49.9%
6. Production facility: RO membrane production facilities
Auto winders for RO element
 - * Beginning of construction: May 2009
 - Start of operations: April 2010 (expected)
 - * Location: Industrial development area of Shunyi Airport in Beijing
 - * Capital investment for new plant construction: about 500 million CNY (about 7.5 billion yen)

< Background of this JV Establishment >

“Jieneng Jianpai” (Save Energy& Emissions-Reduction) and “Ling Paifang” (Zero-Emission) Policy of China Gov.



For realizing this policy, Wen Jiabao instructed BlueStar to establish “State-class Water Treatment Company” urgently



BlueStar approached Toray since Toray developed all kinds of water treatment membranes by herself.



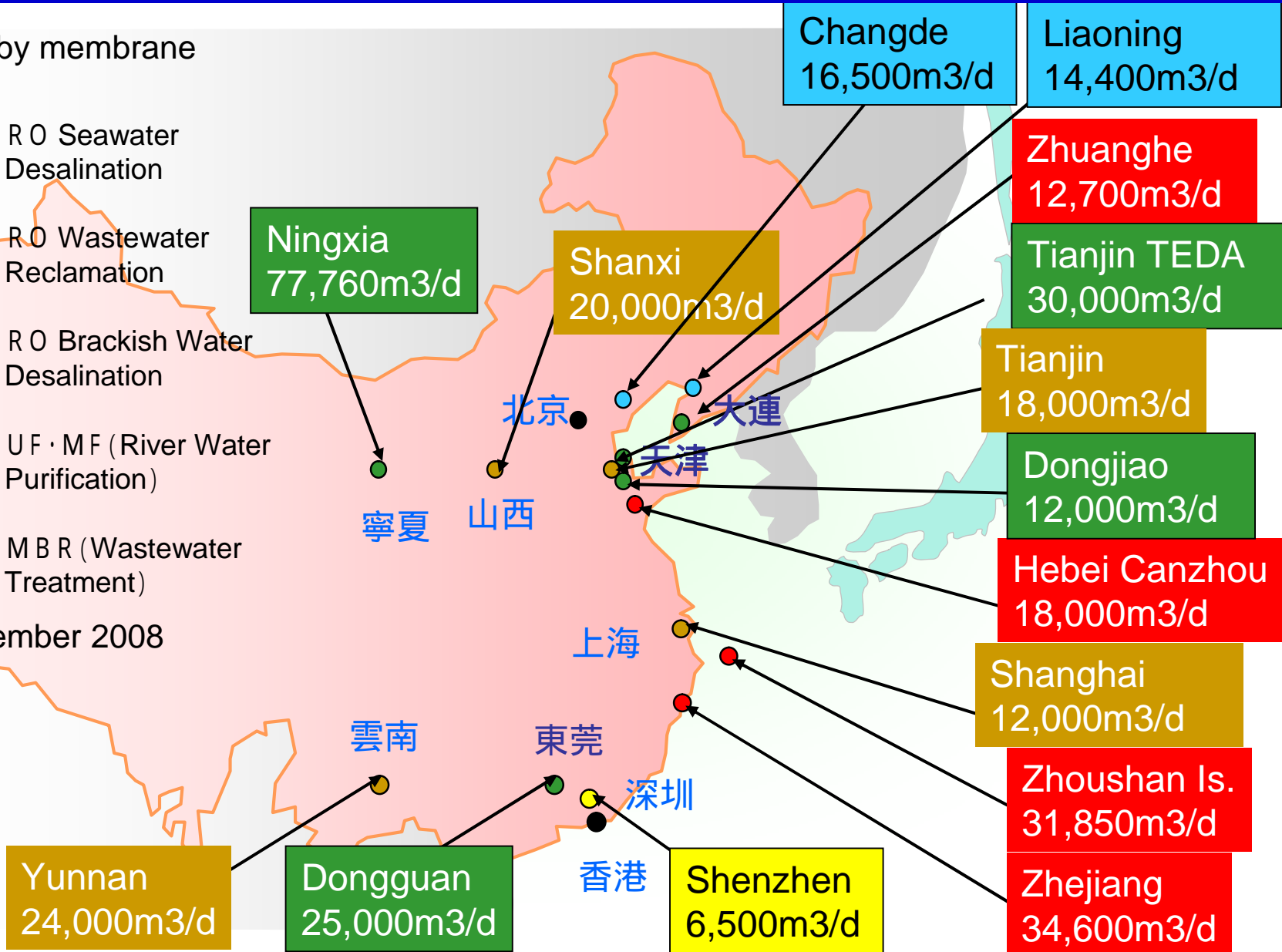
- China is a huge growing market for water treatment, and annual growth ratio of RO market exceeds 20% in China.
- Toray can contribute to environment improvement in China.
(Meeting Toray’s Corporate Philosophy)

China Business Development of Toray's Water Treatment (Main Awarded Projects)

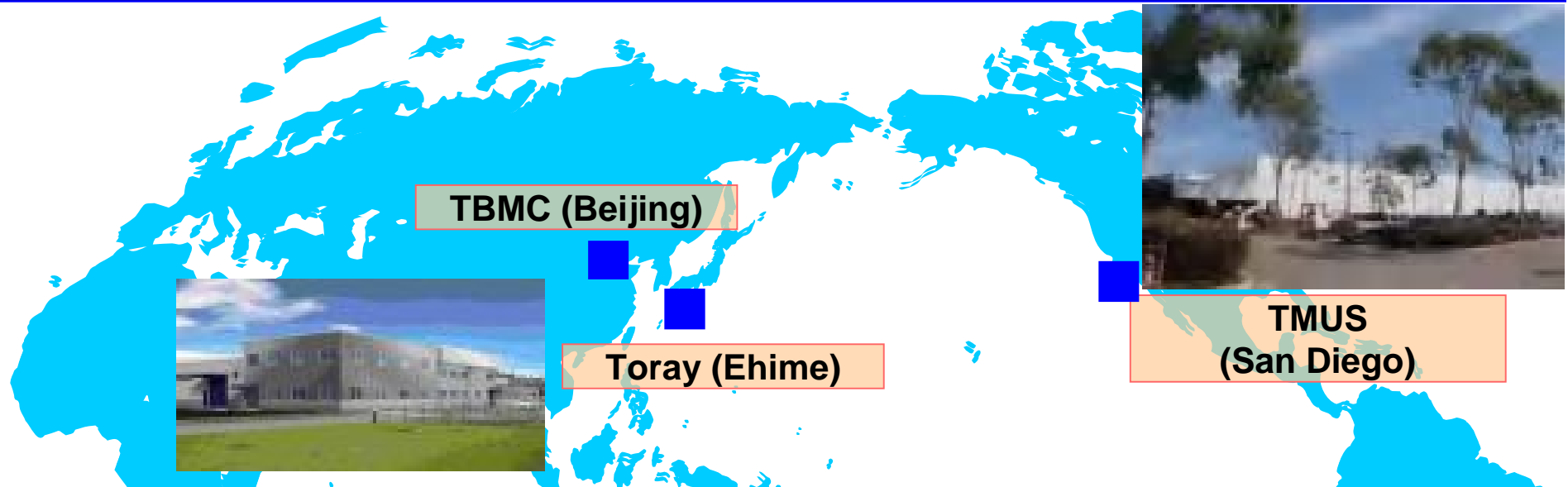
By usage/by membrane

- R O Seawater Desalination
- R O Wastewater Reclamation
- R O Brackish Water Desalination
- U F · M F (River Water Purification)
- M B R (Wastewater Treatment)

As of November 2008



Expansion of RO Production Capacity



For RO membrane production, Toray established the Japan-U.S. production capacity by the end of fiscal 2007 in order to meet rapid demand increase. From 2008 onward, Toray produce all the RO elements by its leading-edge automatic winder.

As a result of above, production capacity of RO elements is increased, Ehime: 2 times and San Diego: 4 times, as a total: 2.7 times as much the capacity of March 2007.

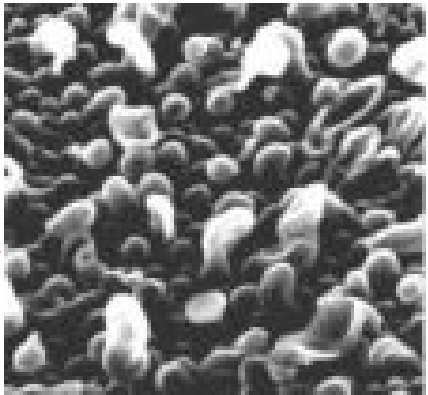
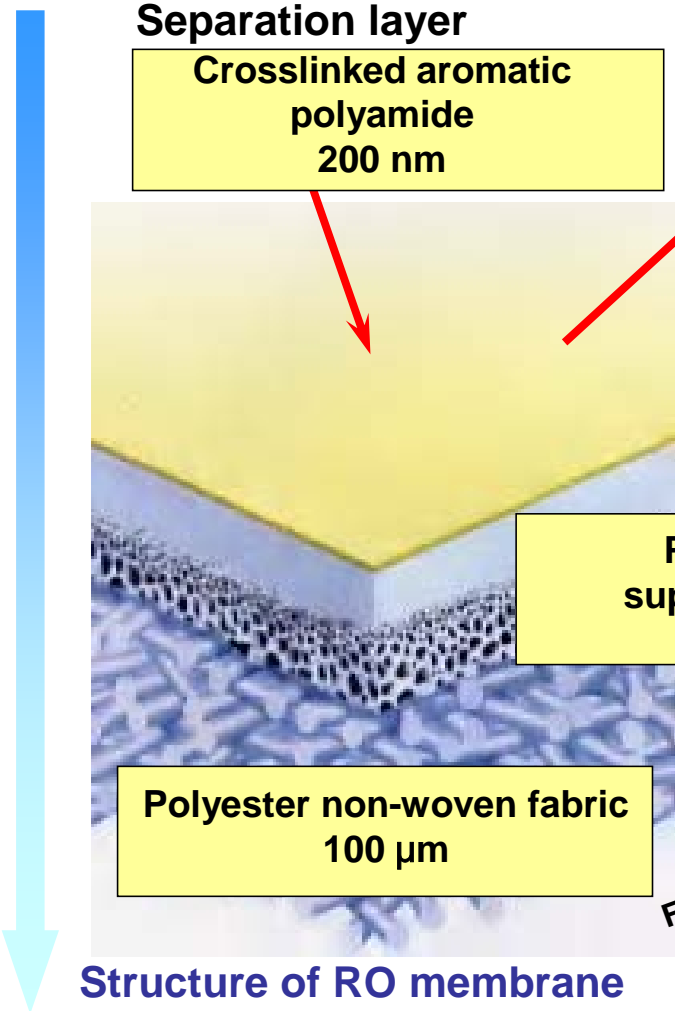
In addition to above, it will be expanded 4 times as much as the capacity of March 2007 when TBMC started its Production.

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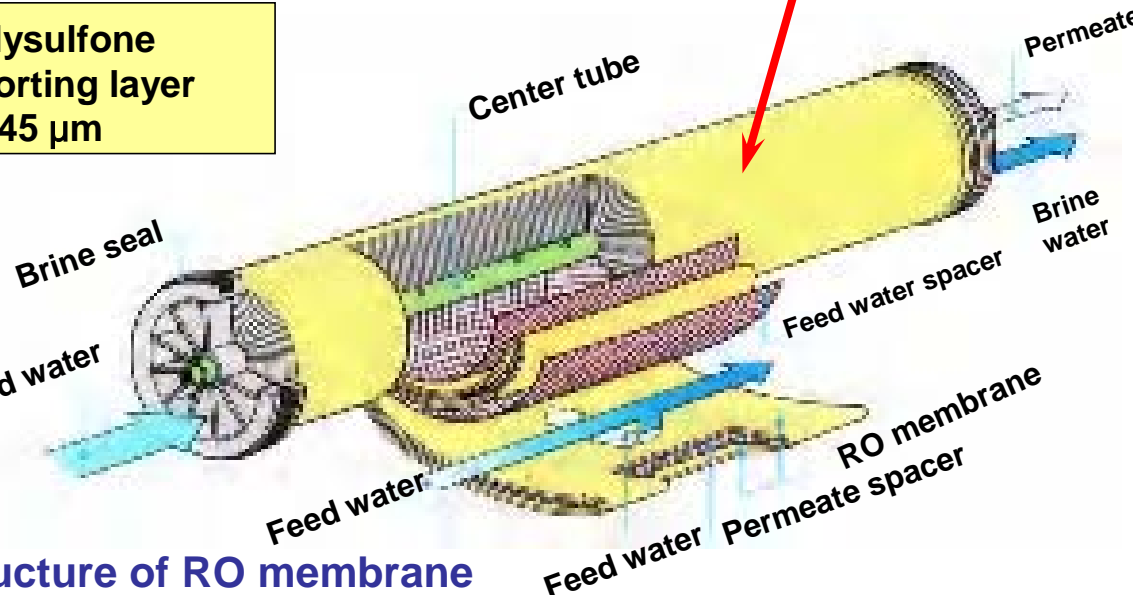
RO (Reverse Osmosis) Membrane

Feed Water



200 nm

Surface structure of RO membrane



Structure of RO membrane element

Permeate

Global Sales Expansion of Toray RO

Representative
Acquired Projects

[As of Aug.08]

RO for
Seawater
Desalination

<Trinidad >
136 km³/d

<Algeria>
200 km³/d

<KSA>
150 km³/d

<Israel>
93 km³/d

<Singapore >
136 km³/d



RO for
Wastewater
Reclamation

<Kuwait>
320 km³/d

<Singapore >
228 km³/d

<China >
78 km³/d

RO for Brackish
Water Desalination

<KSA >
120 km³/d

<Iran >
100 km³/d

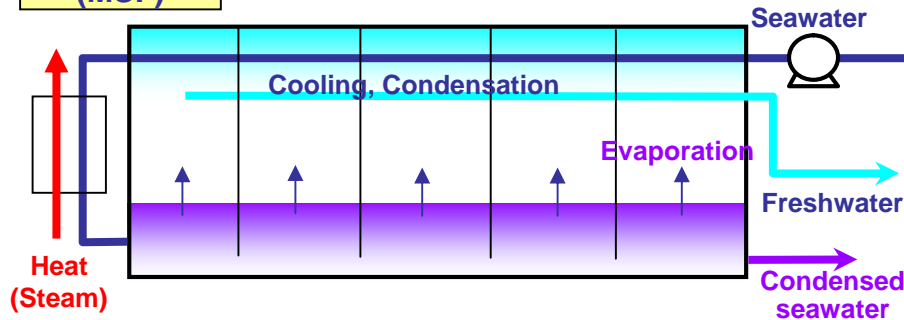
(Equivalent to Water Production)

- ◆ Total Shipment of RO : 14 mil m³/d (equivalent to daily life water of 60 million people)
- (including) Seawater Desalination : 2.8 mil m³/d (daily life water of 10 mil people, **Top share**)
- Wastewater Reclamation : 1.0 mil m³/d (Supplied to World's 1st and 2nd largest Plant)
- Brackish Water Desalination : 7.0 mil m³/d (Largest application, main market is USA, ME,FE)

Features of Evaporation Methods and Membrane Method

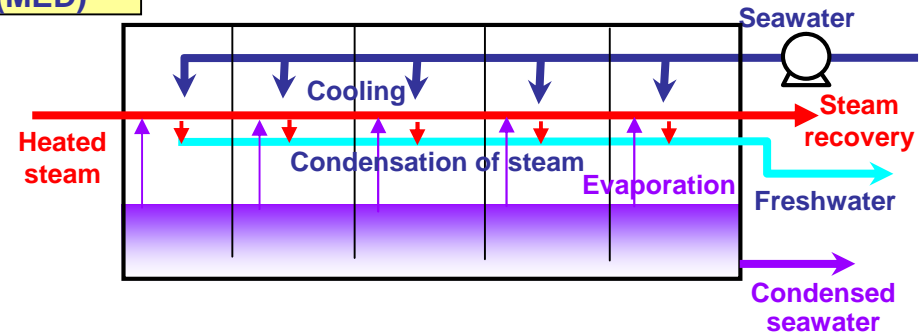
Evaporation Method (MSF)

Seawater is evaporated and condensed to obtain freshwater. One of the main evaporation methods for the desalination of seawater in the Middle East



Evaporation Method (MED)

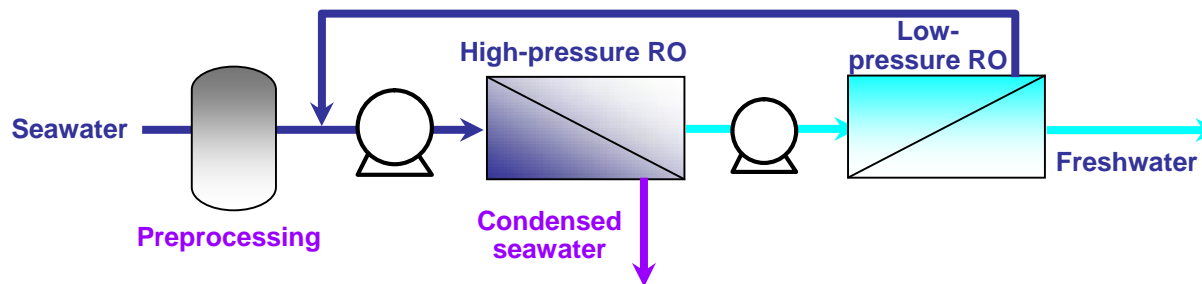
Heated steam and evaporated seawater are condensed. Efficiency is higher than MSF, but complex.



Features: By parallel establishment with an electric power plant, it can utilize the heat sources. (The reason why it is the mainstream in the Middle East.)
It requires almost no preprocessing and provides simple operation. (MED is rather complex.)

Membrane Separation Method (RO)

Pressurized water is transported across the membrane. Multi-staging is available as required for the water quality.

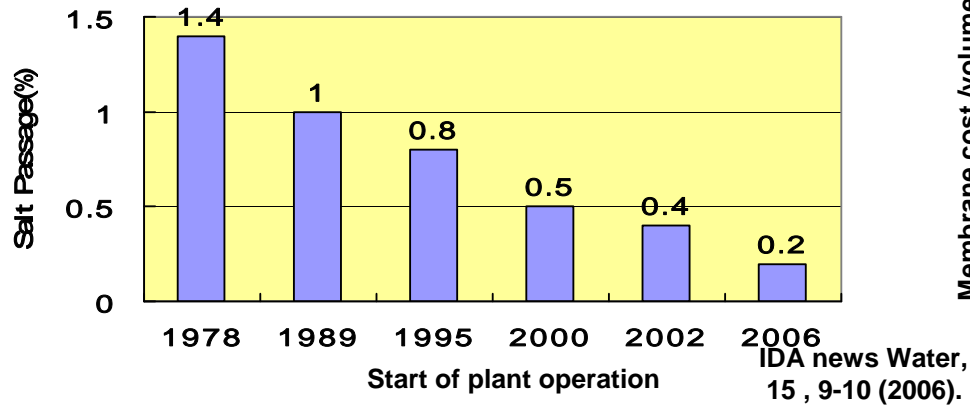


Features: Low facility cost
Low seawater usage (High recovery rate)
Low energy consumption (Heat + Electric power)

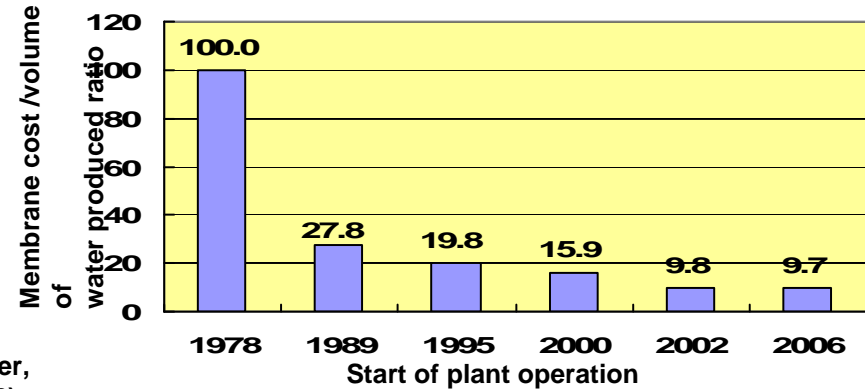
0.5 – 0.9 times compared to evaporation methods
1/4 or less compared to evaporation methods
1/5 or less compared to evaporation methods

RO Membrane for Seawater Desalination: Technology Progress and Desalination Cost Reduction

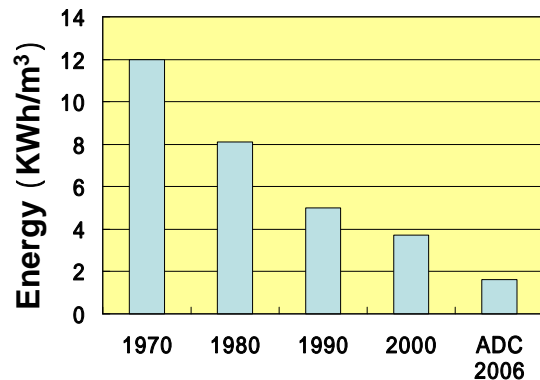
1. Improved performance of RO membranes (lower permeability rate)



2. Decline in RO membrane costs per volume of water produced



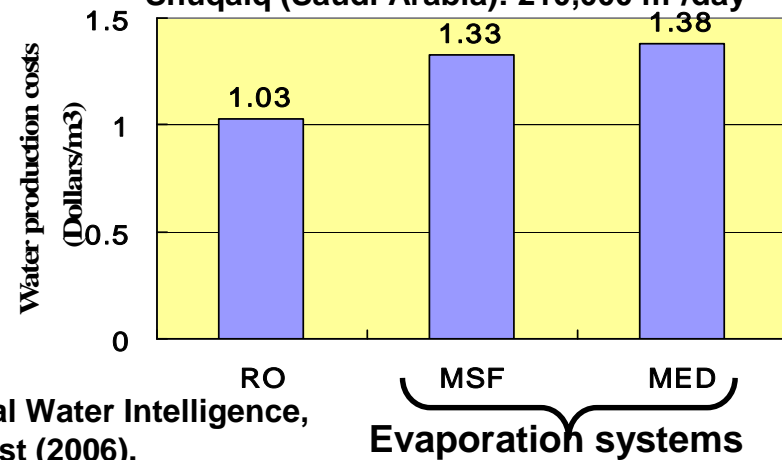
3. Changes in desalination energy



D&WR, 16(2), 10-22 (2006).

4. Comparison of water production costs for RO with evaporation systems (MSF, MED)

Example of water production cost comparison
Shuqaiq (Saudi Arabia): 210,000 m³/day



Global Water Intelligence, August (2006).

RO method is introduced to global water stress area as key process of desalination technology by its technology progress and cost reduction.

Development of High Boron Rejection RO Membrane

By quantifying sub-nanometer (1/10 nanometer or 1/1 billion meter) pore size distribution of RO membrane for seawater desalination, Toray Group has become the first substantiator of correlation between rejection ratio of Boron, hazardous material, and pore size distribution in the world. Based on this information, Toray has succeeded the development of “**High Boron Rejection RO Membrane**”, of which sub-nanometer pore size is controlled by Toray’s original polymer designing technology.

Boron

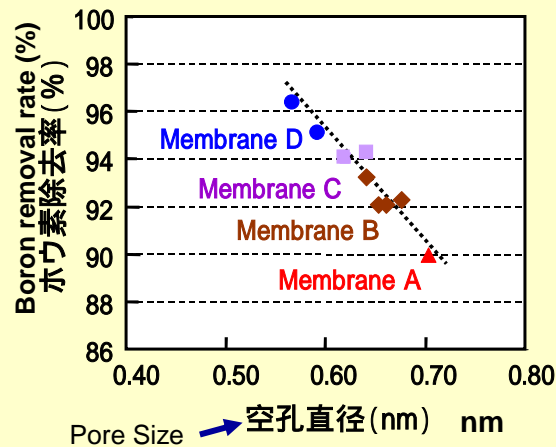
- **Seawater has high density Boron** than the river water.
- Boron has **toxicity**, and it causes human reproductive dysfunction and orange wilt.

Removal by RO for seawater desalination

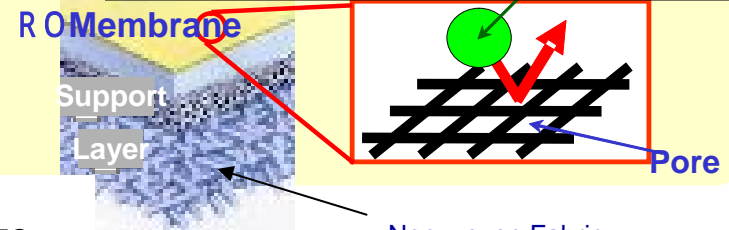
RO can remove almost all the material, but conventional RO can **hard to remove Boron** since it is too small.

High Performance RO

Toray and **Toray Research Center** have become the first substantiator of **correlation between rejection ratio of Boron and pore size distribution**.



By designing suitable pore sized polymer, Toray has developed new high performance RO with increased Boron rejection performance (**20% decreased Boron concentration than conventional RO**).



Received Nikkei Global Environmental Technology Award

1. Pore-size control technology of RO membrane by using nanotechnology
2. High Boron rejection membrane developed by the technology

In recognition for these technologies, Global Environmental Lab. of Toray received the 18th Nikkei Global Environmental Technology Award.



Toray's Supply for Large Seawater Desalination Plants

as of October 2008

No.	Country	Location	Capacity *1 m ³ /d	Operation Year *2	Notes
1	Algeria	Hamma	200,000	2008	
2	Saudi Arabia	Shuaibah	150,000	(2009)	
3	Trinidad & Tobago	Point Lisas	136,000	2002	
3	Singapore	Tuas	136,000	2005	
3	UAE	Fujairah 2	136,000	(2010)	
3	Kuwait	Shuwaikh	136,000	(2010)	
7	Algeria	Oued Sebt	100,000	(2010)	
8	Israel	Palmachim	92,250	2007	
9	Saudi Arabia	Al Jubail-III	90,909	2000	*3 : 24,240 m ³ /d
10	Spain	Mallorca	69,300	2001	*3 : 23,100 m ³ /d
11	Spain	Alicante	65,000	2002	expansion: 15,000m ³ /d (2006)
12	UAE	Dubai	64,000	(2008)	
13	Nambia	Swakopmund	55,000	(2008)	
14	Malta	Ghar Lapsi, etc.	53,500	(2008)	replacement for three places
15	Saudi Arabia	KAUST	40,000	(2009)	
15	Japan	Okinawa	40,000	1997	*3 : 30,000 m ³ /d
17	Qatar	The Pearl	35,000	(2008)	
18	China	Yuhuan	34,600	2006	*3 : 11,500 m ³ /d
19	Saudi Arabia	Jeddah	32,000	(2009)	
20	China	Zhoushan Is.	31,850	2006	
21	Oman	Qarm Aram	25,000	(2008)	
22	Spain	Maspalomas-II	22,000	1994	*3 : 19,000 m ³ /d
22	Spain	Adeje Arona	22,000	1997	
24	Spain	Bahia de Palma	21,000	1999	
24	Spain	Teneriffe	21,000	2002	
26	India	LANCO	16,500	(2009)	
27	St. Marteen	St. Marteen	15,000	2008	
28	China	Zhuanghe	12,700	(2008)	
29	Netherlands Antilles	Curacao	11,400	2000	
30	Saudi Arabia	Jeddah	10,000	(2009)	
30	South Africa	Mpumalanga	10,000	2008	
30	Cyprus	Famgusta	10,000	(2009)	

(Notes)

*1 Total output of all units

*2 The year in which the plant was commissioned, () shows a project

*3 Toray's initial installation

=Acquired projects for last 2 years.

**Toray's Cumulative Capacity for Seawater Desalination (Product Water Basis):
2,800,000 m³/day (Top Share in the World)**

The Largest Seawater Desalination RO Plant in Africa (Hamma, Algeria)



Photo Credit: GE Water & Process Technologies

Seawater desalination plant constructed close to Alger, the capital city of Algeria.

(Capacity : 200,000m³/day Online: Feb. 2008)

Largest Seawater Desalination RO Plant in Western Hemisphere (Point Lisas, Trinidad & Tobago)



Trinidad & Tobago, the Caribbean Sea, Seawater Desalination Plant
(Capacity: 136,000m³/d, Online: 2002)

Development of Low-fouling RO for Wastewater Reclamation

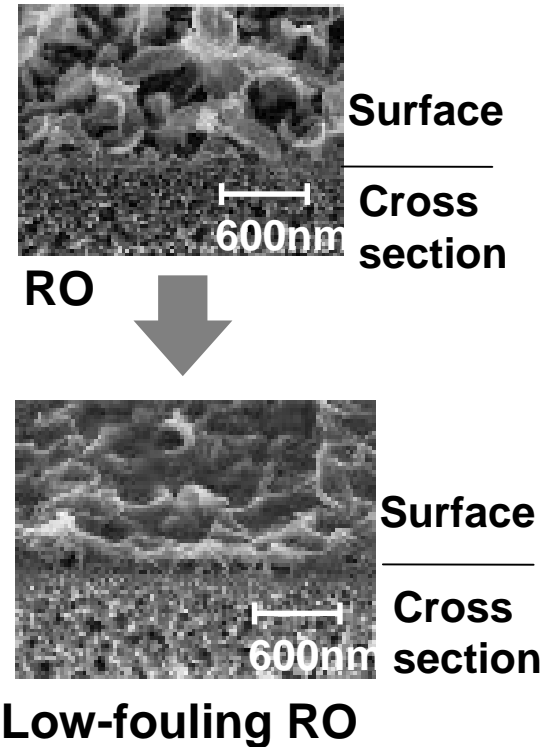
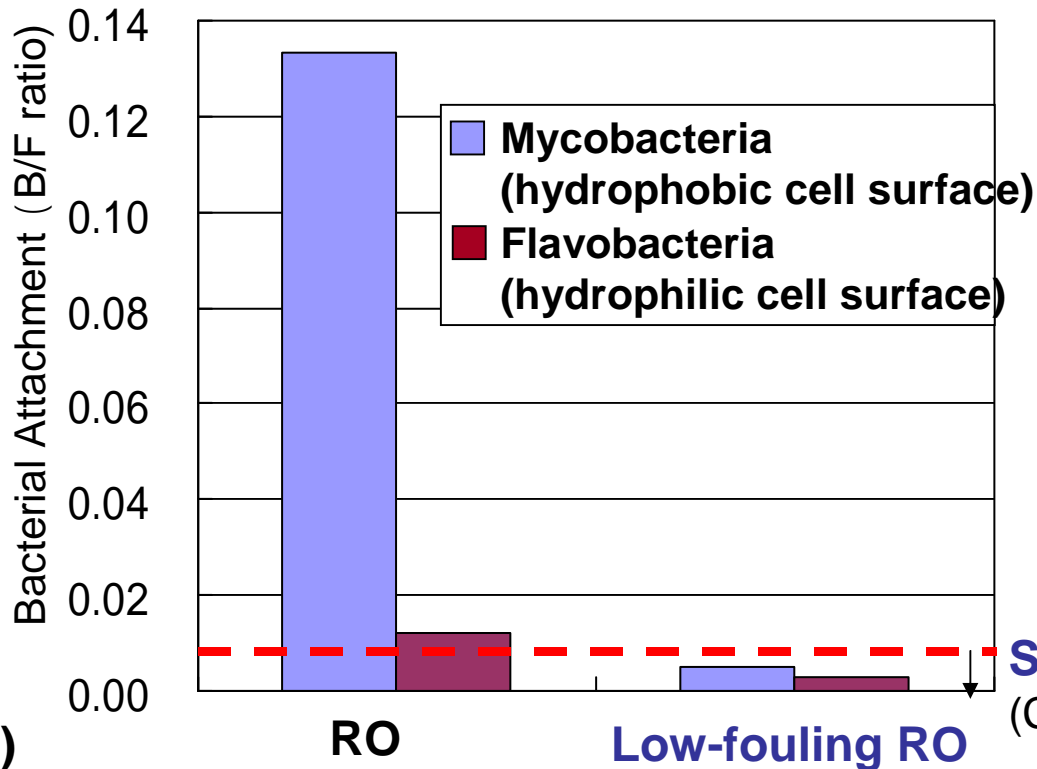
Results of Membrane Bio-fouling Assay

(Orange County water district: Dr.Ridgway)

Bad
(High attachment)



Good
(Low attachment)

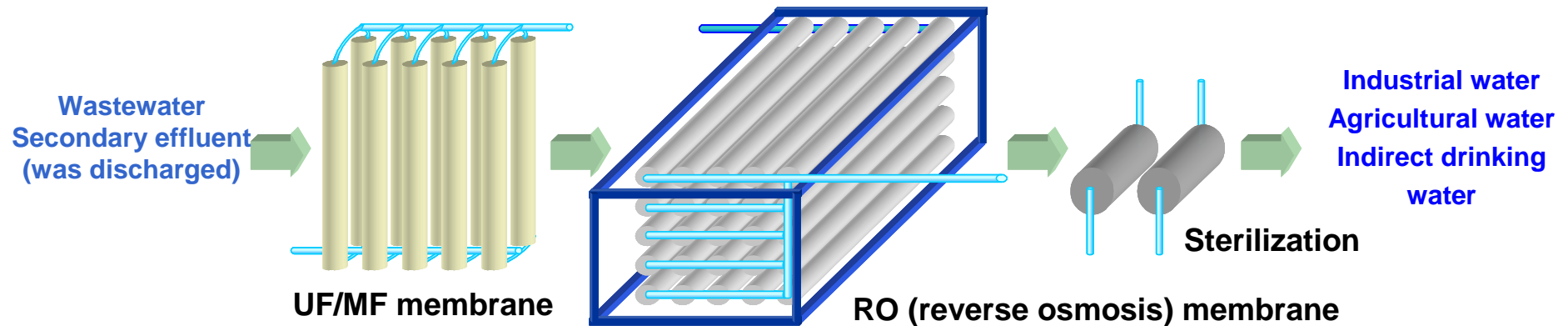


Standard level
(Cellulose Acetate Membrane)

*Fouling : Deterioration of membrane performance caused by stains

Toray has developed low-fouling RO membrane with extremely low bacteria attachment

Toray Acquires Large Scale Wastewater Reclamation Projects



as of October 2008

No.	Country	Location	Capacity (m ³ /d)	Operation Year
1	Kuwait	Sulaibiya	320,000	2005
2	Singapore	Changi	228,000	(2009)
3	China	Ningxia	78,000	(2008)
4	Australia	Luggage Point	66,000	(2008)
5	China	Tianjin TEDA	30,000	2006
6	China	Dongguan	25,000	2005
7	Singapore	Seletar	24,000	2004
8	China	Tianjin Dongjiao	12,000	(2008)
			=Acquired Projects for Last 2 years	

**Toray's Cumulative Capacity for Wastewater Reclamation (Product Water Basis):
1,000,000 m³/day (Top Share in the World)**

World's Largest Wastewater Reclamation Plant : Sulaibiya (Kuwait)

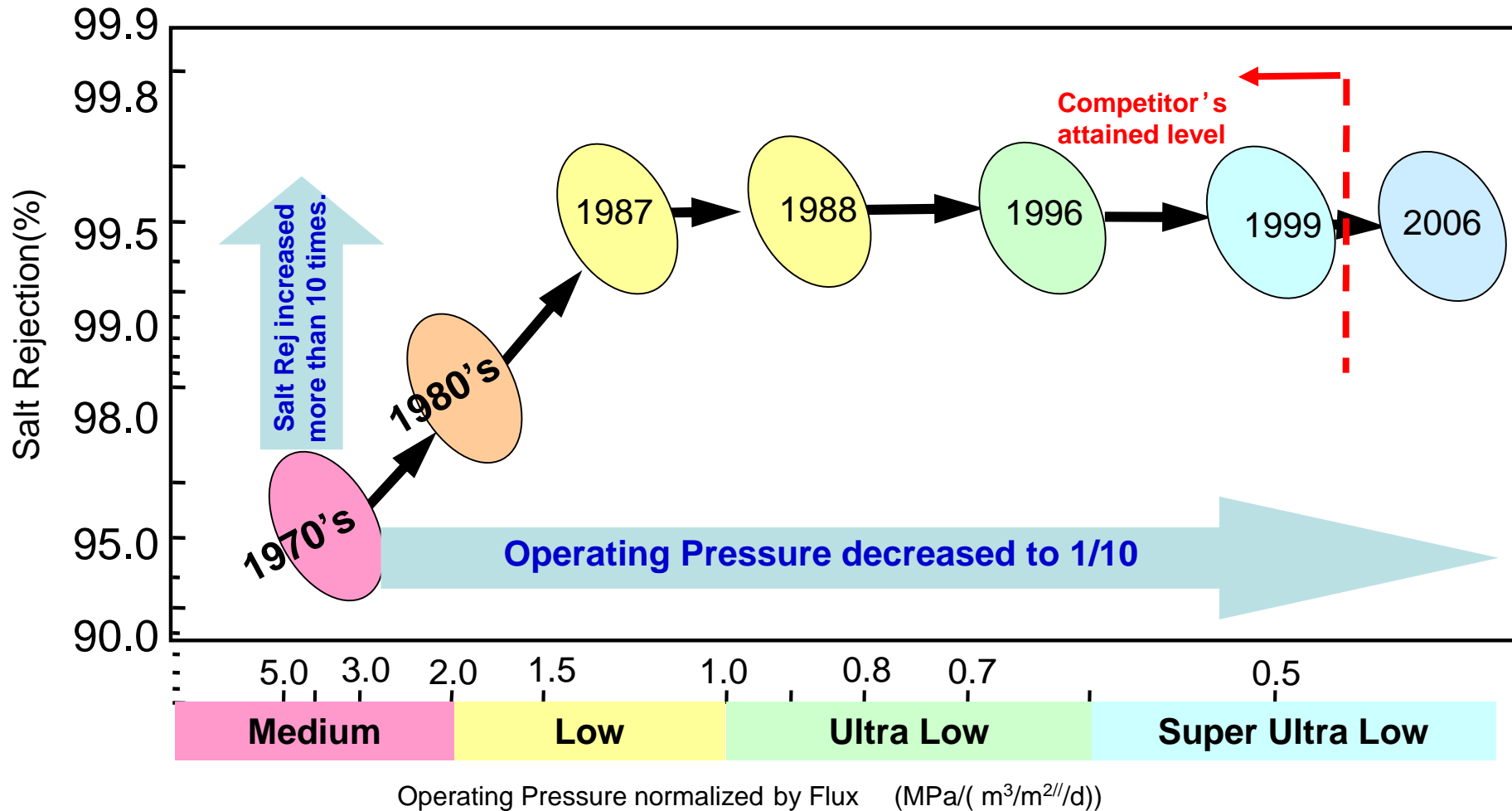


Photo credit : GE-Ionics (USA)

Using Toray's low-fouling RO membranes
Treated water is used for irrigation and industrial water.

(Capacity: 320,000 m³/day, Online: 2005)

Progress of Brackish Water RO Performance



Improvement of membrane materials and manufacturing technology realized the development of super ultra low pressure membrane with high salt rejection and lower operating pressure

**World's most advanced
Membrane for Energy-saving**

The Largest Brackish Water Desalination Plant in East Asia (Korea)



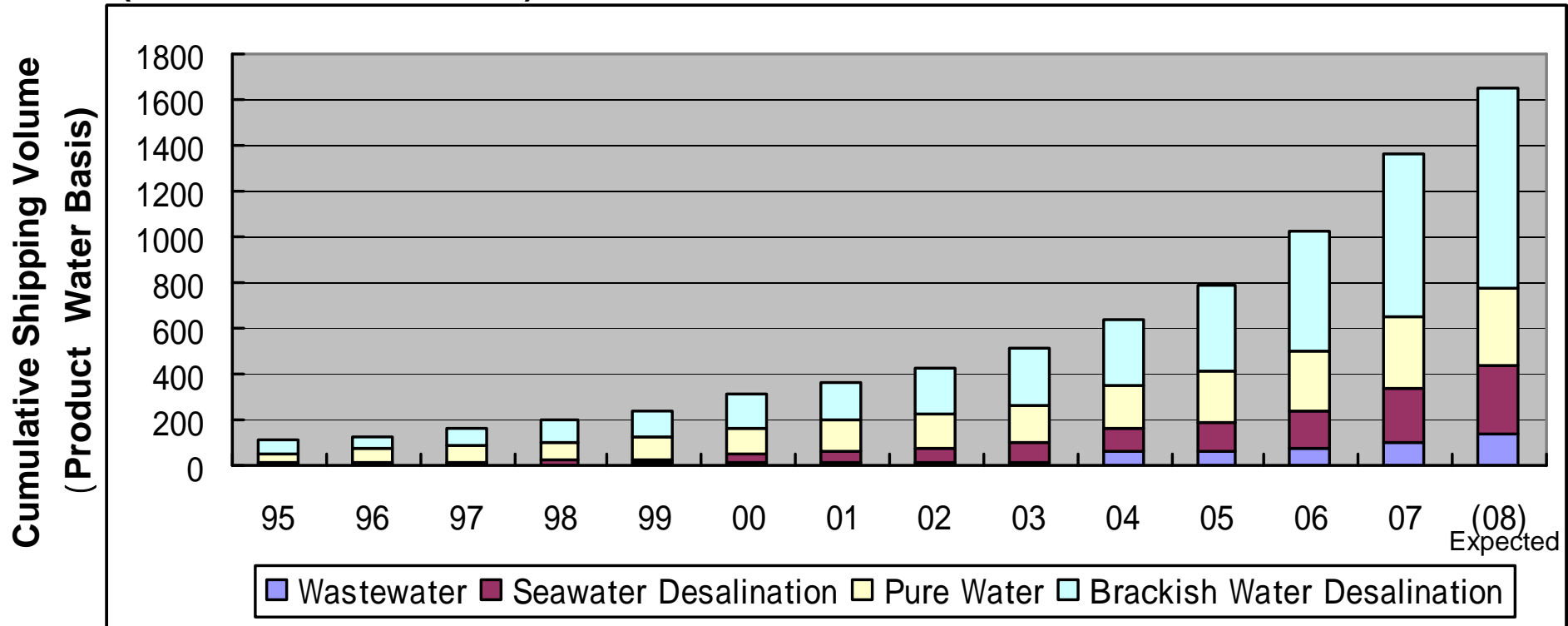
Brackish Water Desalination Plant for Petrochemical Industry

(Capacity: 84,000m³/day, Online: 1997)

Toray RO Membrane Elements Sales Volume by Usage (Trend of Cumulative Shipping Volume)

[As of Nov. 2008]

(Unit: 10 thousand m³/d)



◆ Total Shipping Volume: 14,000,000 m³/d
(Equivalent to water for 60,000,000 people)

New Products-1: 16-inch RO Elements

1. Advantages of 16-inch RO element

Autowinding production realizes Stable element quality and Large membrane area

These features will allow **Lower Capex and Opex (abt. 15-20% down)** and **Smaller footprint (abt. 15% down)**.

2. Product line up

Full line up of RO Membrane elements:

Brackish Water Desalination: TM740-160

Low Fouling: TML40-160

Seawater Desalination: TM840-160



16-inch element (left) and conventional 8-inch element

New Products-2: Food and Beverage

- ◆ **Application** Target at present is Dairy: Condensation of whey or milk protein
In the future, will develop condensation of juice or other food & beverage application
- ◆ **Market** USA, New Zealand, and Europe

- ◆ **Membrane Variation**

RO	Started sales from last November
NF	Will launch April 2009
PES-UF	Will launch April 2009

- ◆ **Features** Good protein rejection
And excellent permeability
(= difficult to clog)

<Pursuit of High Profitable Application>

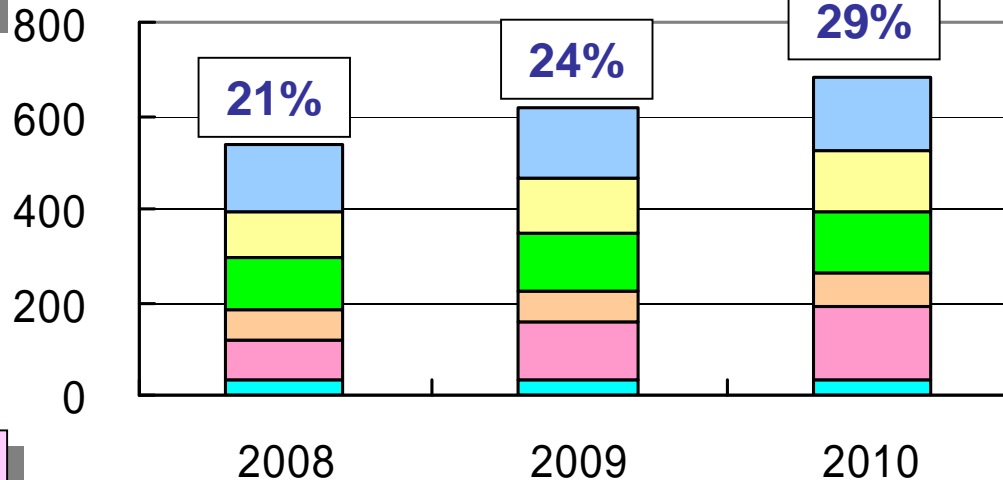


Shape of elements

Summary of RO Membrane Market

Market by Region

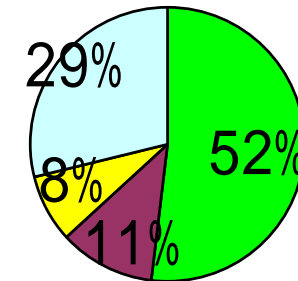
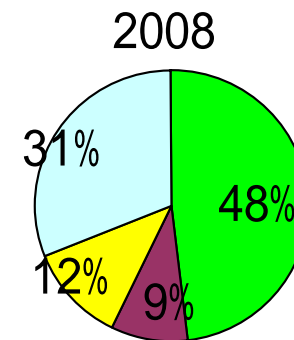
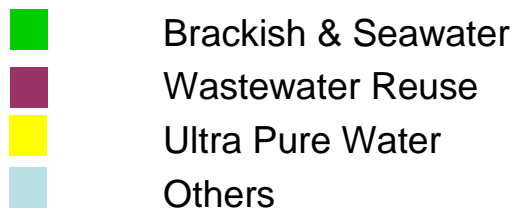
(100 Million Yen)



Market Growth (per Y)

N. America	4%
Middle East	16%
Europe	8%
Asia Pasific	8%
China	32%
Japan	1%
Total	12%

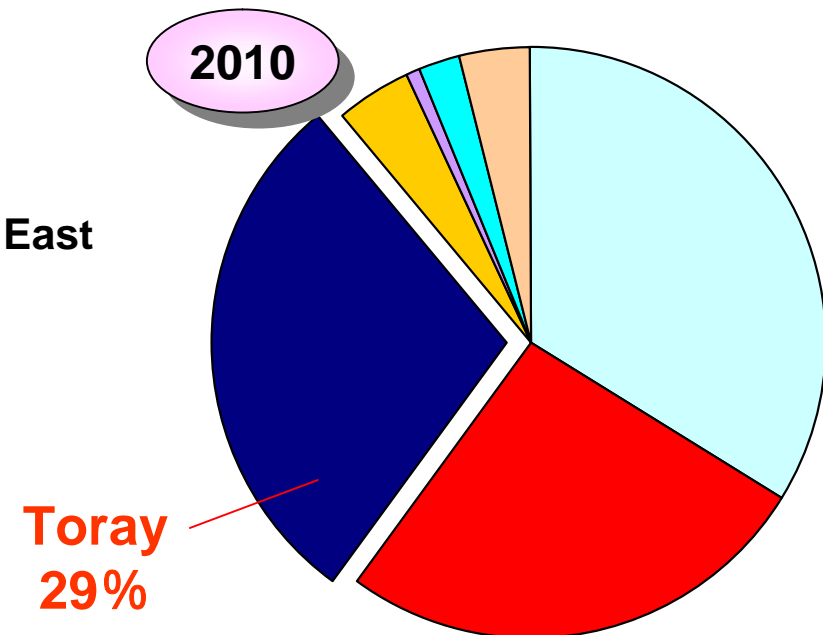
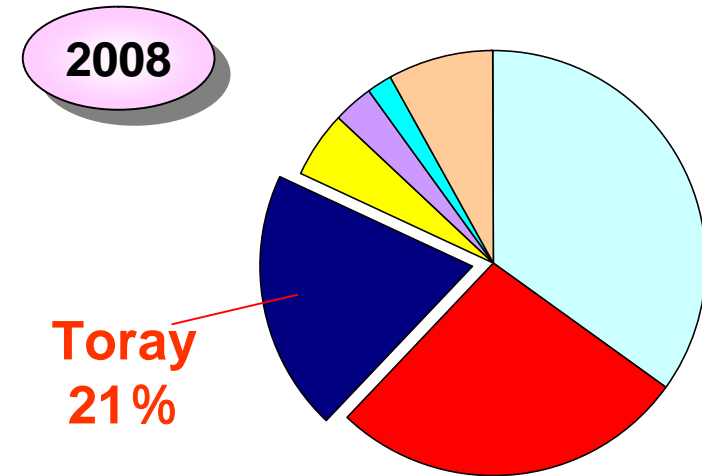
Market by Application



Asia and Middle East are predicted to expand by regional factors while seawater / brackish water desalination and wastewater reuses are expected to expand by application. Toray develops them by Global Sales Team.

Expansion Strategy of RO Membranes

- **Expand business utilizing high performance membrane**
 - Seawater desalination application (high boron rejection membrane)
 - Wastewater reuse (low-fouling membrane)
- **Strengthen marketing competitiveness**
 - Develop global marketing system
 - Strengthen engagement with major engineering-related companies
- **Enlarge marketing area**
 - Expand bases in USA, Europe, and Middle East
 - TBMC-based China Development
- **Strengthen cost competitiveness**
- **Develop and commercialize new products**

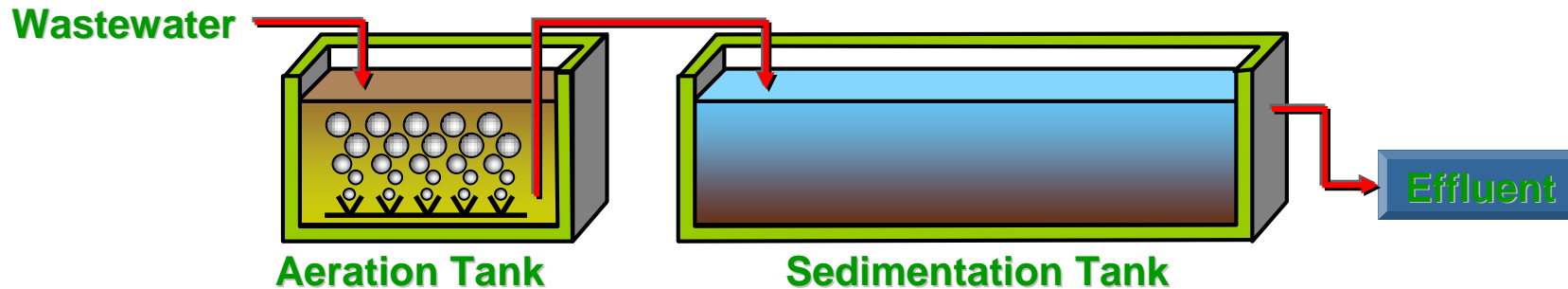


Contents:

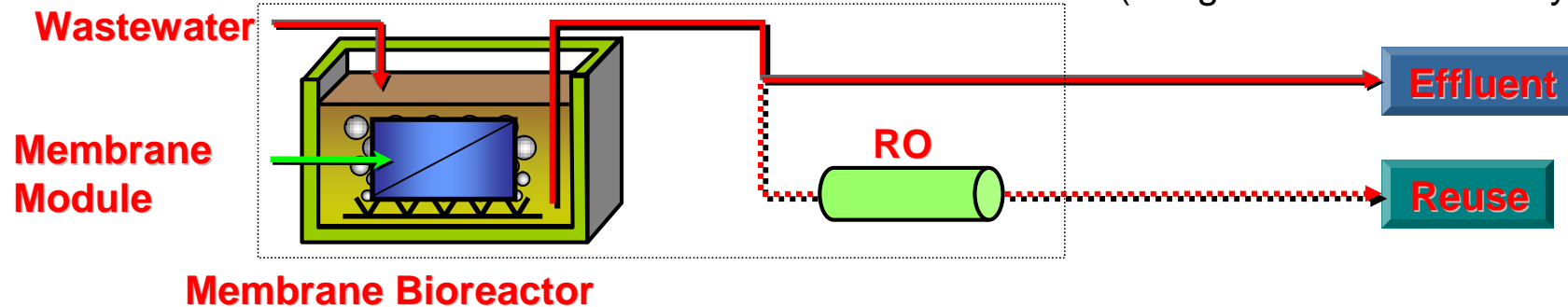
1. Global Water Environment and Toray's Activity
2. Toray's Water Treatment Business
3. Reverse Osmosis (RO) Membrane Business
- 4. Submerged Membrane Business for Membrane Bioreactor (MBR)**
5. Hollow Fiber UF/MF Membrane Business
6. IMS (Integrated Membrane System)
7. Expansion Plan of Water Treatment Business

Wastewater Treatment: Conventional and MBR Method

Conventional Activated Sludge Method (ASM)



MBR (Membrane Bioreactor) Process (+RO) IMS (Integrated Membrane System)



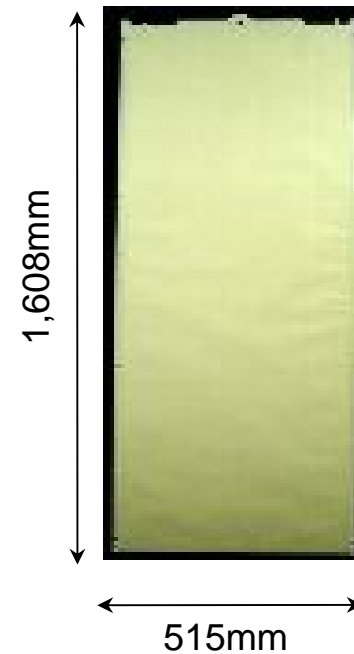
Feature of MBR

Process	Effluent Quality	Maintenance	High concentration Sludge	Energy Consumption	Small Footprint
ASM	not good	not good	poor	excellent	poor
MBR	excellent	good	good	good	excellent

Toray Submerged Membrane Module for MBR, “MEMBRAY” Series

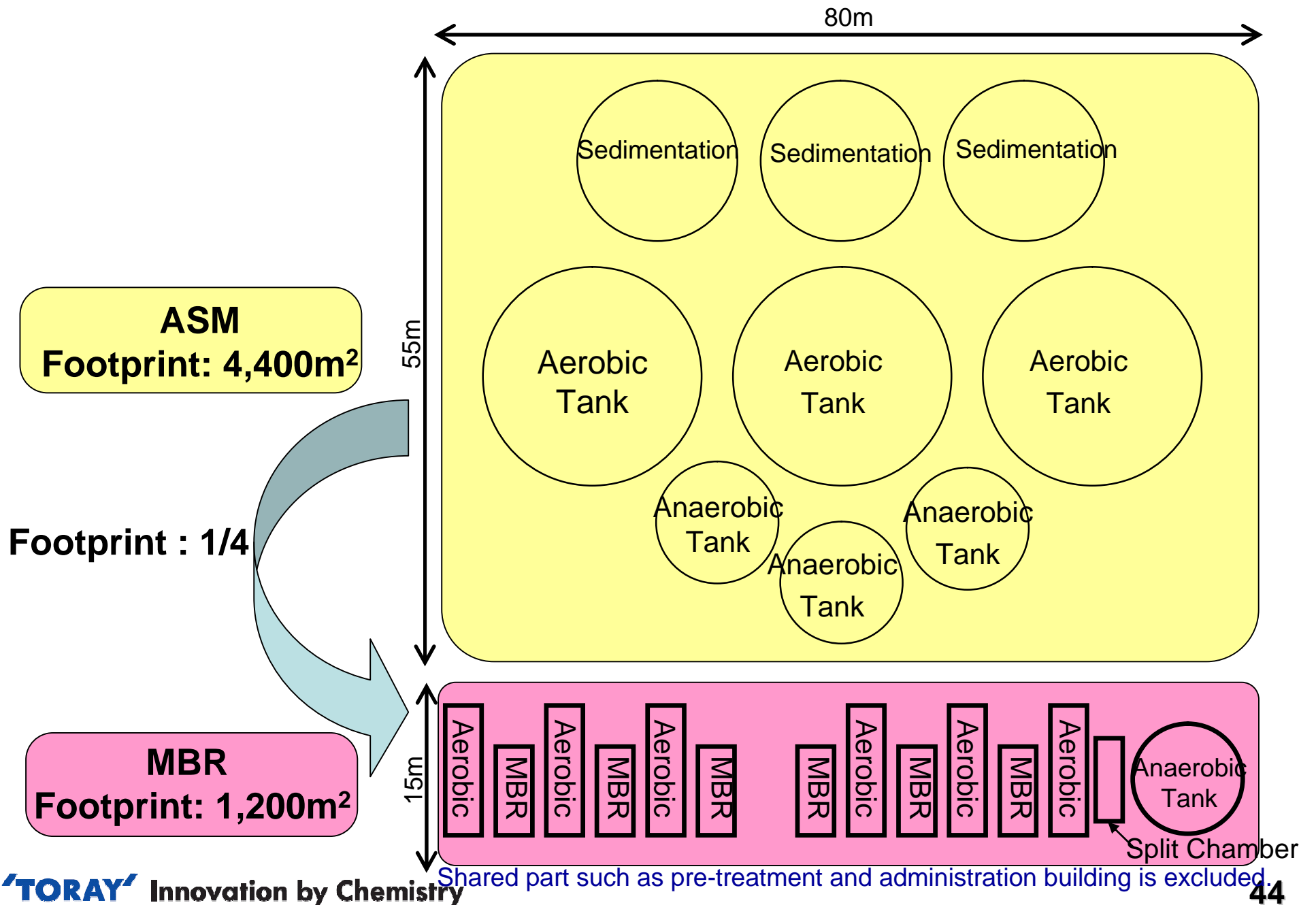


“TMR140-100a”
(100EL, 140m²)








Standard Element “TSP-50150”
(1.4 m²)

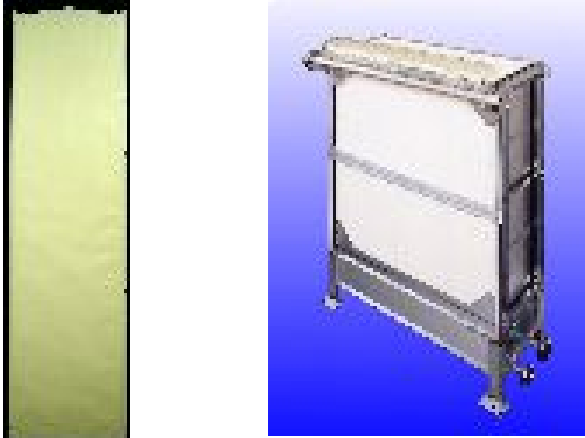

Footprint Comparison: ASM v.s. MBR (capacity: each 5,000m³/d)



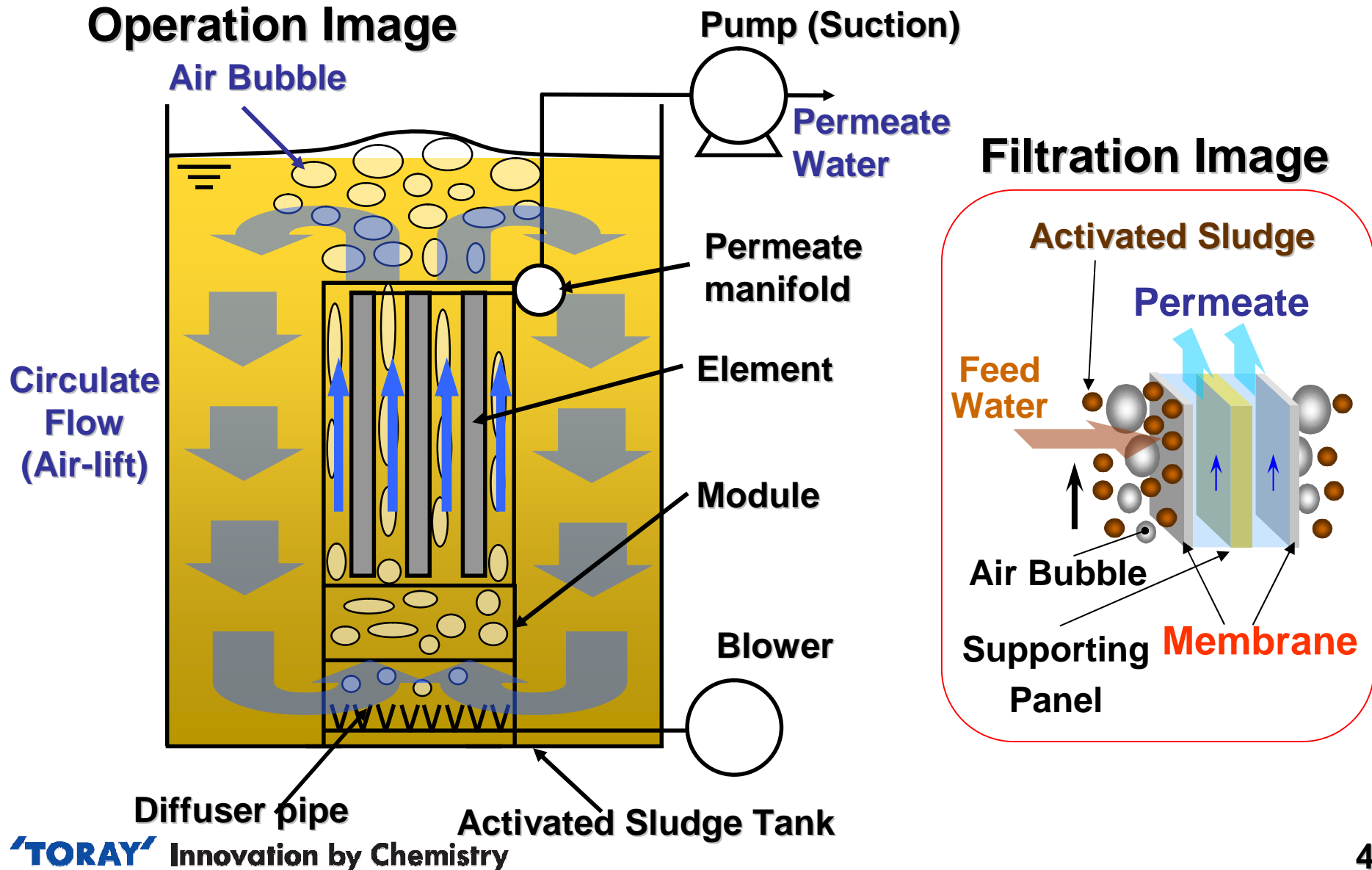
MBR Membrane Module Manufacturers

	A	B		C	Toray
Membrane	Hollow Fiber	Hollow Fiber		Flat Sheet	Flat Sheet
Material	PVDF	PE	PVDF	PVC	PVDF
Pore Size	0.04 μm	0.4 μm		0.4 μm	0.08 μm
Module Type	- -	- -	- -	- -	TMR140-200D
Membrane Area	67 m^2	210 m^2	500 m^2	320 m^2	280 m^2
Outside Cleaning	Required	Required		Not Required	Not Required
Module Configuration					

MBR Flat Sheet vs Hollow Fiber Membrane

Membrane Type	Flat Sheet	Hollow Fiber
Membrane & Module	 <p>Flat Sheet</p> <p>Module</p>	 <p>Hollow Fiber (cross section)</p> <p>Hollow Fiber</p> <p>Module</p>
Merits	<ul style="list-style-type: none"> - Effective clean up with scouring air - Less pressure loss (Operate with gravity) - Higher flux - Easy maintenance 	<ul style="list-style-type: none"> - Large membrane area per footprint - Backwash cleaning
Demerits	<ul style="list-style-type: none"> - Small membrane area per footprint - Difficult to apply backwash 	<ul style="list-style-type: none"> - Fouling with SS (Inter-fiber fouling) - Frequent chemical cleaning (every week) - Small screen net size for pretreatment (1mm opening or smaller)

Filtration Principle of Flat Sheet MBR



Design Concept of Membrane

Required Features of Membrane:

- High Physical and Chemical Durability
- Excellent Permeability
- Low Fouling and Easy to Clean

Flat Sheet Type:

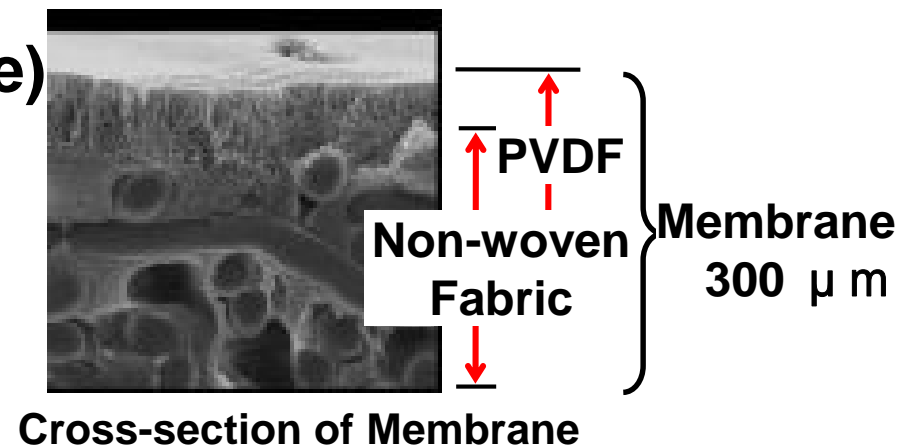
- Reinforced by Polyester Non-woven Fabric
- Less Fouling and Easier to Clean than Hollow Fiber Type

PVDF (Polyvinylidene DiFluoride)

- Excellent Chemical

Durability

- Excellent Physical Strength



Membrane Surface Structure and Its Feature

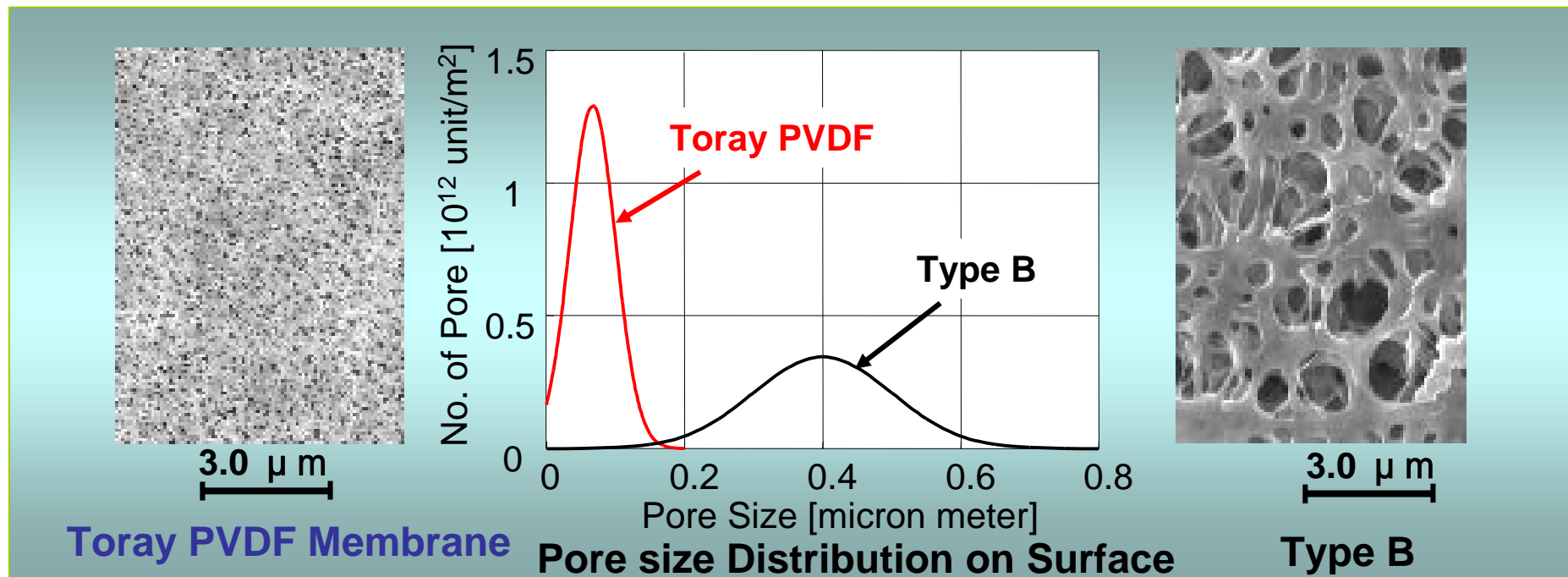
Ideal Membrane Surface Structure:

- Small Pore Size
- Narrow Pore Size Distribution
- Many Pores

Item	Toray	Type B
Average Pore Size [μm]	0.08	0.4
Pure Water Permeability [$10^{-9}\text{m}^3/\text{m}^2/\text{Pa}/\text{s}$]	40	30

Hydrophilic Dry Membrane

Membrane Surface Structure Realizes **Excellent Permeability** and **Low Fouling**



Track Record Toray MBR Membrane Modules



Heenvliet Plant

Recently Awarded Large Projects

Country	Application	Capacity (m ³ /d)
China	LCD WW	6,500
UAE	Sewage	38,000
UAE	Sewage	45,000
KSA	Sewage	30,000

Cumulative Capacity :
300,000 m³/d (130 plants)
(as of Sept. 2008)

Pilot Test with Municipal Wastewater in Holland (sponsored by Dutch Government)

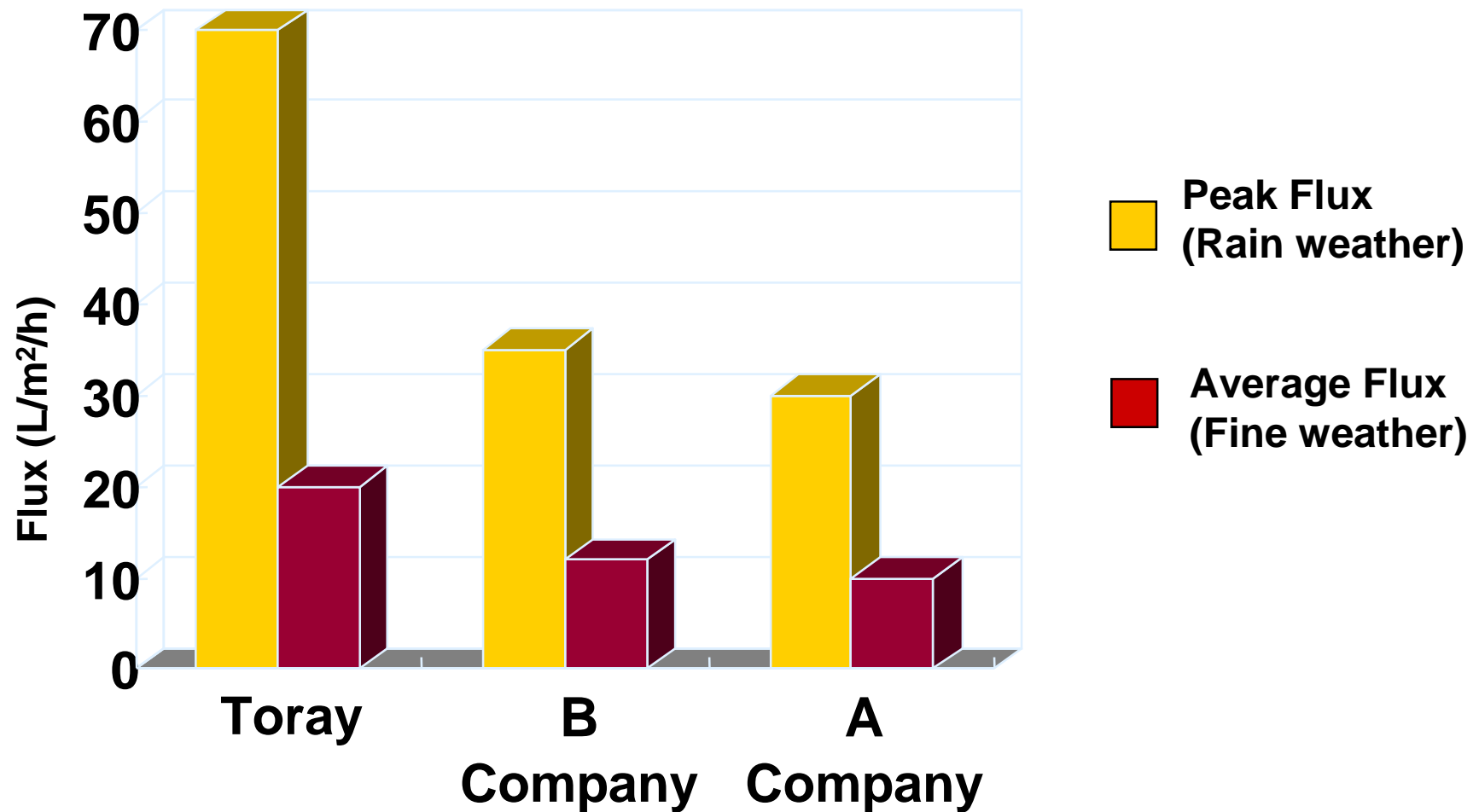
Pilot test started at Beverwijk WWTP in March 2003,
cooperated with Seghers Keppel Technology Group (SKG).

Toray as Membrane Supply

SKG : MBR system design &
plant operation



Pilot Test Results at Beverwijk WWTP



Toray's Flux is twice as large as other companies'

Al-Ain Fast Track MBR Plant (UAE)

Sewage Reuse for Irrigation, Operation started in Mar. 2008

- Capacity : 15,000 m³/d (5,000 m³/d x 3 plants)
- Membrane Module : TMR140-200W x 72 units

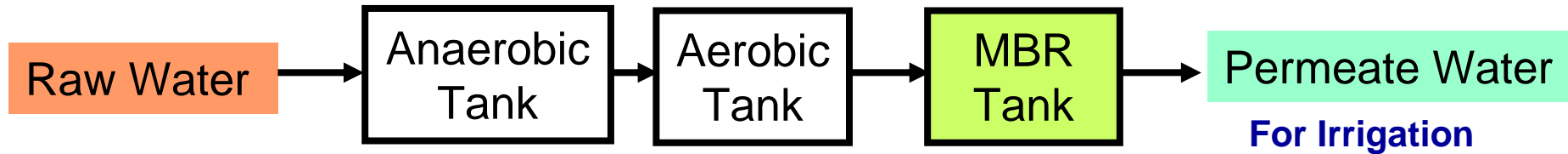


Location



MBR Plant Overview

Al-Ain Fast Track MBR Plant (UAE)



Process Outline



MBR Tank Design Picture

Water Quality (design value)

		Influent	Effluent
TSS	mg/L	218	1
BOD ₅	mg/L	231	10
NH ₄ -N	mg/L	30	5
Turbidity	NTU	-	1

Heenvliet Hybrid MBR Plant (The Netherlands)

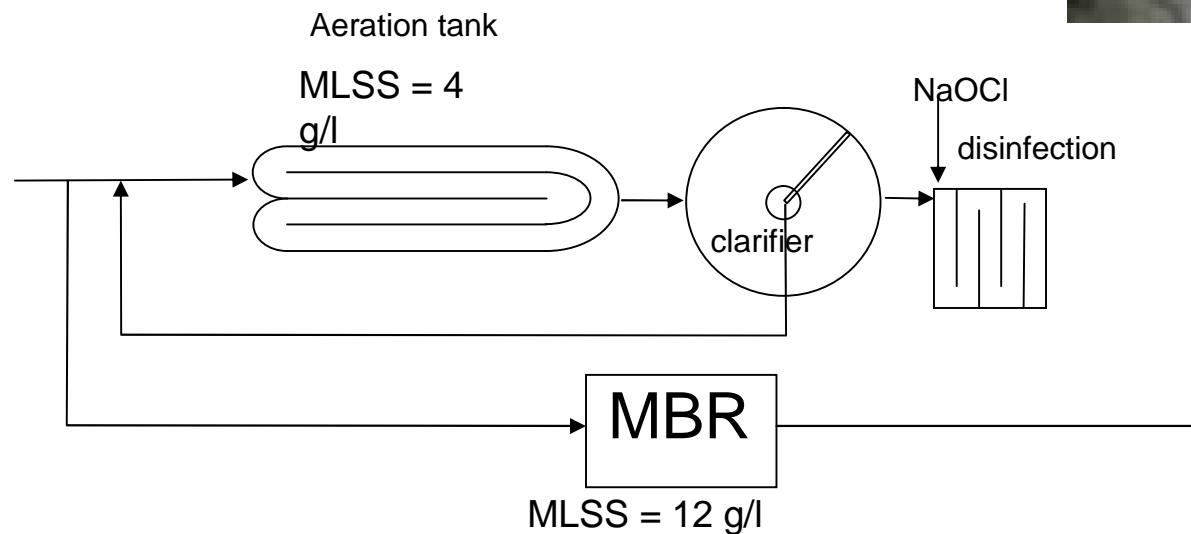
Operation started in April 2006

- Model Plant EUROMBRA Project
- Application : Sewage Treatment
- MBR Capacity : 2,400 m³/d
(Conventional Treatment : 7,000 m³/d)
- Membrane Elements : 3,000 pieces
(4,200 m²)



MBR Plant Overview

Hybrid of Conventional Method and MBR

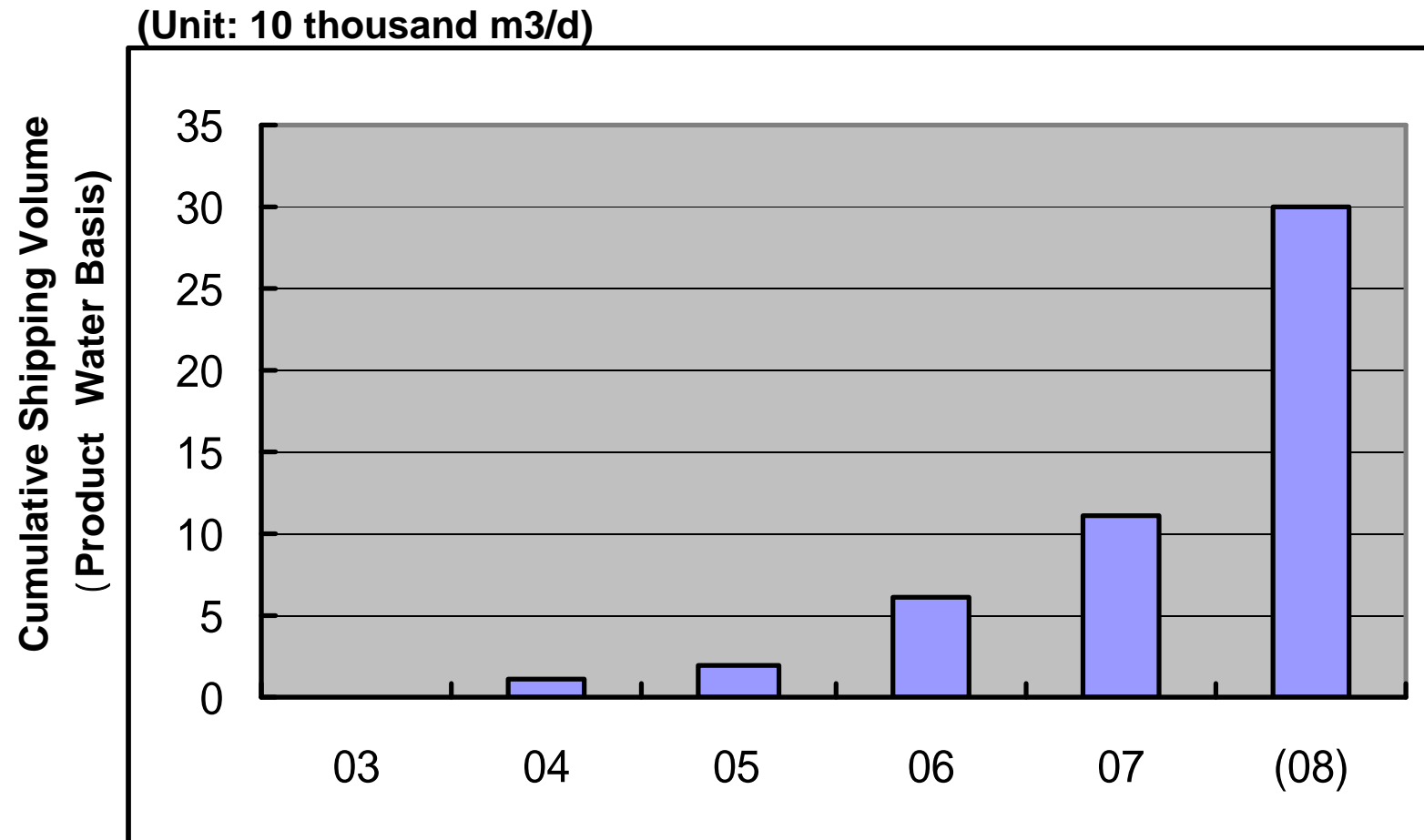


Process Outline



Sales Volume of Submerged Membrane for MBR (Trend of Cumulative Shipping Volume)

As of April 2008

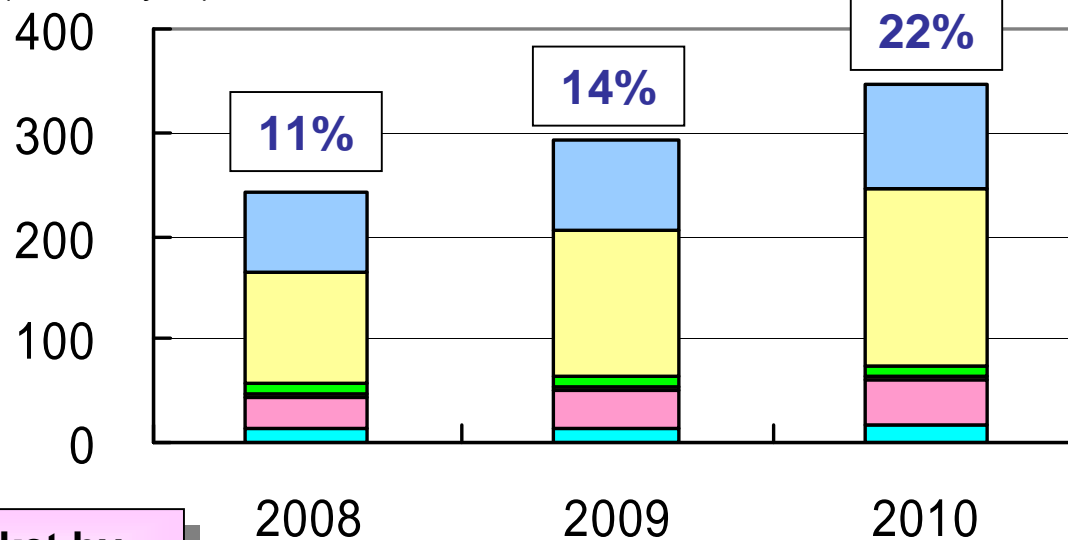


◆ MBR has rapidly increased its sales for waste water processing and reuse usage from 2006

Summary of MBR Market

Market by Region

(100 mil yen) Market Size and Toray's Share



Market Growth Ratio

N. America	15%
ME	25%
Europe	10%
Asia/Oceania	10%
China	20%
Japan	10%
Total	20%

Annual Growth Ratio

Market by Application

Recently sewage treatment by membrane exceeds 75% of MBR market.
Remains are industrial usage for factory wastewater treatment system.

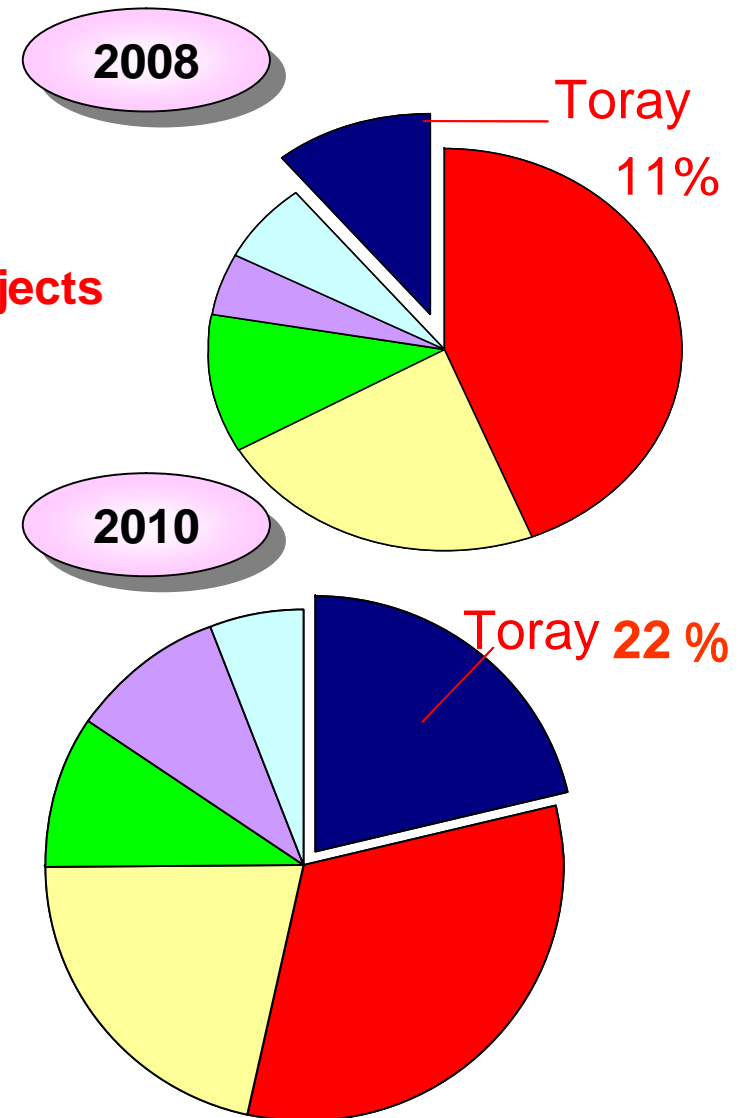
- MBR market is growing more than 20% annually. China and Middle East are most increasing market.
- Wastewater reclamation system (IMS) projects with RO are increasing as environment-conscious method for obtaining water resource.

Expansion Strategy of Submerged Membrane for MBR

- **Expand sales by utilizing high performance immersed membrane elements**
- **Win orders of large wastewater treatment projects (size over 10,000 m³/day)**
- **Strengthen marketability in Europe, USA, and the Middle East**

TMEu for Europe and ME, and TMUS for USA

- **Increase production capability**
Will increase capacity to 1 million m³/d by 2009 (equivalent to treated water basis)



Contents:

1. Global Water Environment and Toray's Activity
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- 5. Hollow Fiber UF/MF Membrane Business**
6. IMS (Integrated Membrane System)
7. Expansion Plan of Water Treatment Business

Toray PVDF Large Size Module

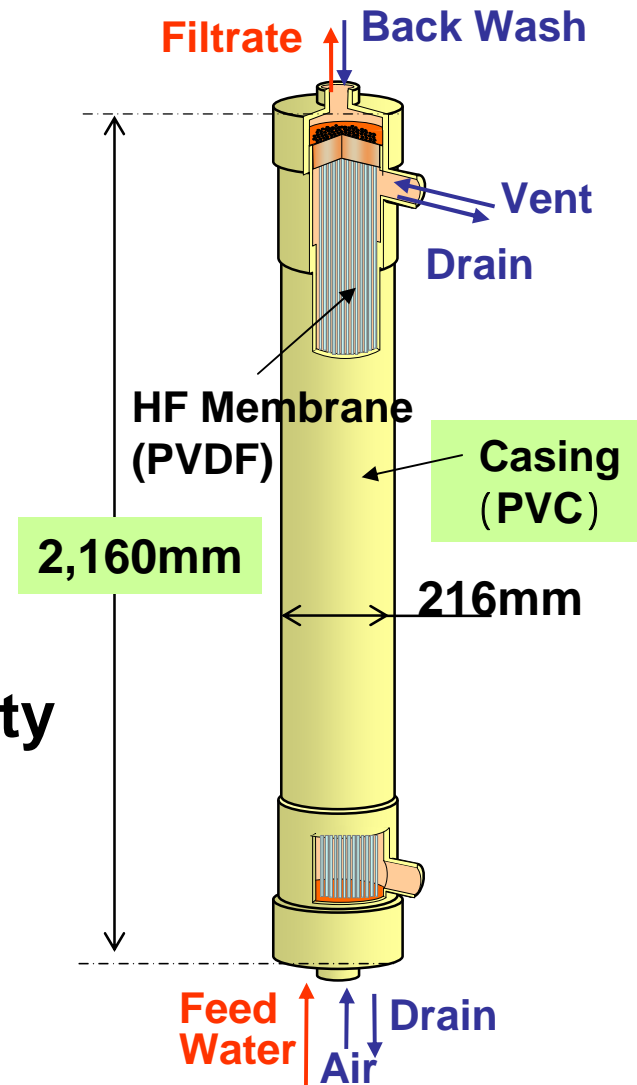
- Type : HFM/HFS/HFU-2020 -

Features


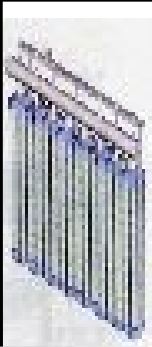
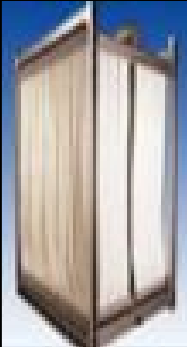


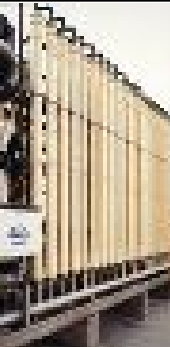


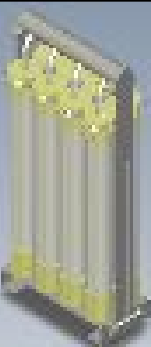
- Module Type : Pressured Type
 - Filtration Method : Outside to Inside
 - Membrane Area : 72 m²
 - Dimension : 216D x 2,160L [mm]
- (The Largest Dimension and Membrane Area as 8-inch Module)

Advantages

- Stable Continuous Filtration
- High Filtration Flow : 110 – 260 m³/d
- High Chemical Resistance
- High Physical Strength and High Integrity



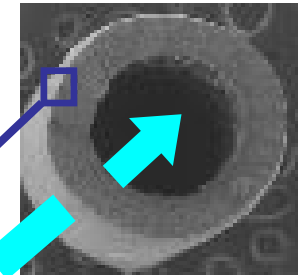
Comparison of Hollow Fiber Membrane Modules

Company	A		B		C	D		Toray	
			B-1	B-2					
Membrane Material	PP·PVDF(MF)		PVDF(MF)		PES(UF)	PVDF(MF)		PVDF(MF/UF)	
Filtration Mode	P	S	S	S	P	P	S	P	S
Pore Size (μm)	0.04		0.04	0.02	0.01	0.1	0.1	0.1-0.01	0.01
Membrane Area(m ²)	15	25.3	67	36	57	50	25·50	72	25
Module Configuration									

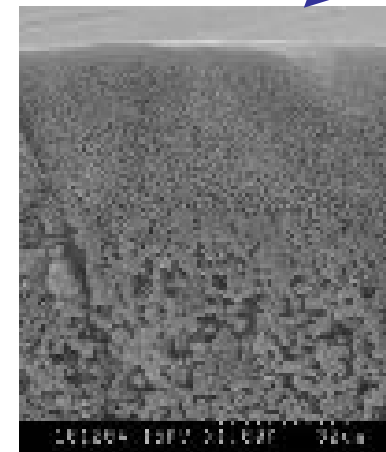
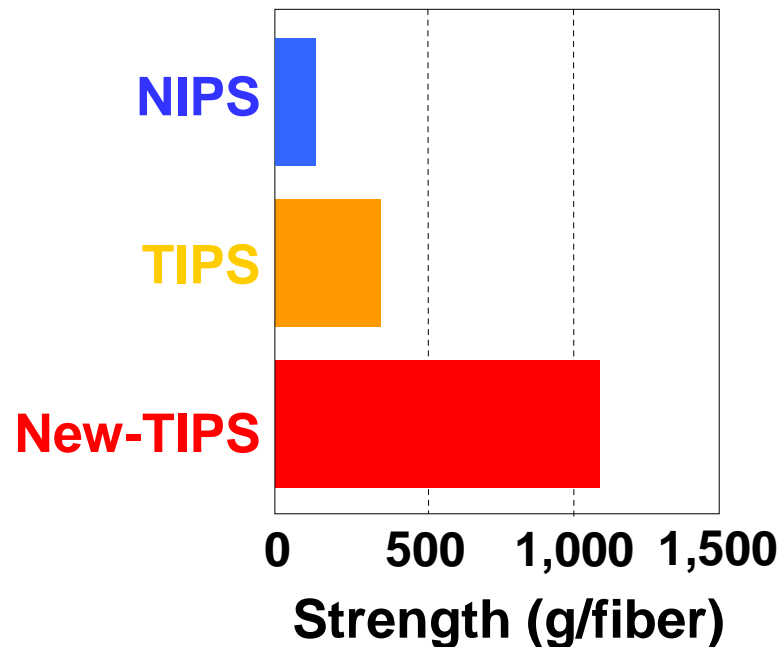
*P=Pressure Type S=Submerged Type

Design Concept of PVDF Hollow Fiber Membrane

1. Using chemically and mechanically durable PVDF as membrane material
2. Made with special spinning method (New-TIPS) which satisfies both high intensity and high permeability
3. The world's first composite membrane that features low fouling characteristics. Realizes the supply of secure and safe water with low cost



Flow Direction



Low fouling layer

Support layer
(high flux & high Strength)

Composite membrane

- NIPS: Non-solvent Induced Phase Separation
- TIPS: Thermally Induced Phase Separation

PVDF hollow fiber MF/UF membranes

		M1	M2	M3
Pore size or MWCO*		0.1 μ m	0.05 μ m	150kDa (0.01 μ m)
Pure water flux (m/h@100kPa)		2.4	1.6	0.8
Membrane Structure		Symmetrical	Asymmetrical (Composite membrane)	
Suitable Feed water	Type	Pretreated Water Clean Ground Water	River & Lake Surface Water	
	Turbidity (NTU)	~ 0.05	0.05 ~ 30	5 ~ 100

*MWCO: Molecular Weight Cut Off

Most Suitable membrane can be selected to meet the feed water quality.

Receiving the Society of Chemical Engineers Technology Award 2007

Toray received the Society of Chemical Engineers, Japan (SCEJ) Technology Award for developing water purification process using PVDF hollow fiber membrane modules.

SCEJ selected Toray for this award because it rated highly Toray's superior membrane technology in water purification process, its economic advantages, and its contributions to environmental protection offered by its water reclamation and reuse system.



Pilot Test Competition in Korea (Drinking Water Production)

Competition for Full Scale Project

Test Term : Mar – Aug 2005

Participants: Toray, Company A, B


Toray is selected

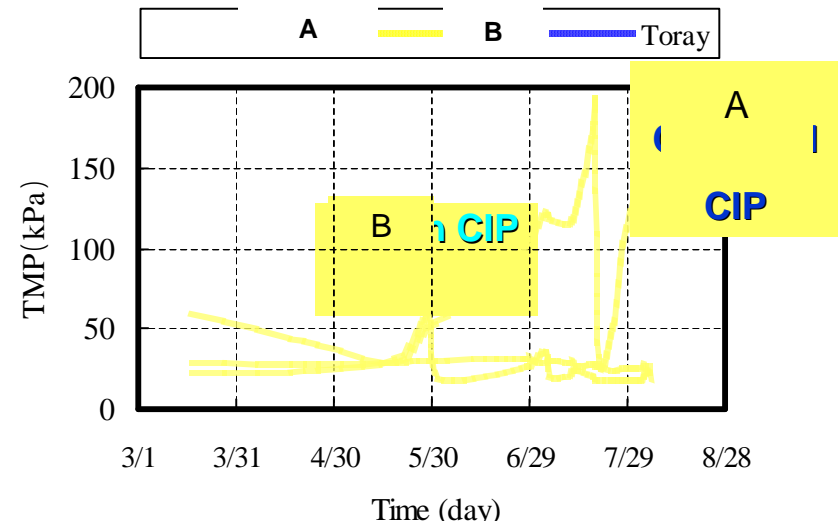
as the most preferable supplier

Most Stable Operation

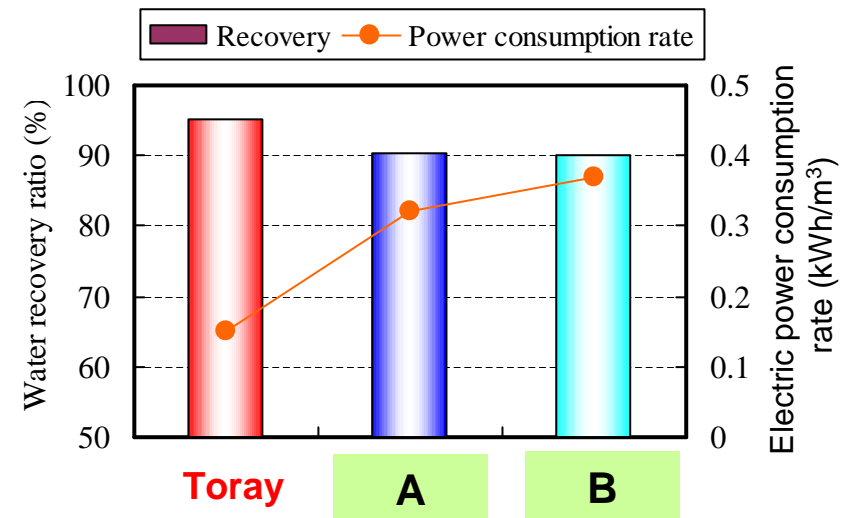
Least Electricity Consumption

Highest Water Recovery

Supplier	Toray	A	B
Membrane Material	PVDF	PVDF	PVDF
Nominal Pore size (Micro-meter)	0.02	0.1	0.04
Filtration system	Pressurize / Dead-end	Pressurize / Cross-flow	Submerged / Suction
Membrane area (m ²)	72	50	31.6
Module		-	-

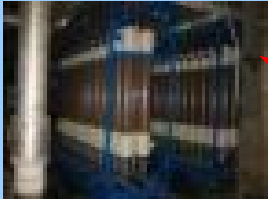


TMP: Trans Membrane Pressure
CIP: Cleaning In Place



Track Record Toray PVDF Hollow Fiber Membrane Modules

Boiler Water Production Plant in USA
Total: 6,500 m³/d
HFS 3,300m³/d
 (2/2004 start)



HFS 3,200m³/d
 (6/2004 start)

HFS 30,000m³/d
Drinking water in Korea
 (7/2009 start)
Korea's Largest

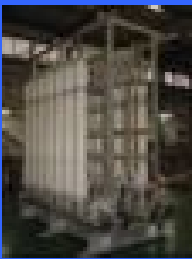
HFS 8,640m³/d
Drinking water in Indonesia
 (12/2007 start)

Outside of Japan

HFM 2,700m³/d
Pretreatment for seawater desalination
 (9/2003 start)



HFM 3,500m³/d
Drinking water; Cryptosporidium Removal
 (5/2003 start)



Drinking Water Cryptosporidium Removal
Total: 13,000 m³/d
HFM 5,000m³/d
 (7/2002 start)



HFM 8,000m³/d
 (8/2003 start)




HFS 8,000m³/d
Drinking water;
 (10/2005 start)

HFS 19,000m³/d
Drinking water;
 (1/2009 start)

HFM 88,000m³/d
Drinking water;
 (3/2007 start)



Cumulative Plants Capacity:
300,000 m³/d (as of Sept. 2008)

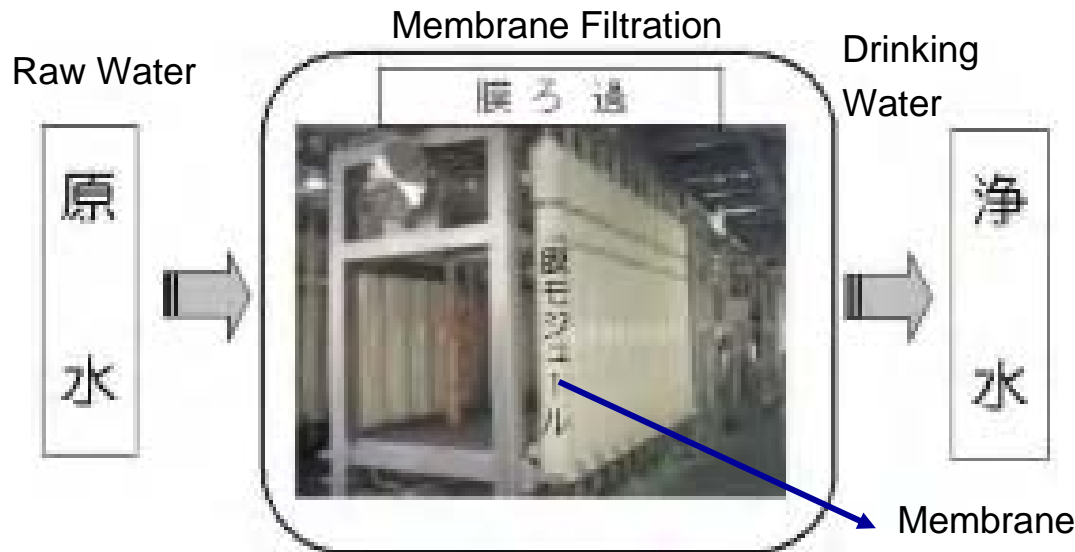
Largest plant in Japan

The Largest Membrane Treatment Plant in Japan (Kinuta Water Works)

[Treatment Method] Membrane Filtration

Outline of the Plant [Capacity] Kinuta/Kinuta Shimo: each 40 km³/day (Total 80 km³/day)

[Membrane Module] MF Membrane for Drinking Water



Kinuta Water Works Membrane Filtration Facility



Operation started March 2007

Membrane Type	Pressured Type MF Membrane
Shape of Membrane	Hollow Fiber Membrane
Membrane Material	Polyvinylidene DiFluoride
Nominal Pore Size	0.1 μm
Membrane Area/pc	75m ²

Membrane Module

Raw Water	Tamagawa River-bed Water	
Treated Water	44,000 m ³ /day x2	
Main System	3 train x 2	Module 22 pcs/train
Recovery System	1 train x 2	Module 5 pcs/train
Recovery Ratio	99.9%	

New Products : Submerged PVDF Hollow Fiber Membrane Module (under development)

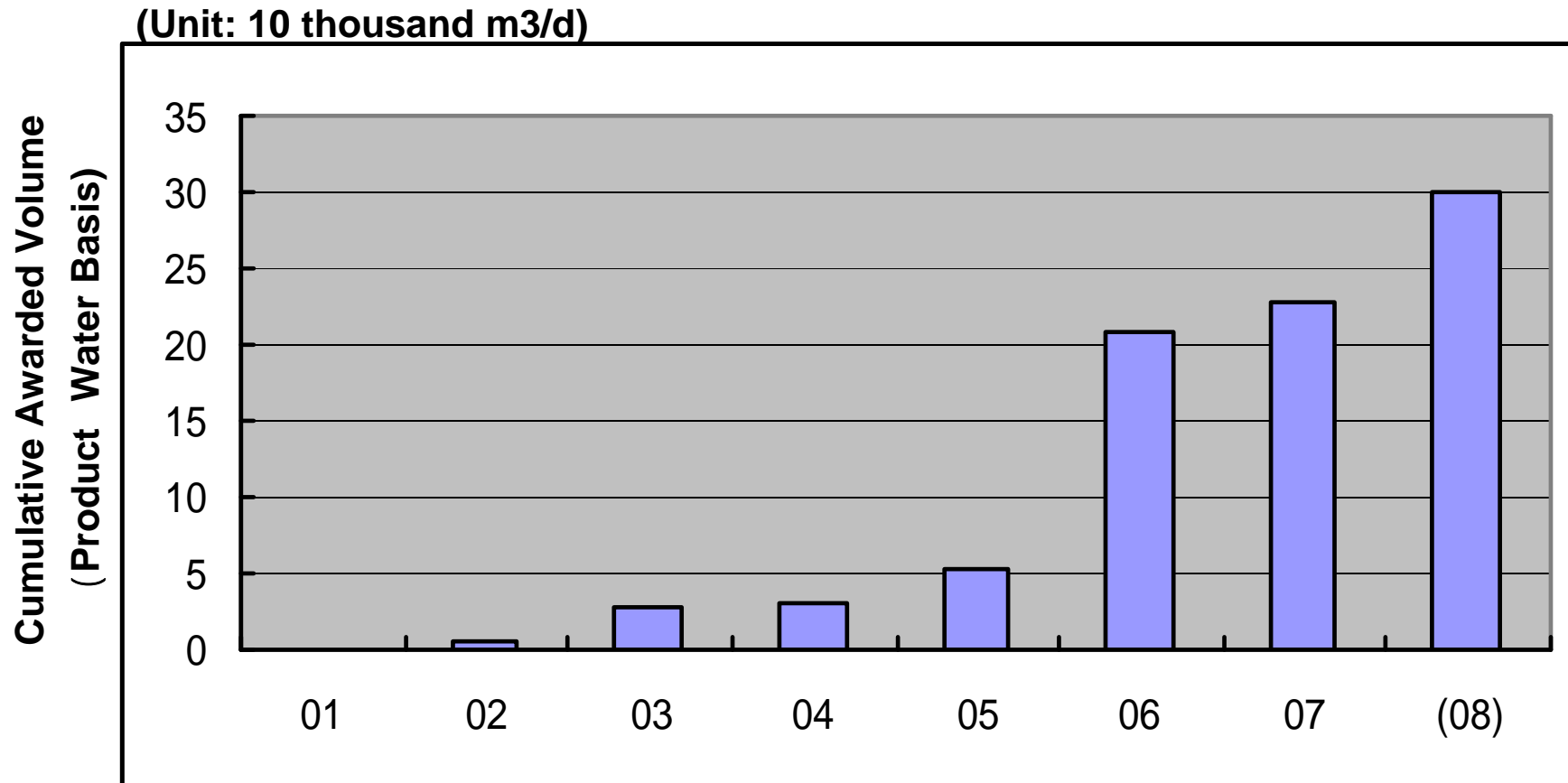
1. Target Application : Drinking Water Production, RO Pretreatment of Seawater Desalination, Tertiary Treatment of Waste Water, Industrial Water Treatment

2 . Feature

Module Type	Submerged Type	Conventional : Pressured Type
Product Figure	<p>Filtrated Water ← (P)</p> <p>Raw Water</p> <p>Raw Water Hollow Fiber Membrane</p>	<p>Filtrated Water ←</p> <p>Hollow Fiber Membrane</p> <p>Raw Water ← (P)</p>
Filtration Method	Suction	Pressured
Raw Water	Low ~ High Turbidity (River Water ~ Activated Sludge Water)	Low ~ Middle Turbidity (River Water, Lake Water)
Plant Size	Lower Cost at Large Plant (little piping)	Suitable for Small and Medium Size
Listed Item	Not applicable	Applicable

Hollow Fiber UF/MF Membrane Modules Sales Volume (Trend of Cumulative Shipping Volume)

As of April 2008



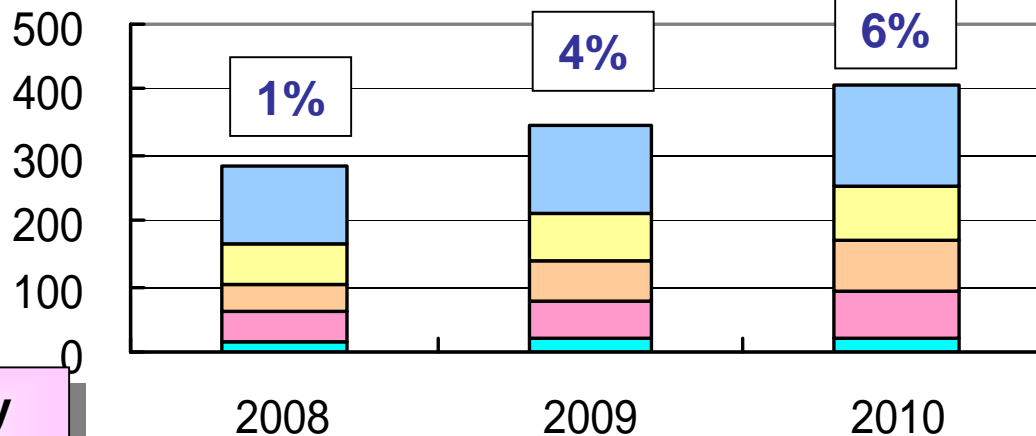
◆ MF/UF Membrane modules is expanding its sales in drinking water usage since 2006

Summary of Hollow Fiber Membrane Market

Market by Region

(100 Million Yen)

Market Size and Toray's Share



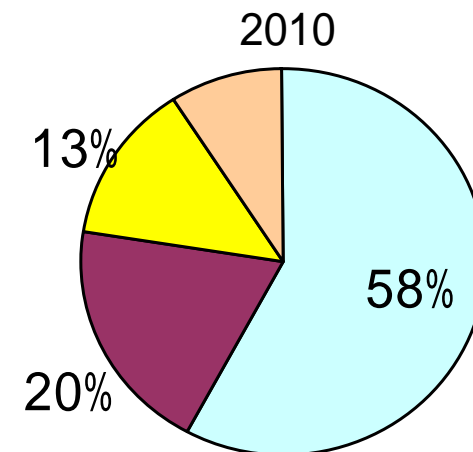
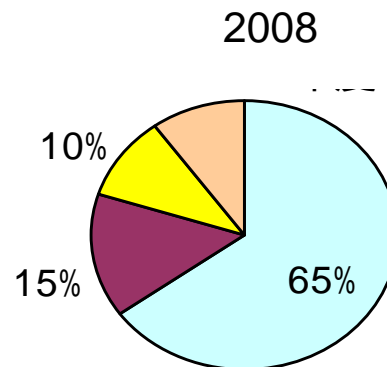
Market Growth Ratio

N. America	15%
Europe/ME	15%
Asia/Oceania	32%
China	30%
Japan	15%
Total	20%

Annual Growth Ratio

Market by Application

- Drinking Water
- Wastewater Reuse
- Pretreatment for SWRO
- Industrial



- Main Market is N. America/Europe/ME. China/Asia/Australia shows rapid growth
- IMS demand is taking off such as pretreatment of SWRO and Wastewater reuse

Expansion Strategy of UF/MF Hollow Fiber Membrane

- **Expand sales by utilizing high performance membranes**

- Since our pressured type is the listed items of the international export control regimes, it takes time to export.

- **Enlarge marketing area**

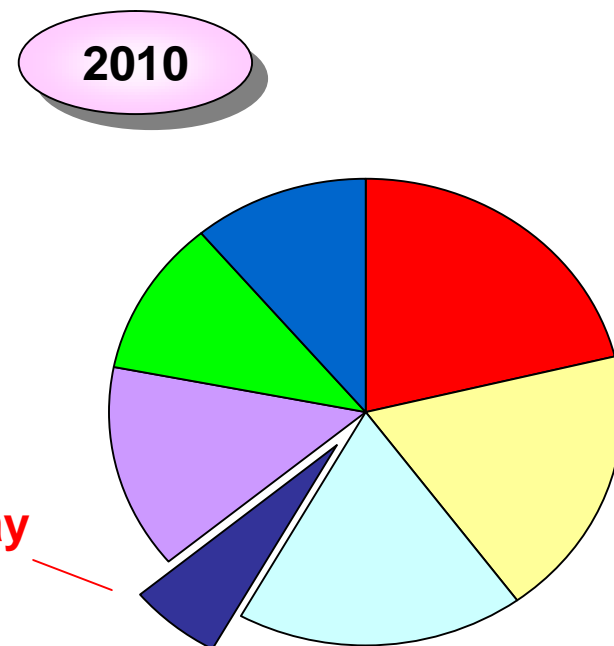
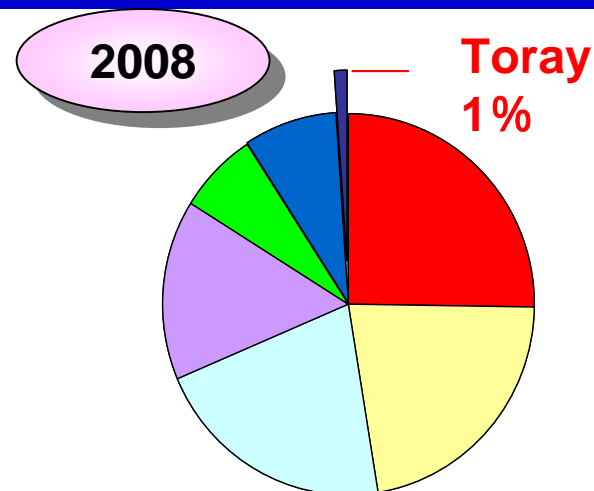
- North America, Middle East, China
- Wastewater reuse, industrial water, large size seawater pretreatment

- **Sales expansion in Japan and East Asia**

- Cooperation with Suido Kiko and Japanese engineering companies
- Involvement in East Asia development project of drinking water treatment technologies

- **Increase production capacity**

- **Commercialization of new product**



Contents:

1. Global Water Environment and Toray's Activity
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3. Reverse Osmosis (RO) Membrane Business
4. Submerged Membrane Business for Membrane Bioreactor (MBR)
5. Hollow Fiber UF/MF Membrane Business
- 6. IMS (Integrated Membrane System)**
7. Expansion Plan of Water Treatment Business

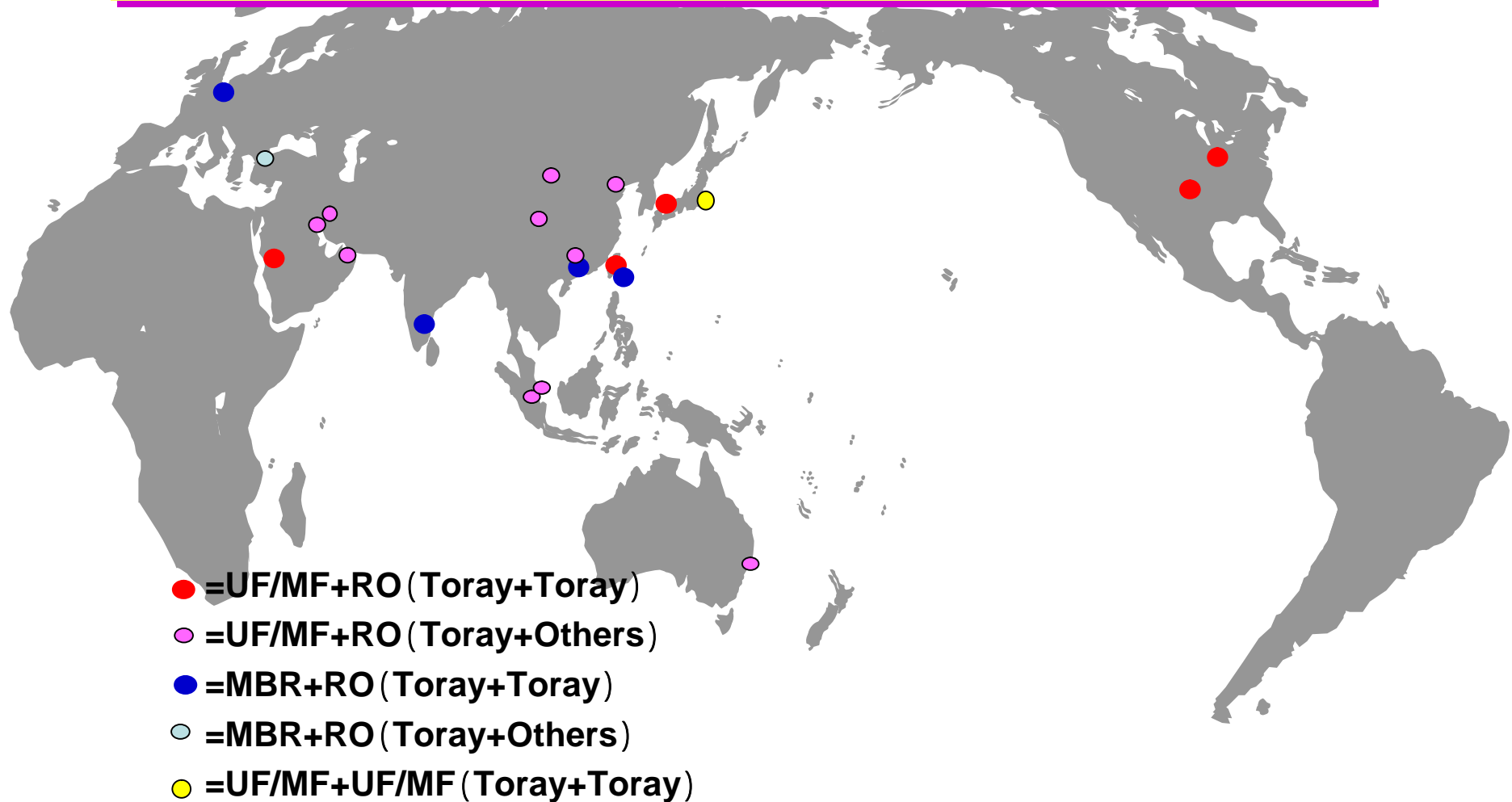
IMS (Integrated Membrane System)

Since Toray has all variation of membranes developed by own technology, Toray can provide the most suitable water treatment membrane system, and can realize the highest performance and cost reduction.

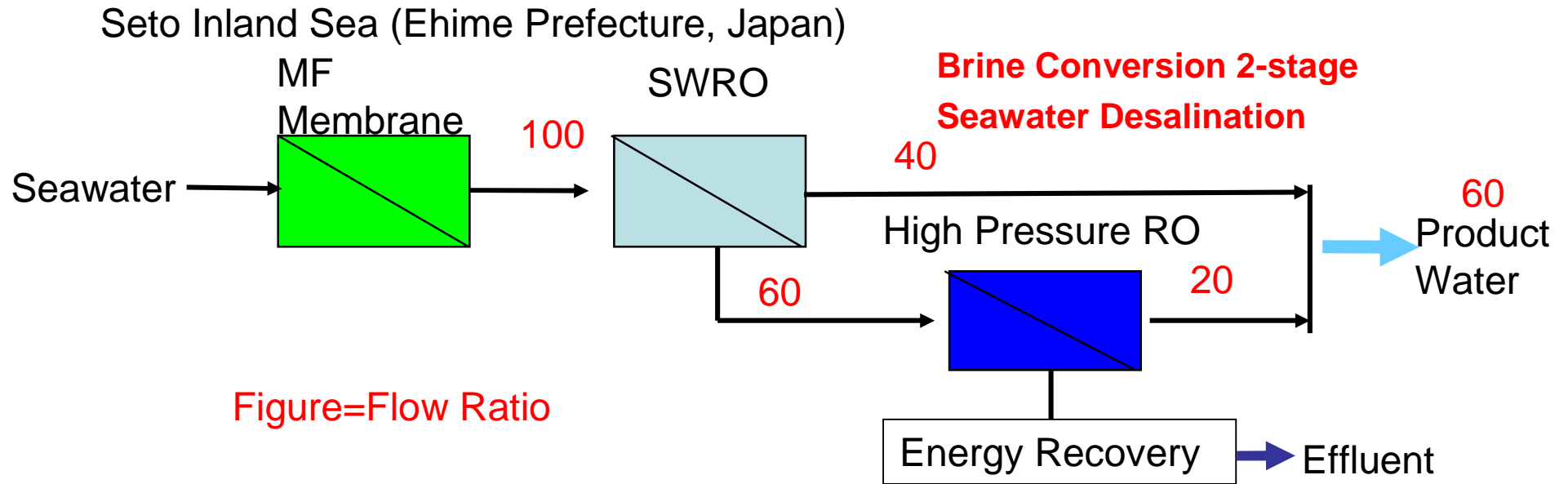
	Typical Process Flow	Actual Plant
Seawater desalination (SWRO)	<p>MF SWRO BWRO</p> <p>Pretreatment Desalination Boron Removal</p>	<p>-Seto Inland Sea/Japan (1,600m³/d:2004) -Dubai/UAE(64,000m³/d:2008)</p>
Wastewater reclamation (WWRO)	<p>MF RO</p> <p>2nd Effluent</p> <p>Pretreatment Reclamation</p>	<p>-Seletar/Singapore(24,000m³/d:2004) -Sulaibiya/Kuwait(320,000m³/d:2005) -Changi/Singapore (228,000m³/d:2009)</p>
	<p>Wastewater</p> <p>MBR RO</p> <p>Biological Treatment Reclamation</p>	<p>-Fuji Film/The Netherlands (1,080m³/d:2005) -Tirupur Textile/India(11,200m³/d:2008)</p>
Water Purification	<p>MF/UF MF/UF</p> <p>Primary Recovery</p>	<p>-Kinuta/Japan (80,000m³/d:2007)</p>

Track Record of IMS

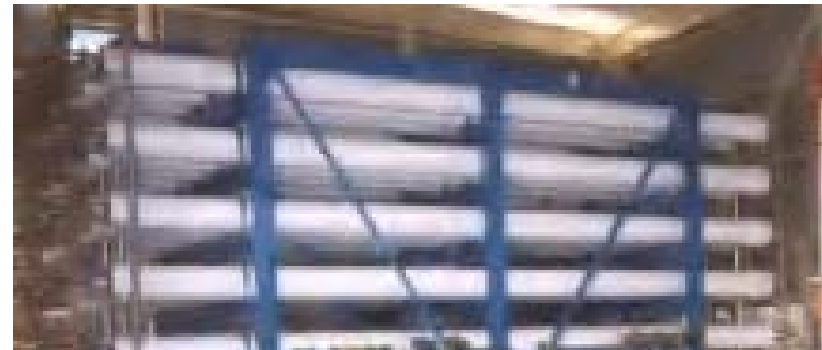
Toray has supplied membranes for 21 IMS plants in the world, and its total capacity exceeds 1,000,000m³/d. 10 plants of 21 IMS plants adopted Toray's membranes for all membrane process in the IMS plant..



SWRO Plant (IMS Case 1)



MF Pretreatment Unit
(3,000 m³/d)



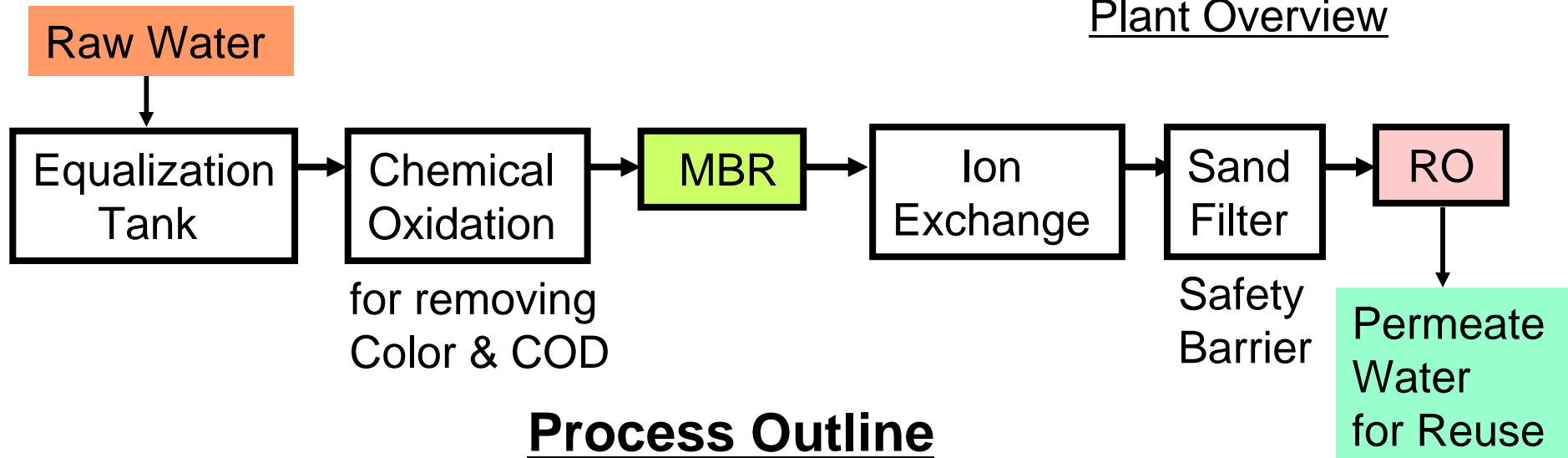
SWRO Unit (1600 m³/d)

Tirupur Textile WW Reuse Project (India) (IMS Case 2) (Under construction)

- Industrial WW Reuse
- Product Water Output: 9,000m³/d
- Membrane Module :
TMR140-100S x 128 units
(MBR Capacity:11,200m³/d)
- RO Elements:
TML20-400 x 600pcs



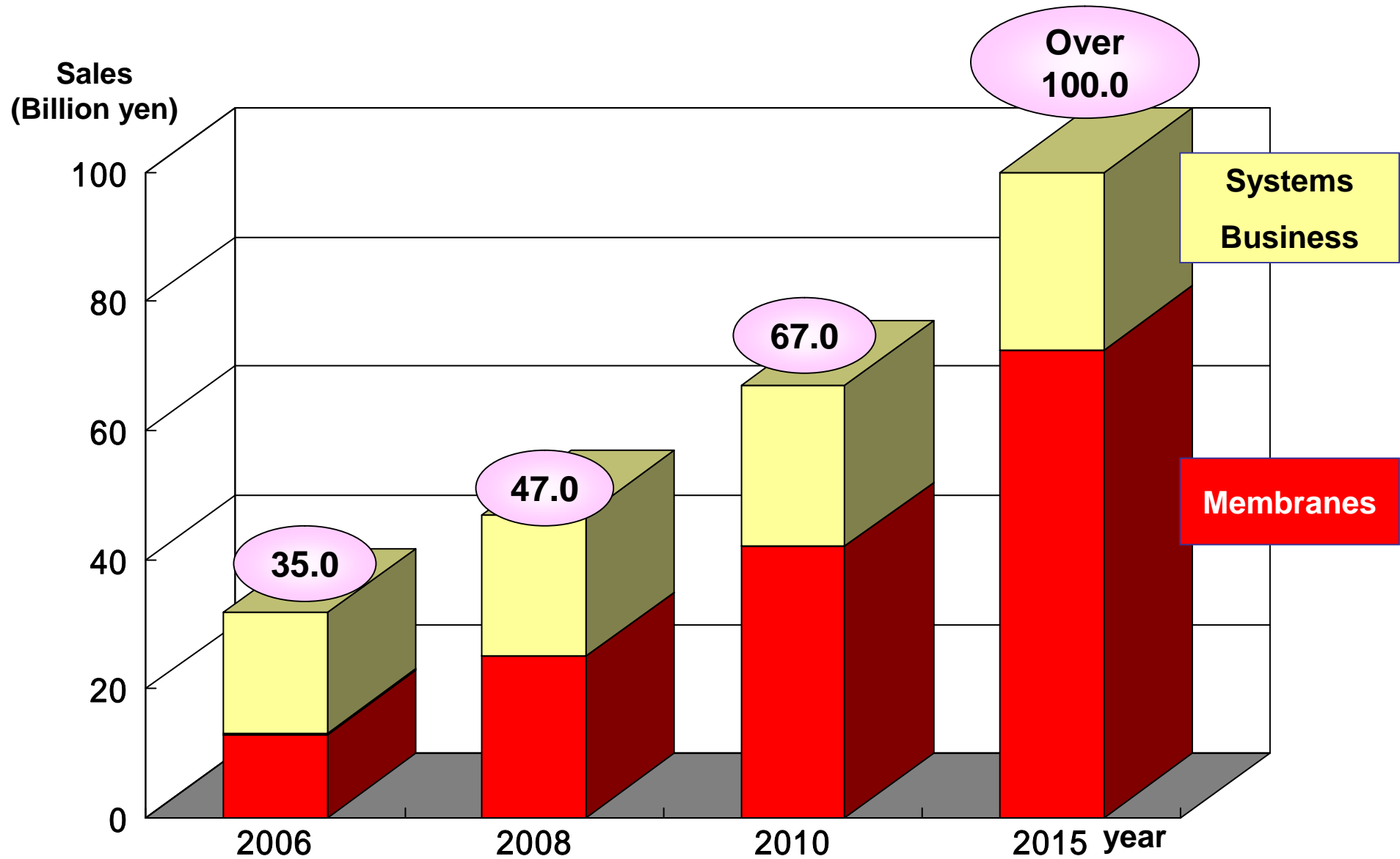
Plant Overview



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Business Plan of Toray's Water Treatment Business



Target - Over 100 Billion Yen Sales Amount and 10 Billion Yen Sales Profit in 2015

Toray Receives 2008 Humanitarian Award from the United Nations Association of New York

The 2008 Humanitarian Award was in recognition for Toray's environmentally friendly business activities and CSR activities targeting climate change prevention and sustainable social growth.

Humanitarian Award from the United Nations Association of New York (UNA-NY)

Each year the UNA-NY presents Humanitarian Awards to corporations, individuals and organizations that have made significant contributions in specific fields. The theme for each year's awards is based on one of the eight Millennium Development Goals adopted at the United Nations Millennium Summit in 2000. Past recipients include UNICEF and the GE foundation. The theme of 2008 was "Environment and Climate Change". The other recipients this year were UN Secretary-General Mr. Ban Ki-moon, and Mr. Olafur Ragnar Grimsson, President of the Republic of Iceland.

Background for winning the award

In recognition for Toray's environmentally friendly business activities such as Water treatment business and carbon fiber composite materials for reducing global heating gas, as well as for CSR activities such as energy saving measures and betterment of workplace.



President Sakakibara with UN Secretary-General Ban Ki-moon, who was also an award recipient

Toray is committed towards fulfilling the role expected of it by the society, striving for the development of a recycle-oriented society that enables sustainable growth by exploiting cutting-edge technology and backed by the "power of chemistry".

Descriptions of predicted business results, projections, and business plans contained in this material are based on predictive forecasts of the future business environment made at the present time.

The material in this presentation is not a guarantee of the Company's future business performance.

'TORAY'
Innovation by Chemistry