TECHNOLOGY of REVERSE OSMOSIS DESALINATION

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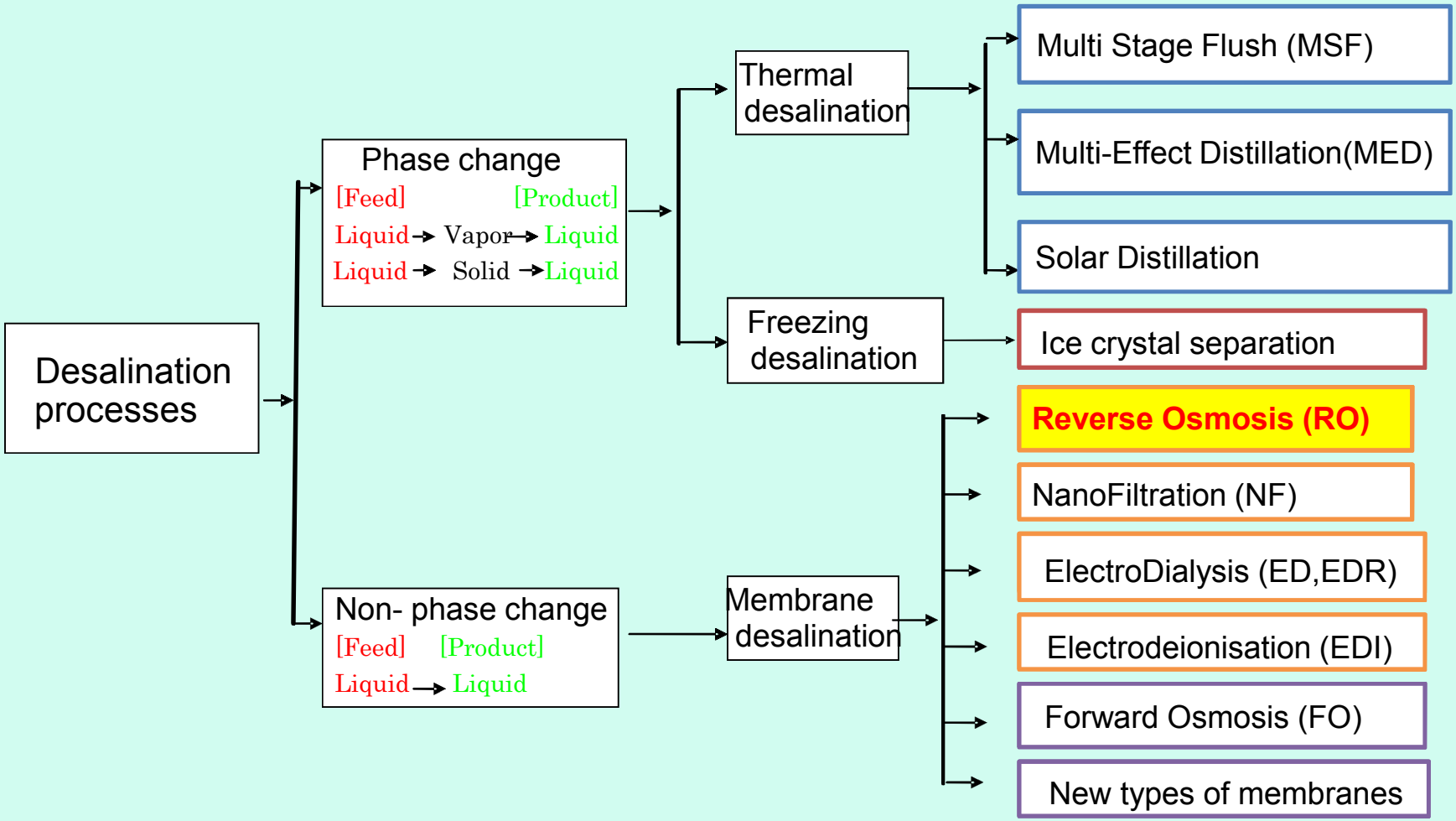
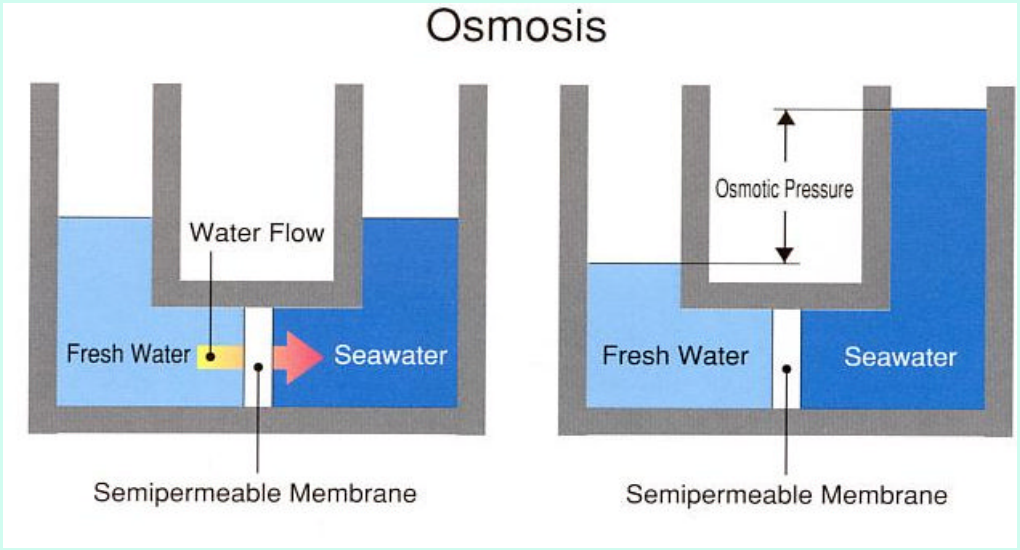
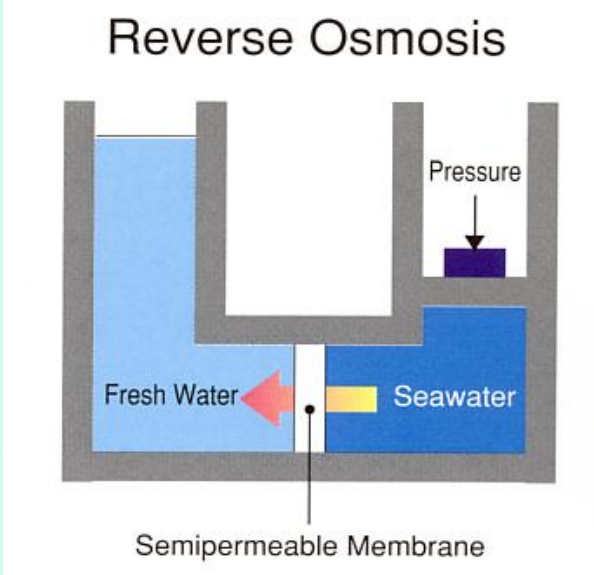
CONTENTS

Classification of Desalination Technologies

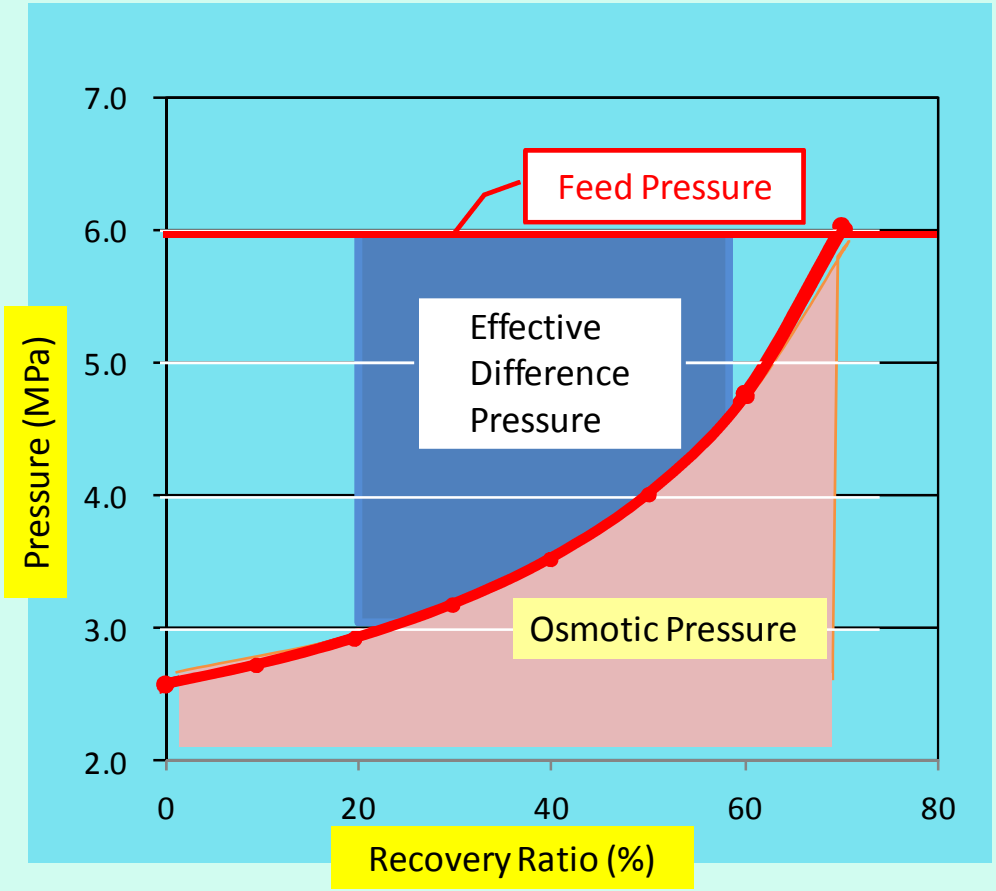


Phenomenon of Reverse Osmosis



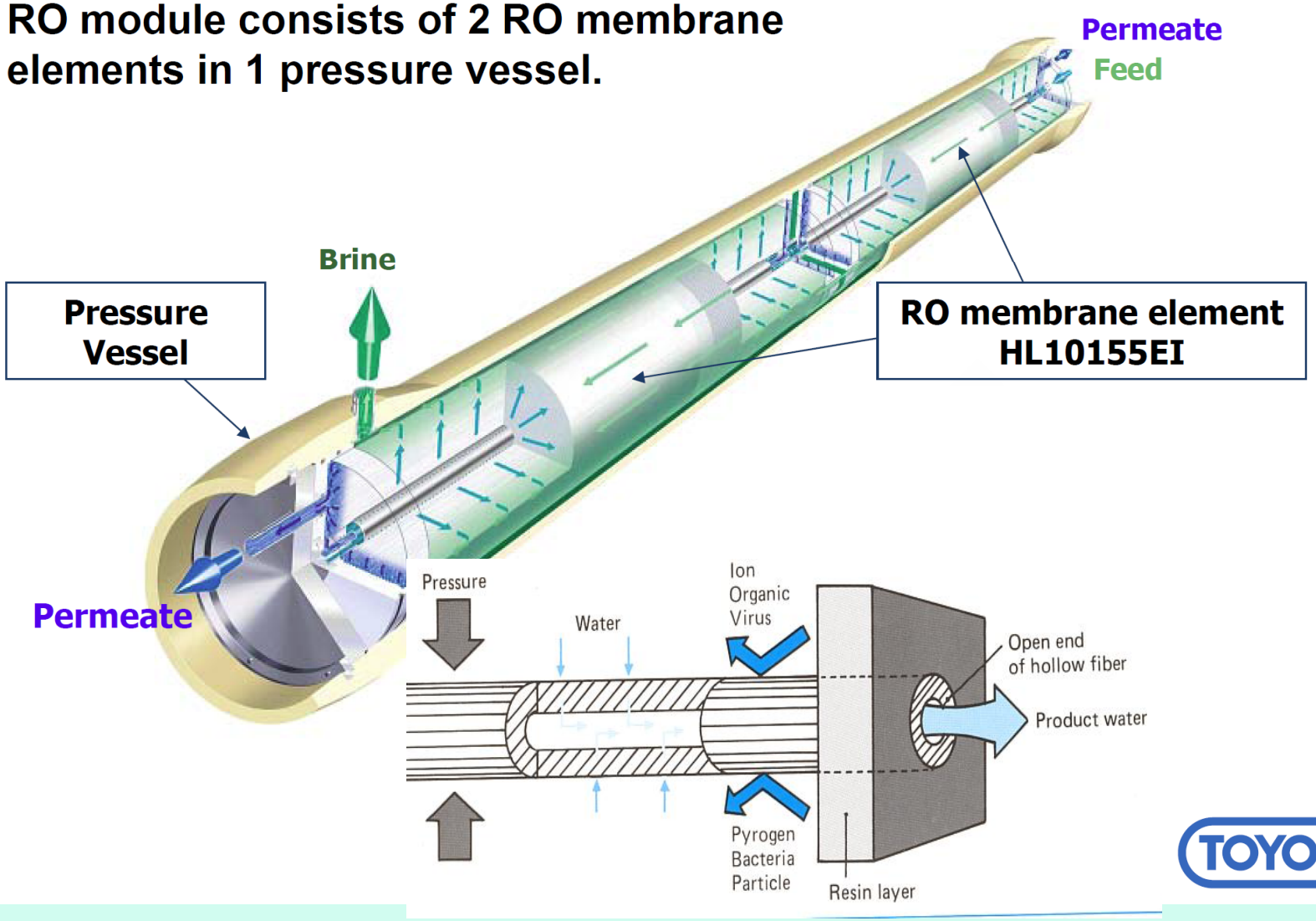


Relations of pressure and the water recovery in the RO system

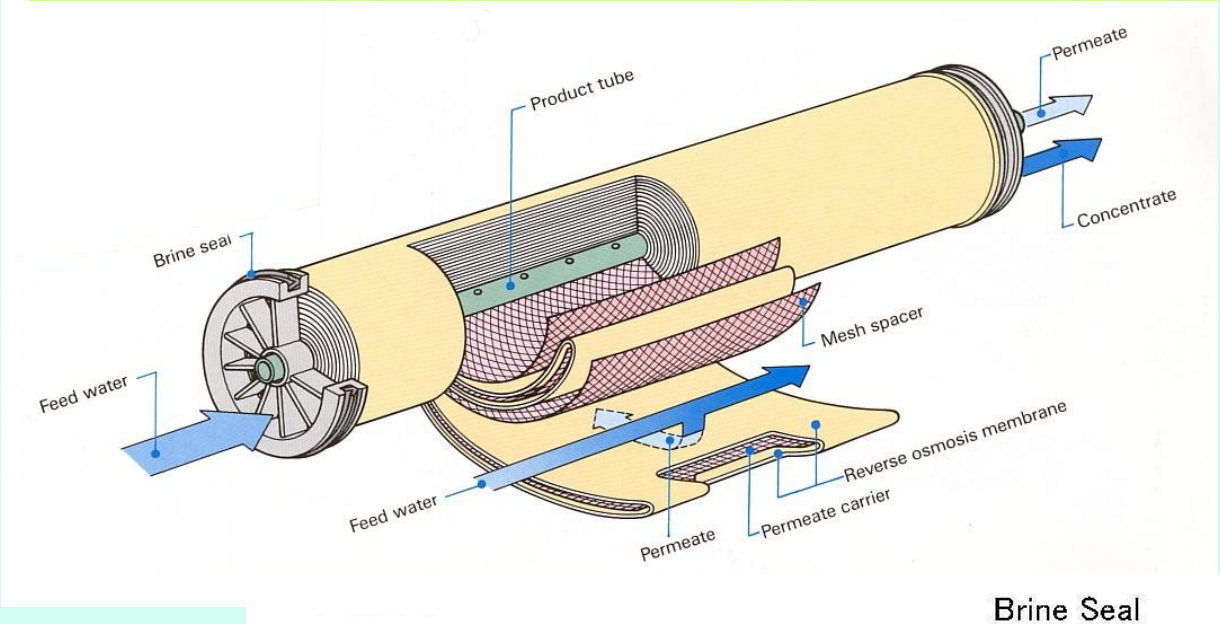


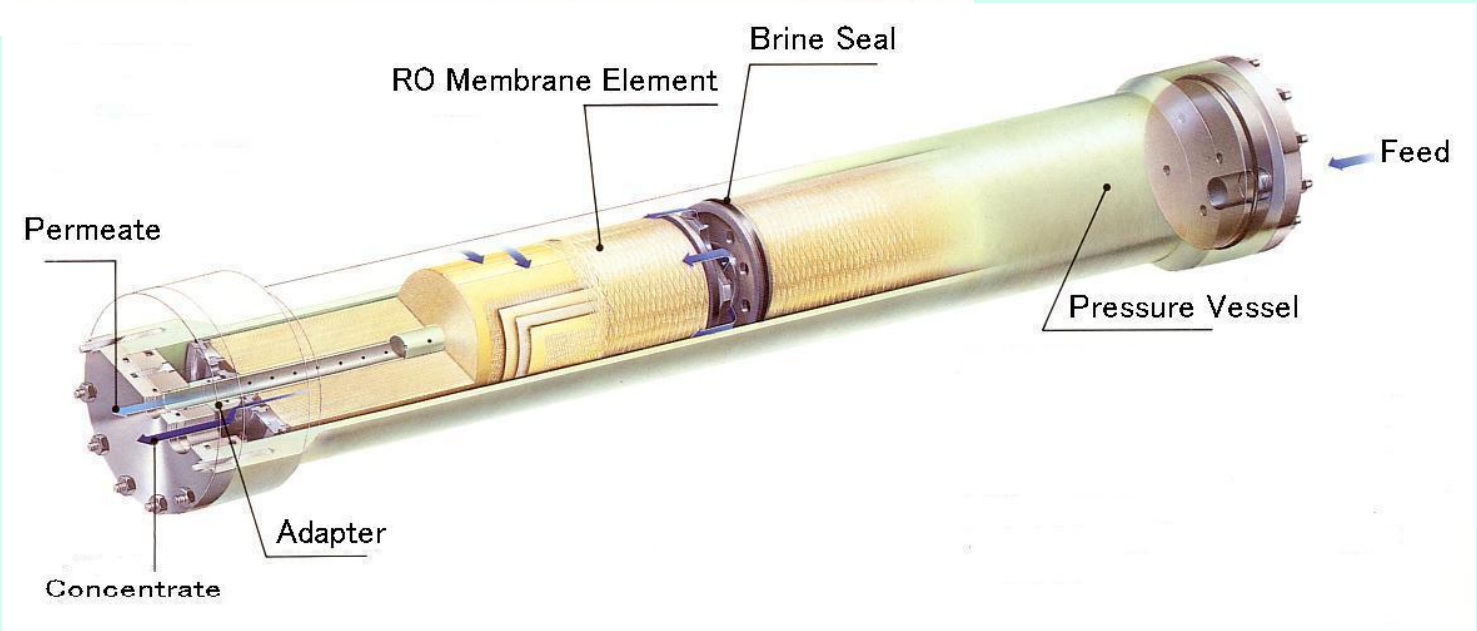
Structure of Hollow Fiber RO Membrane Module

RO module consists of 2 RO membrane elements in 1 pressure vessel.

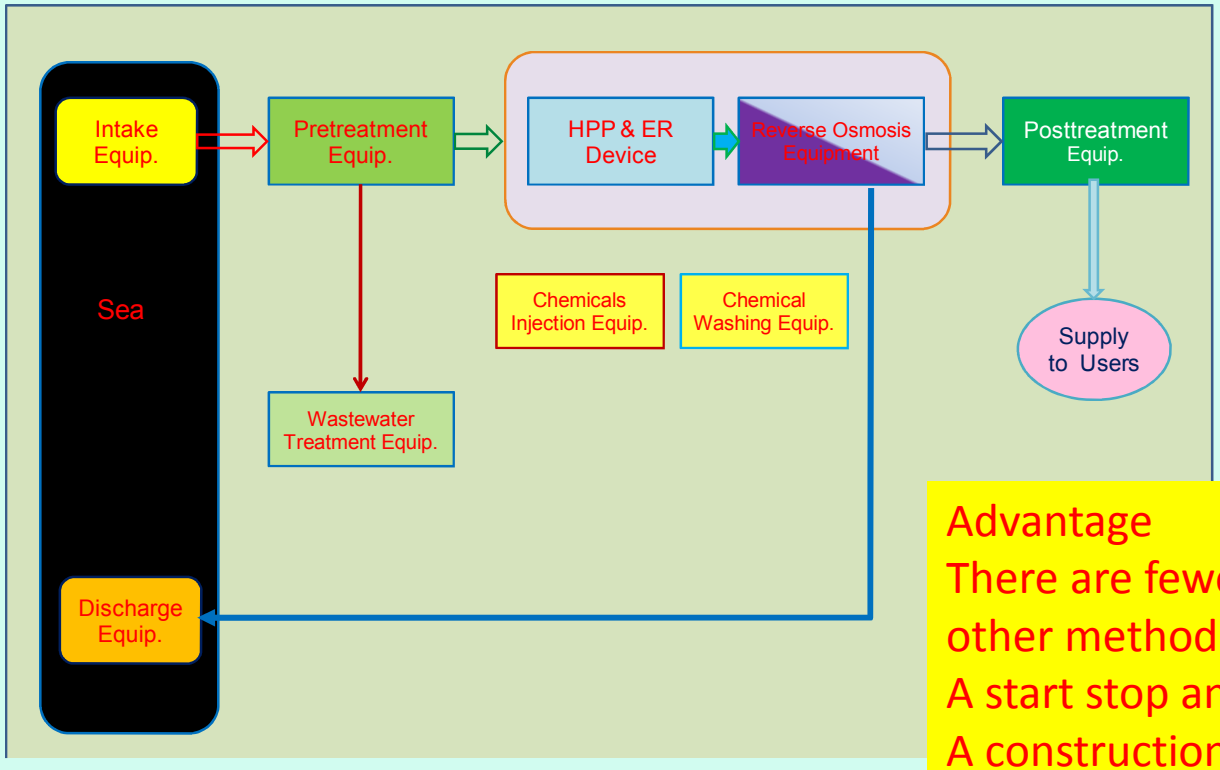


Structure of Spiral Wound RO Membrane Module





Flow Diagram for Reverse Osmosis Desalination Plant



Advantage
There are fewer energy consumptions than other method.
A start stop and control is easy.
A construction period is short.
Because it is driven at normal temperature, there is little corrosion.

Fault
Operating pressure depends on seawater temperature and the density.
Exchange of membrane is necessary.
Pretreatment is necessary
There is membrane degradation by fouling.

History of Development of Main Technologies for RO desalination

Items	Year	1953	1960		1970		1980		1990		2000		2006		2013		Reference
		Conceptual design by Dr. Reid at 1953															
Material	CA																by WRPC
	CTA																
	PA																
	APA																
Structure	SM																
	ASM																
	CM																
Type (system)	SW																
	HF																
Stage	One																
	Two																
	More than Two																
For Sales		JAPAN,1978 -															

CA	Cellulose Acetate	SM	Symmetric Membrane	SW	Spiral Wound
CTA	Cellulose Tri-Acetate	ASM	Asymmetric Membrane	HF	Hollow Fiber
PA	Polyamide,	CM	Composite Membrane	One	Single stage or One Pass
APA	Aromatic polyamide			Two	Double Stage or Two Pass

History of Desalination(WRPC)

Establishment of Water Reuse Promotion Center.

In 1973, Water Reuse Promotion Center is organized and will push forward technology development of seawater desalination and the waste-water treatment reuse.

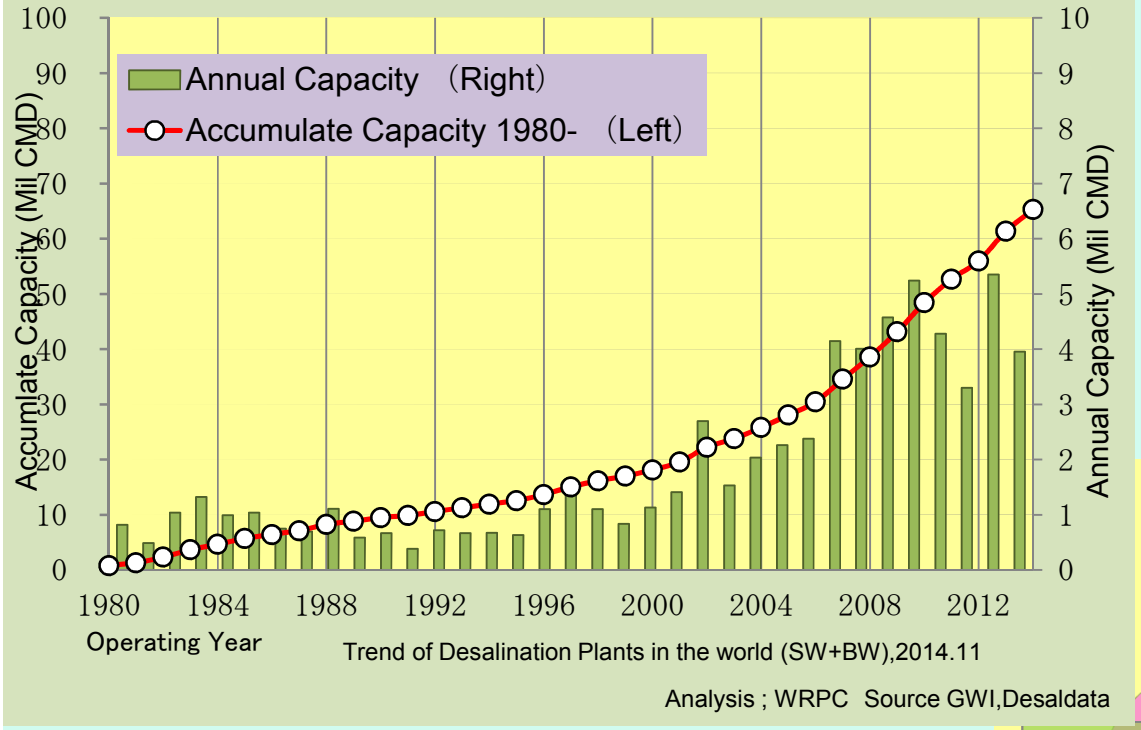
Development on Chigasaki facility (WRPC)

It was started in Chigasaki research facility, at 1974.

The seawater desalination technology development was pushed forward mainly on the practical use of the Japanese membrane.

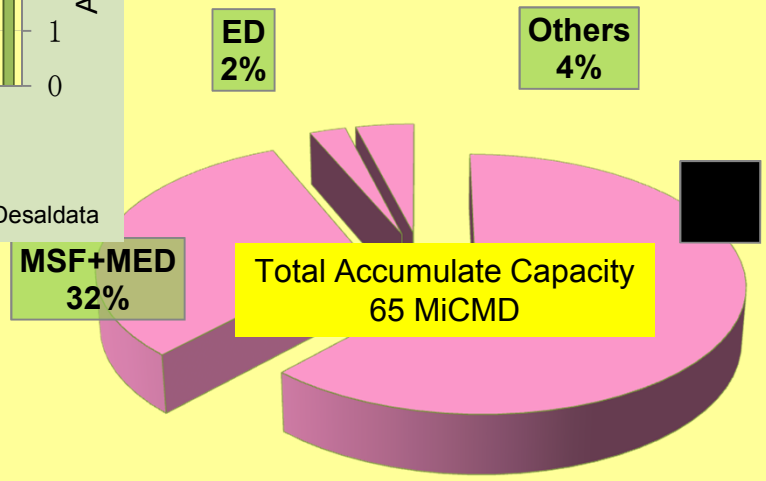
Anther technology development of the pretreatment system, energy recovery system, and membrane filtration system, etc,.

Trend of Desalination Plants in the world (SW+BW)



Trend of Desalination Plants in the world (SW+BW),2014.11

Analysis ; WRPC Source GWI,Desaldata



Ref;

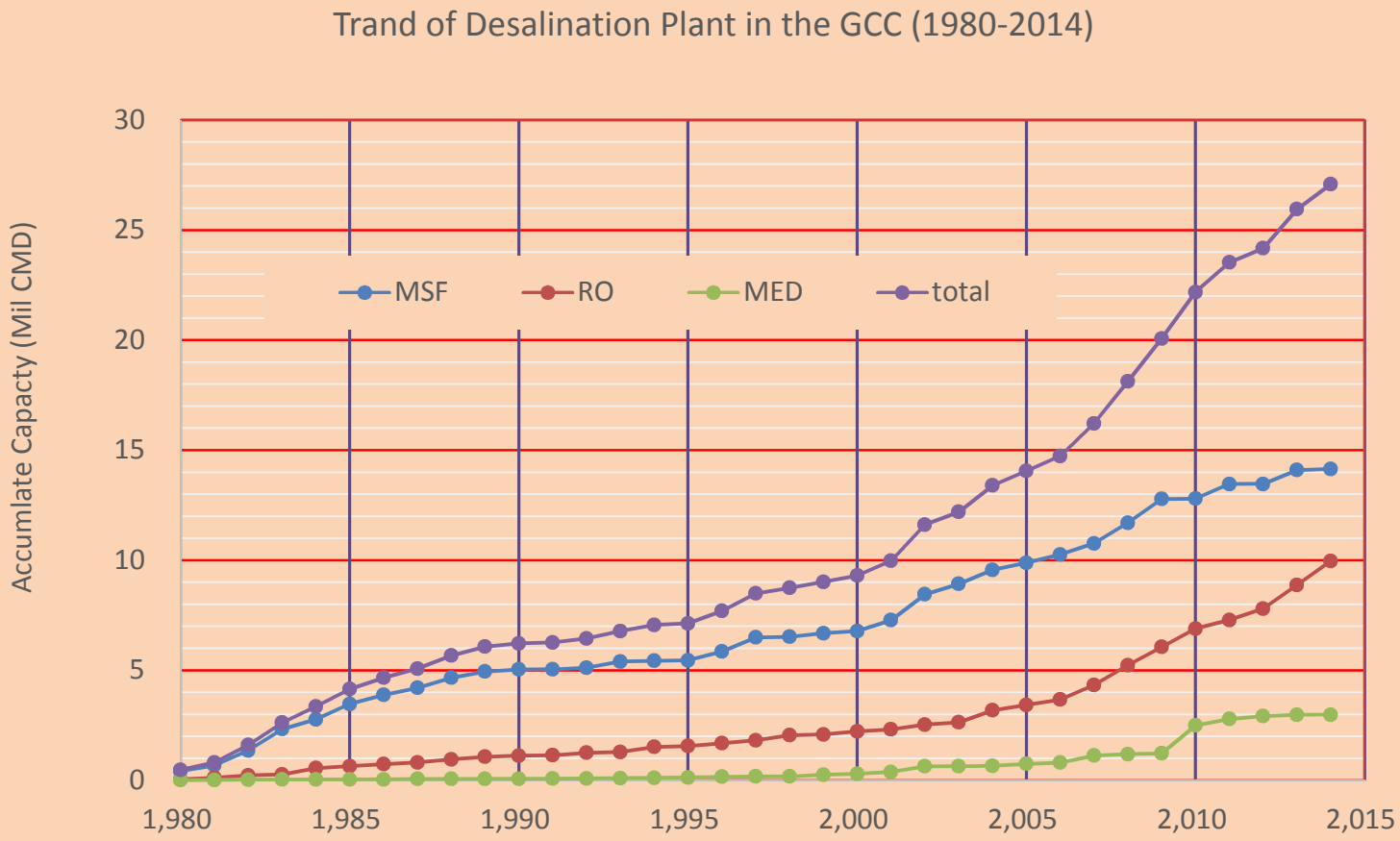
Technology of desalination in the world(SW＋BW)； 1980-2014 (2014.11現在)

Analysis by WRPC Source; Desaldata,GWI

SW: Seawater

BW: Brackish

Trend of Desalination Plants in the GCC (SW+BW)



Ref;
SW: Seawater
BW: Brackish Water

Analysis ; WRPC, Souce ; GWI, Desaldata

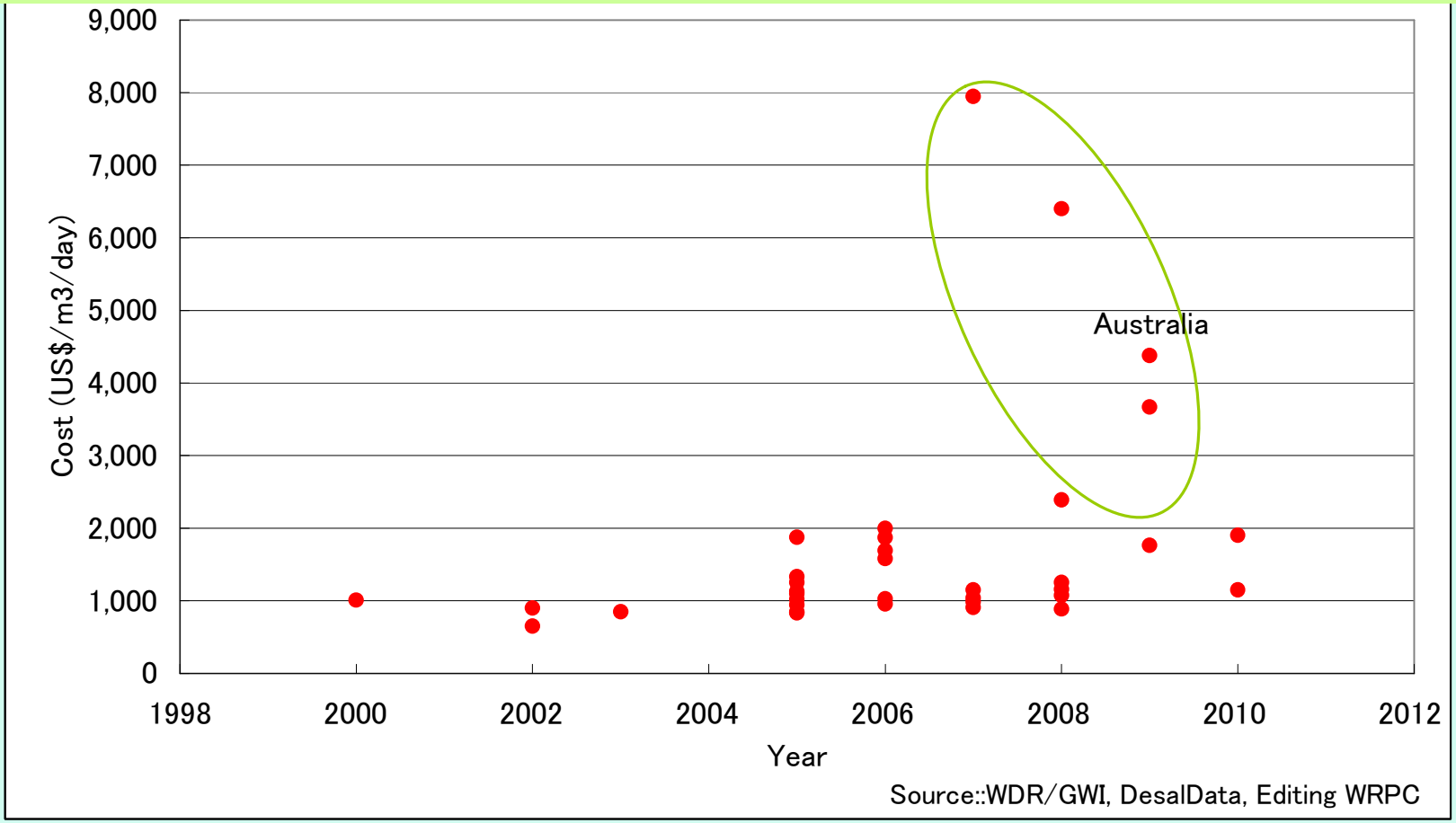
Energy Recovery Systems for RO Seawater Desalination

Source of Energy	Recovery Method	Type of Recovery Equipment
Back Pressure of Brine	Axle (Revolution) Power Recovery	Reverse Running Pump (Francis Turbine)
		Pelton Turbine
		Hydro-Turbo Charger
	volume exchange Recovery	Pressure Exchanger
		Work Exchanger

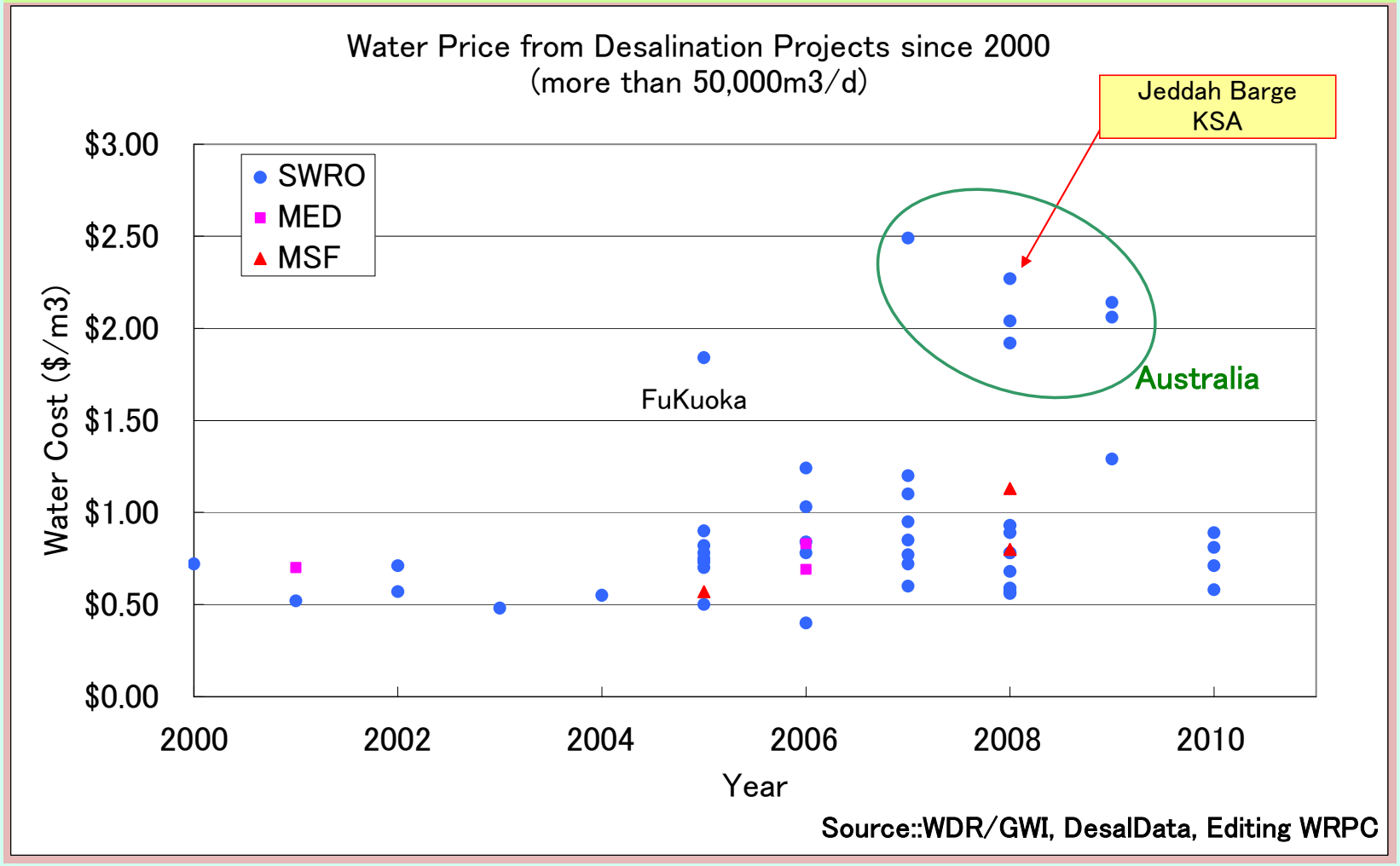
Example of Water Quality of RO Desalination

	Feed in mg/L	Permeate in mg/L	System % Rejection
Calcium	282	0.5	99.88%
Magnesium	850	1.5	99.88%
Sodium	6,670	55	99.46%
Bicarbonate	81	2.0	98.36%
Sulfate	1,800	3.1	99.88%
Chloride	13,300	97	99.52%
Bromide	48	0.41	99.44%
Boron	3.7	1.1	77.27%
TDS	23,064	161	99.54%
Conductivity uS	37,800	365	
pH	6.6	5.1	

CAPITAL COST OF DESALINATION PLANT IN THE WORLD



WATER COST OF DESALINATION PLANT IN THE WORLD



Cooperation project of Seawater Reverse Osmosis Desalination by WRPC & Middle East

CASE 1 2002-2005
Research and development of Seawater Reverse Osmosis Desalination in Oman

Sultan Qaboas University, Oman
&
Water Reuse Promotion Center, Japan

CASE 2 2003-2007
Seawater Reverse Osmosis Desalination for Hybrid System Application in Qatar
Qatar Electric Water Co.
and
Water Reuse Promotion Center

CASE 3 2006-2011
Development of Tri-hybrid NF/RO/MED Desalination System in Saudiarabia
Saline Water Conversion Corporation
&
Water Reuse Promotion Center, Japan

Other Activities of WRPC on Overseas (Recently)

- **Feasibility Study on Wastewater Reuse in Middle East (Qatar)**
- **Feasibility Study on Rehabilitation of Water Environment and Water Circulation.(Venezuela)**
- **Study on Technical Support of Introduction of Production Water Treatment for Oil Industry in the Republic of Iraq (2010-2012)**
- **Study on Technical Support of Introduction of Formation Water Treatment for Oil Industry in the Republic of Iraq(2013-)**
- **The Training Course Program "Desalination Technologies and Water Reuse" For the Ministry of Electricity and Water, Kuwait.(2013)**

THANK YOU FOR YOUR ATTENTION!

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