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SMART HEALTHCARE ENGINEERING

Empowering Engineers for Better Healthcare

Desalination and Water Treatment

Tuesday, July 16th
Federico Leon Zerpa

2023-1-RO01-KA220-HED-000159985

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Universitatea Transilvania din Brașov

MANISA CELAL BAYAR ÜNİVERSİTESİ

Hospital Universitario de Gran Canaria Doctor Negrín

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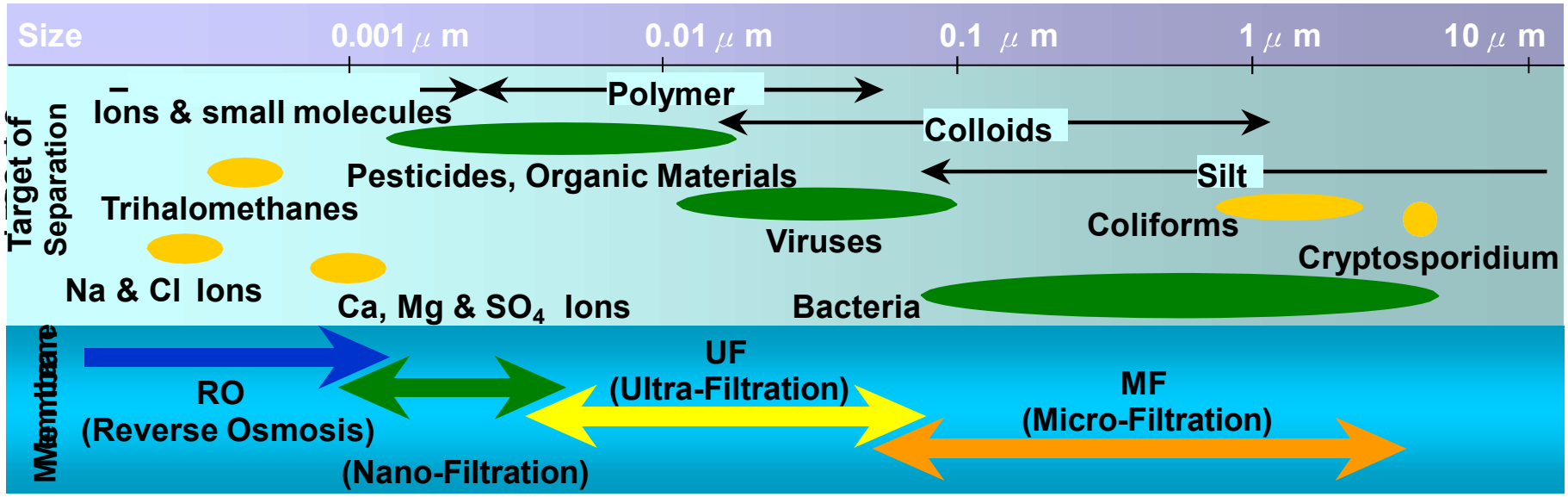
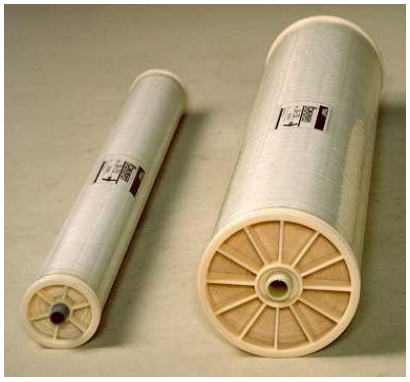
Desalination Membranes





RO/NF for Desalination
"ROMEMBRA"

UF - HF Membrane
Submerged (PVDF

UF - HF Membrane
"Torayfil (PVDF)"

MF for MBR
"MEMBRAY"

The most extensive membrane portfolio in the water treatment industry

159985

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Applications

1. **Drinking Water Production (Municipal & Private)**

2. **Waste Water Reuse (Tertiary Treatment)**

3. **Seawater Desalination (RO Pretreatment)**

4. **Industrial Water Treatment (Boiler Water, Beverage)**

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Synergy of RO, MF/UF and MBR

Combination of Membrane Process have become Common

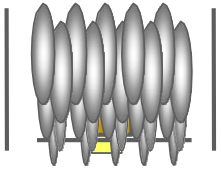
Seawater Water

MF/UF

RO

Drinking Water

Waste Water



WWT Plant

MF/UF

RO

Reuse

MBR

Planning

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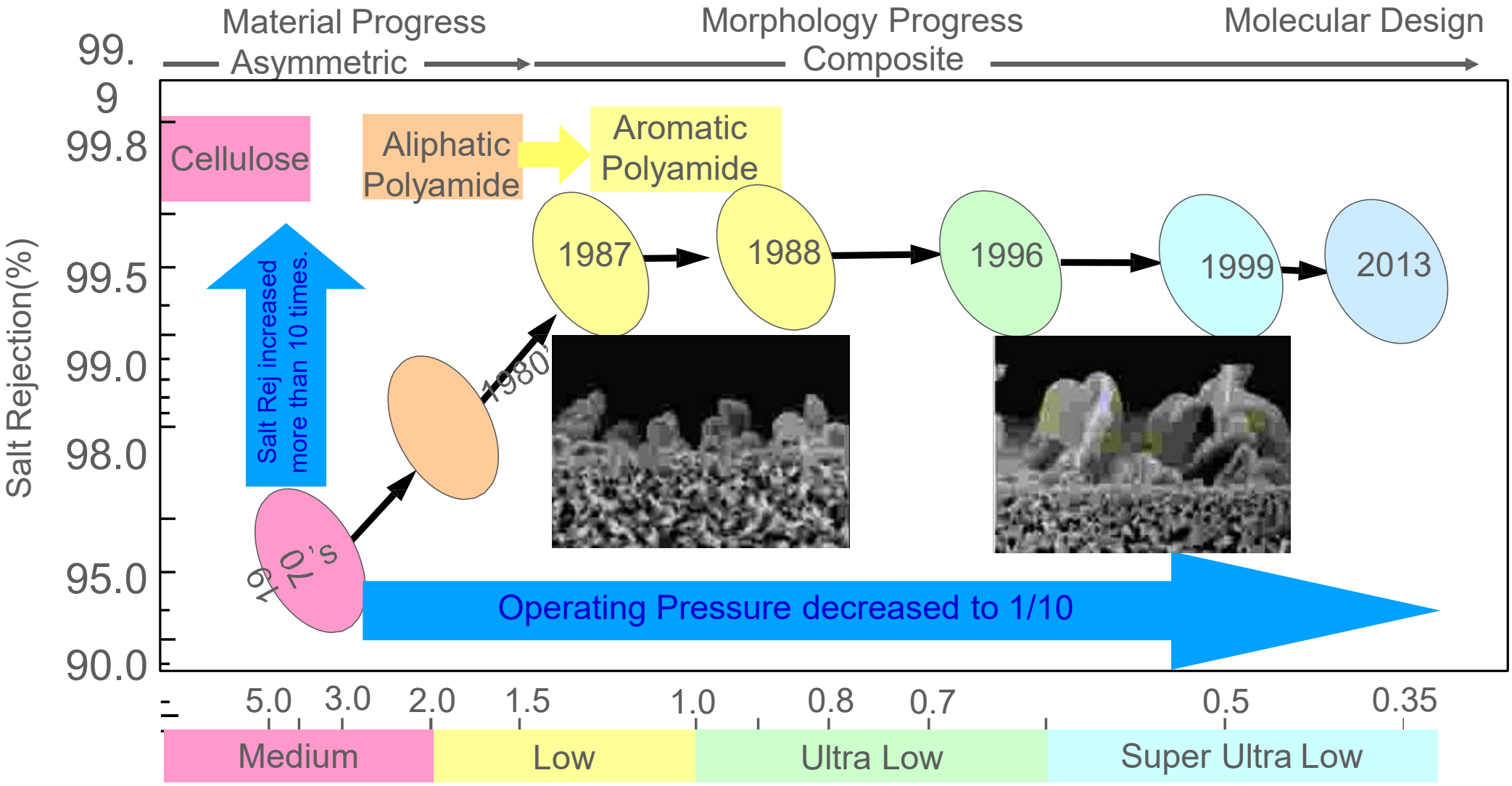
Highest Rejection & Product Flow Product in the Market



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Brackish water membranes
High Rejection & Low Pressure

Module-Type	Permeate Flow [m^3/d]	Rejection [%]	Test Conditions at 25°C Remarks
TM720L-400	32.0	99.5	2'000 ppm NaCl 1.0 MPa
TM720-370	36.0	99.75	2'000 ppm NaCl 1.55 MPa **34 mil spacer**
TM720-400	39.0	99.75	
TM720D-400	**41.6**	**99.80**	
TM720D-440	**45.8**	**99.80**	
TM720-440	42.0	99.75	
TM740-160	159.0	99.75	
TM710	8.3	99.75	
TM720C-430	33.3	99.20	pH 10, boron rej. 95%

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Sea water membranes

Module-Type	Permeate Flow [m³/d]	Rejection [%]	Type	Test Conditions at 25°C
TM820C-400 TM820C-370 TM810 (4")	25.0 23.0 4.5	99.75	Standard Element	32'000 ppm NaCl 5.5 MPa
TM820E-400	28.3	99.75	Standard Element	32'000 ppm NaCl 5.5 MPa
TM820V-400 TM820V-440	34.1 37.5	99.80	Low Pressure, High Flow & Rej.	32'000 ppm NaCl 5.5 MPa
TM820R-400 TM820R-440	32.2 35.6	99.80	Med. Pressure, High Rej.	32'000 ppm NaCl 5.5 MPa

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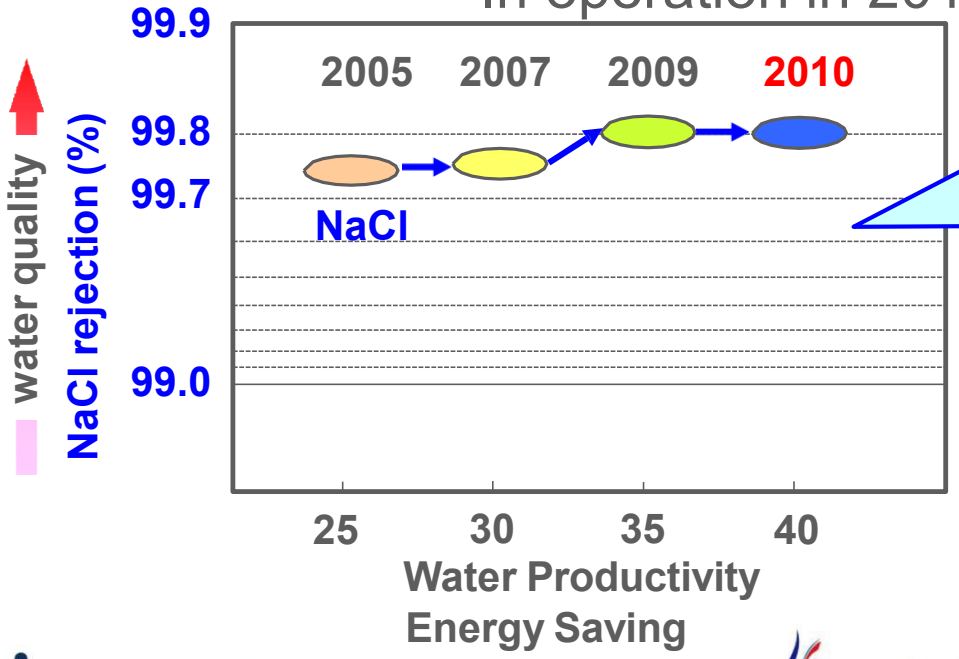
World's Largest SWRO Plant in Magtaa, Algeria

Huge SWRO plant on the Mediterranean Sea

- 500,000 m^3/day capacity
- Single-stage RO treatment system
- High temperature, salinity and boron concentration
- In operation in 2013



Advanced energy-saving and extremely high rejection SWRO, TM820R is adopted.

" WATER DESALINATION REPORT"
4 March 2013 published "New 'world's largest swro' nears Startup" by Hyflux spokesperson.

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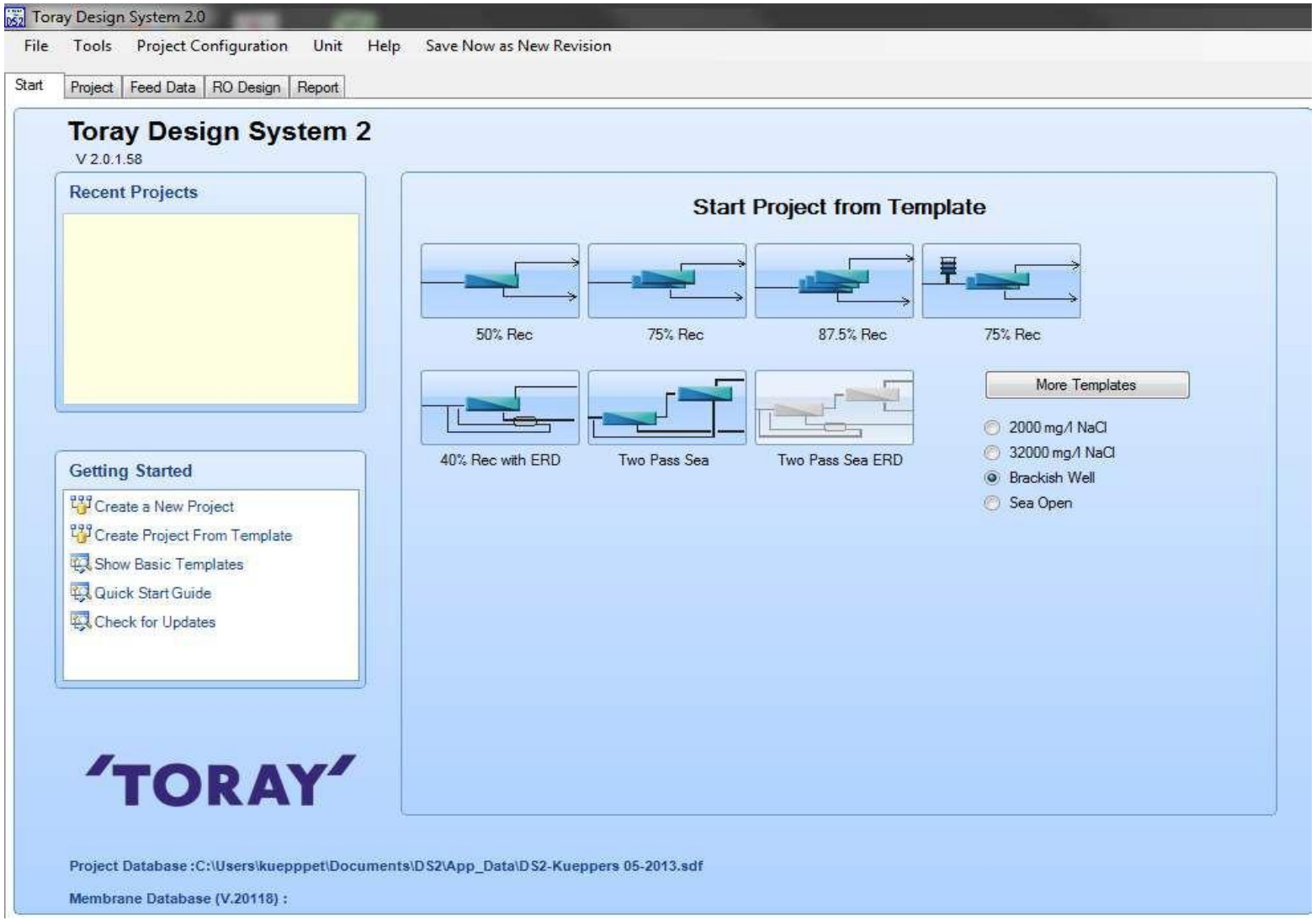
Design Program TDS2



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“ROPUR “RPI Scale Inhibitors

Ratings chart is based on equal concentration of antiscalant in RO brine

BW = Brackish water
SW = Sea water

ROPUR antiscalants	RPI 2000	RPI 2800	RPI 3000A	RPI 4000A	RPI 4500A	RPI 4900	RPI 5000A	RPI 6000	RPI 7000
Feedwater source	BW/SW	SW	BW/SW	BW	BW	BW/SW	BW	BW	BW
$CaCO_3$	✱✱✱	✱✱	✱✱✱	✱✱✱	✱✱	✱✱	✱	✱✱	✱✱
$CaSO_4$	✱✱	✱	✱✱✱	✱✱✱	✱✱	✱✱	⊙	✱✱✱	✱
$BaSO_4$ / $SrSO_4$	✱	⊙	✱✱✱	✱✱✱	✱✱	✱✱	⊙	✱✱	✱
SiO_2	○	○	○	⊙	✱	⊙	✱✱✱	•	✱✱
CaF_2	⊙	○	✱	✱✱	⊙	✱✱	○	✱	⊙
$Ca_3(PO_4)_2$	✱	⊙	○	⊙	✱	•	✱✱	○	✱✱✱
Fouling Inhibition	✱	✱✱	✱	⊙	•	○	✱	•	✱✱✱
Fe / Mn	⊙	⊙	✱✱	✱✱✱	✱✱	✱✱	✱✱	⊙	✱✱✱

✱✱✱ *Excellent* ✱✱ *Very Good* ✱ *Good* ⊙ *Fair* ○ *Limited* • *Not Effective*

UNE-EN regulation:

- UNE-EN 15039:2007
- UNE-EN 15040:2007
- Approval by the German “Umwelt-Bundes-Amt” to be used in potable water production by Reverse Osmosis
- Highly effective on poorly soluble Silica ($MgSiO_2$), resulting in concentrate saturation of up to 250 mg/l
- Up to 15000 ppm Calcium Sulfate saturation
- High performance scale inhibitor for Calcium Phosphate and Fe / Mn

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Desalination in Canary Islands

- Canary Islands are in the Atlantic Ocean, inside Spain and UE, however with strong relations between three continents: Europe, Africa and America.

- Desalination in Spain started in Canary Islands, where started up the first Sea Water Desalination Plant for Drinking Water in 1965 with 2,500 m3/day. It was the beginning of Desalination in Canaries and in Spain. Nowadays in Canary Islands there are more than 300 RO Desalination Plants producing around 660,000 m3/day.

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Desalination in Canary Islands

- Moreover, this production will be increased with new desalination plants and extensions in Canaries, therefore the quantity of water produced by Desalination will increase more than threse 660,000 m3/day very soon. Mostly water consumption comes from Desalination RO Plants in Canary Islands, between 80%-100%.

- Therefore, the longest experience of Spain operating desalination plants is in Canary Islands. In fact there are many desalination plants with Toray membranes working since more than 30 years ago: Maspalomas II, Las Palmas III, Adeje Arona, Roque Prieto I & II, etc.

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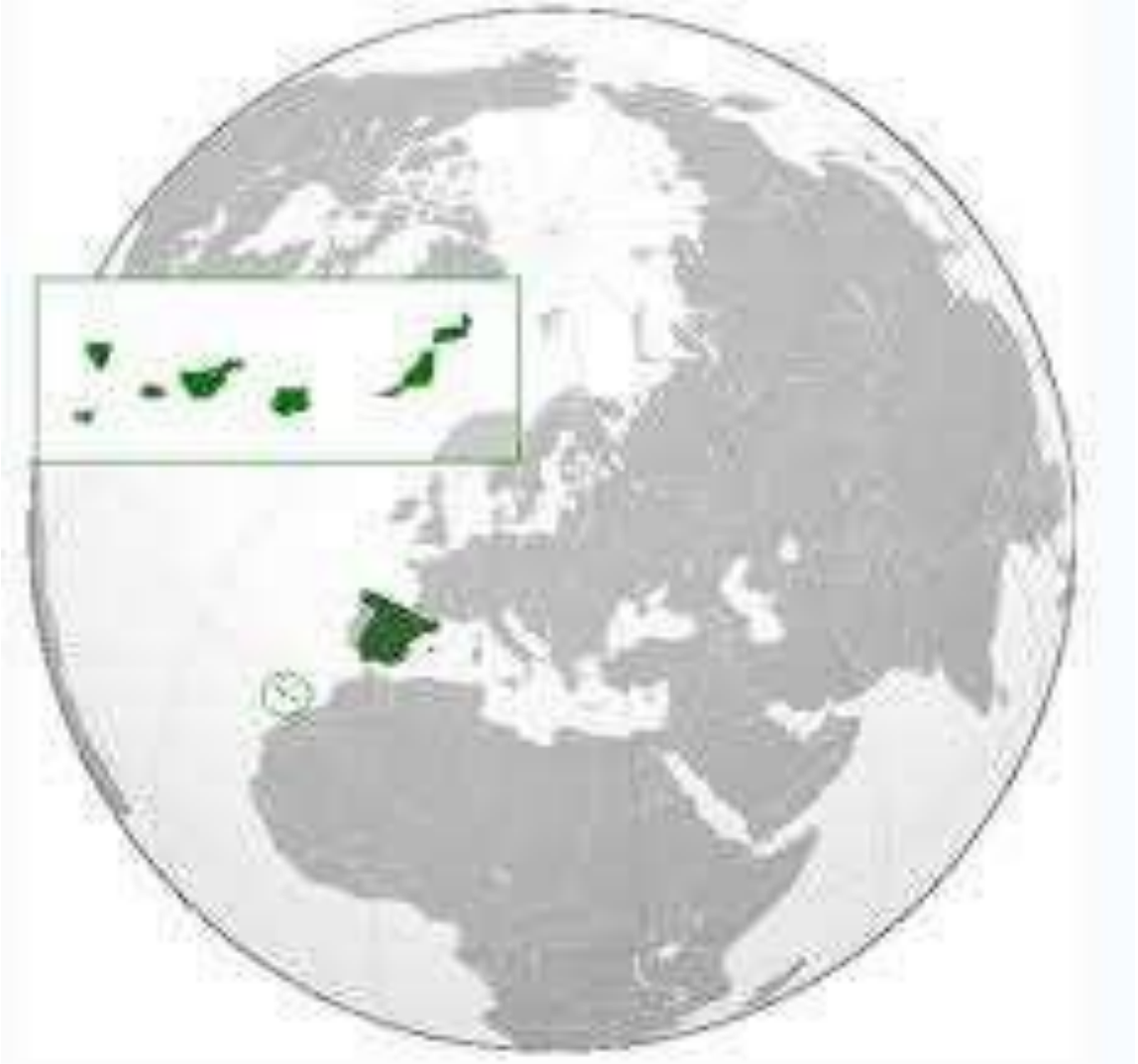
Canary Islands situation in the world



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Canary Islands situation in the world

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Maspalomas II, Canary Islands (40,000m3/d)

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Maspalomas II SWRO Plant / Spain (22,000m3/d)

(Operation Started in 1998 with Brine Conversion System)

" Long term reliable operation experience with
BCS (Brine Conversion System) SWRO "

-Capacity : 22,000m3/d

-10years reliable operation with BCS retrofit

-Toray's membrane is replaced competitor's membrane

-Membrane Type

1st stage : SU-820, 2nd stage :SU-820BCM

(for ultra HP operation : <9.8MPa)

-No Boron regulation

- Recovery Rate : 60% (Total)

BCS (Brine Conversion System)

Conventional SWRO (40% Rec.)

No. 1 Plant 4,500 (m^3/d)

No. 2, 3 Plant 9,000 (m^3/d)

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Las Palmas III, Canary Islands (80,000m3/d)

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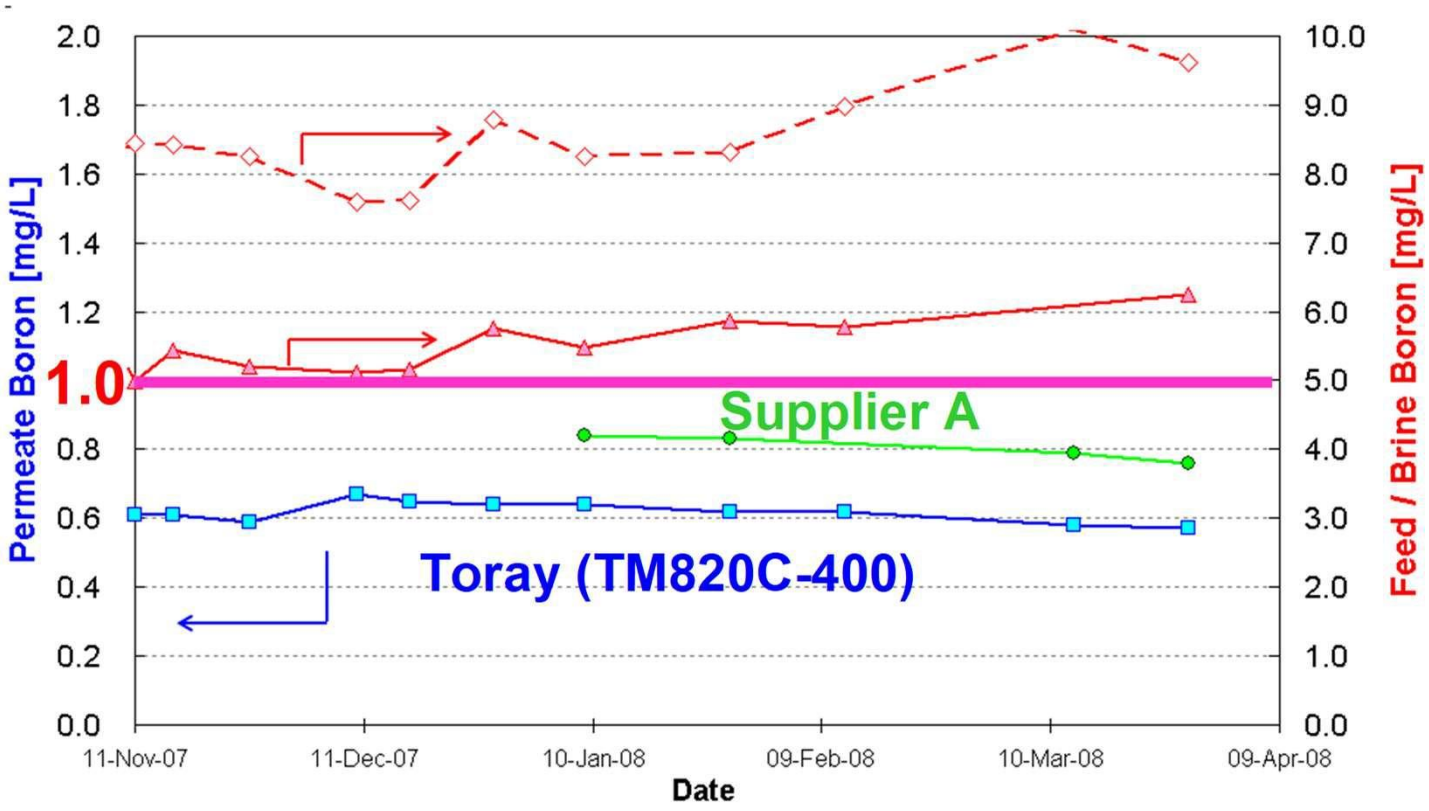
Las Palmas III SWRO Plant / Spain (80,000m3/d)

“ SWRO membrane having high Boron rejection and durability “

“ Stable and good Boron concentration of permeate (<0.7mg/l) “



Actual Product, RO Feed and RO Brine Boron vs. Time

-Capacity : 80,000m3/d (total)
-Three major RO membrane supplier's products are installed in this plant.
- **SWRO membrane** having high B rejection was installed in 1st stage of one train in Oct. 2007.
- Membrane Type : **TM820C-400**
- BCS is applied for high recovery rate.
Recovery Rate: Total 55%
1st Stage 40%
-Actual Boron concentration : < 0.70mg/l

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Adeje Arona, Canary Islands, 30’000m³/d

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Roque Prieto I & II, Canary Islands, 10’000m³/d

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Canary Islands, 660’000m³/d

Red Points: Under Construction
Green Points: Operating

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Desalination in Spain

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