

Aigua i Indústria Química: Necessitats i solucions



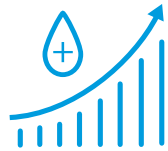
Dr. Guillem Gilabert-Oriol

January 31, 2023

Col·legi d'Enginyers de Catalunya – Tarragona



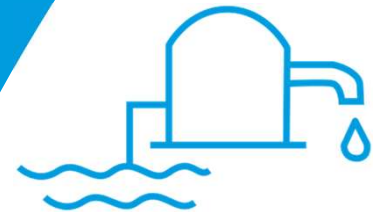
Rise of desalination



Population growth
and **climate change**
continue to place demands
on limited freshwater
resources.



By 2050, **30% more water**
needed to keep up with rising
population and **400%**
more water needed for
manufacturing.



Desalination

is fast becoming a safer
investment for
securing water supply.

Reverse Osmosis vs Thermal Desalination

- Membrane based desalination can save more than 55% energy compared to thermal processes

Membrane process



3 kWh/m³

Thermal process

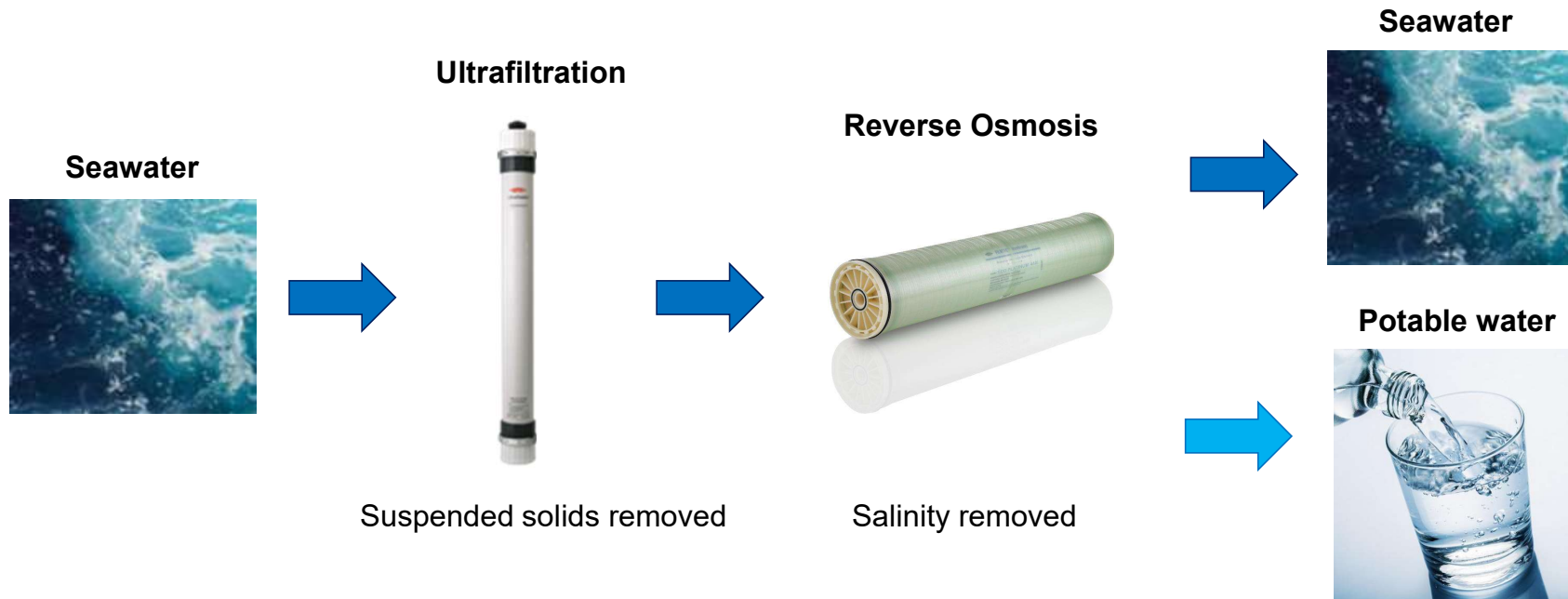


7-10 kWh/m³

Source: "Water Desalination: History, Advances, and Challenges - Manish Kumar, Tyler Culp, and Yuexiao Shen." National Academy of Engineering. 2017.
Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2016 Symposium

Desalination Installation

- A typical desalination plant has a system to remove suspended solids and a membrane step to reduce salt content
- Uses energy recovery device to minimize energy consumption



Desalination Facts

Is it expensive?

- The cost of desalinating water for a family of 4 people for a year equals the cost of a refrigerator for one year



1 L = 0.50 €



1 L = 0.002 €
(1,000 L = 2 €)



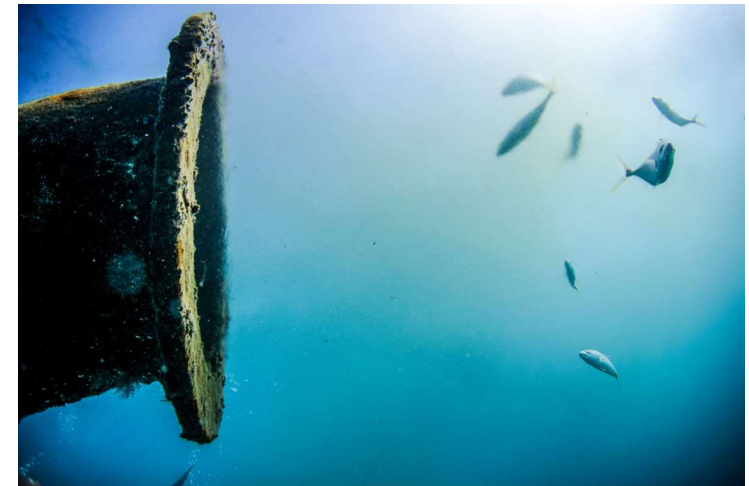
1 L = 0.0005 €
(1,000 L = 0.50 €)



Desalination = $3 \text{ kWh/m}^3 \cdot 0.15 \text{ €/kWh} = 0.50 \text{ €/m}^3$
Refrigerator = $400 \text{ kWh/y} \cdot 1 \text{ y} / 365 \text{ d} \cdot 0.25 \text{ €/kWh} \cdot \text{d} = 100 \text{ €/y}$
Desalinated Water = $4 \text{ person/d} \cdot 140 \text{ L/person} \cdot 365 \text{ d} \cdot 0.0005 \text{ €/L} = 100 \text{ €/y}$

What about the discharge?

- Brine has a bit less than twice the concentration of seawater
- With a proper mixing, it is just seawater returned to the sea
- It can be valorized

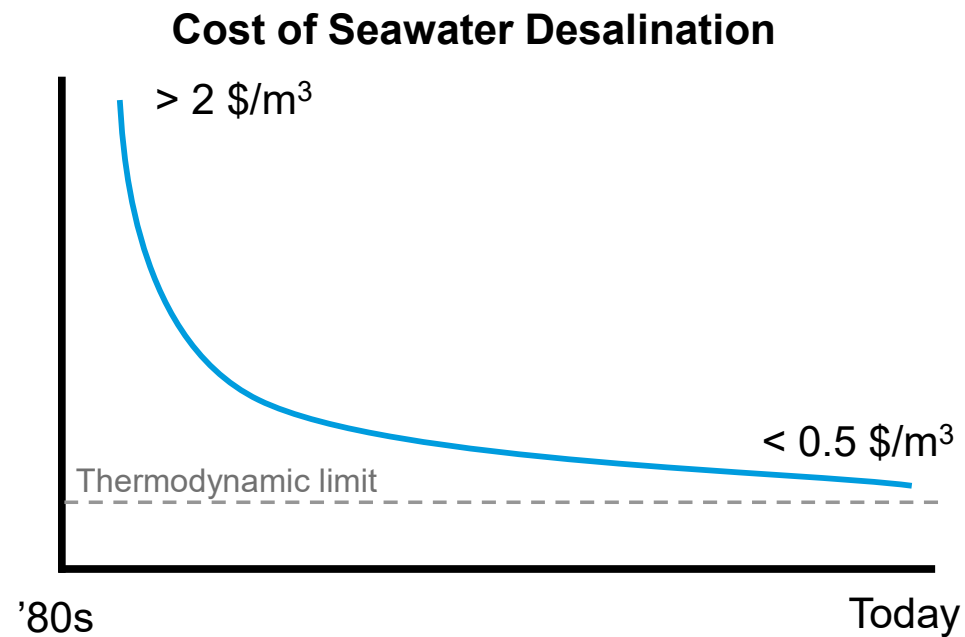


Source:

https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176834&menu=ultiDatos&idp=1254735976602
https://www.mincotur.gob.es/es-es/IndicadoresyEstadisticas/BoletinEstadistico/Energ%C3%ADa%20y%20emisiones/4_12.pdf

Cost of Seawater Desalination

- As the technology approaches its thermodynamic limit, **innovation beyond product specification** becomes more relevant



Source: Shrivastava et al., Energy efficiency breakdown of reverse osmosis and its implications on future innovation roadmap for desalination, *Desalination*, 2015. 368: p. 181-192.

©2023 DuPont Cannot be used without the express written consent of DuPont



Customers benefit from superior membrane life

- Well designed and operated membranes can last very long

Alicante Desalination Plant

> 6,000 membranes

14+ years in operation



Large-scale municipal desalination plant in Alicante, Spain runs reliably with FilmTec™ technology

The challenge

Freshwater supplies in southeast Spain are significantly impacted by climatic change and population growth. The Alicante II Seawater Desalination Plant, located in the Spanish Mediterranean coast, was built with the aim of minimizing the effects of water scarcity and drought conditions suffered by local communities.

The solution

Since installing roughly 6,300 DuPont FilmTec™ reverse osmosis (RO) elements in 2008, the plant has delivered high-quality drinking water throughout the region without issue.

The benefits

The plant operates at a recovery of 45% for the single pass seawater RO. The well-maintained membranes have demonstrated excellent operating performance and durability for 12 years with no replacements.

Fast Facts

Country: Spain

End-user: Mancomunidad Canales de Taibilla (MCT)

Technology: DuPont FilmTec™ SWRO

Total # of elements: 6,272

Plant capacity: 65,000 m³/day

Start-up date: 2008

Feed water quality: 41,000 ppm TDS, 5 ppm B

Product water quality: <250 µS/cm TDS, <1 ppm B

Temperature range: 14-30 °C

Pretreatment: Dual media filters

14+ years operating membranes without replacement.

See how much you could be saving

www.desalapp.com

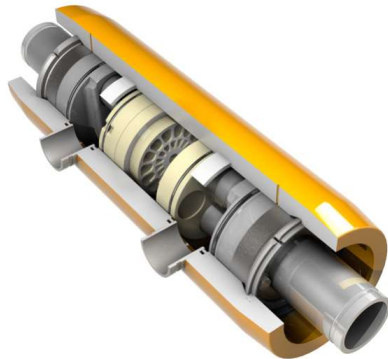


No freedom from infringement of any patent or trademark owned by DuPont or others is to be inferred. DuPont does not warrant and applicable law may offer no remedy for neither and may change with time. Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. The product shown in this document may not be available for sale outside the United States where DuPont is represented. The claims made may not have been approved for use in all countries. DuPont assumes no obligation or liability for the information in this document. DuPont is not responsible for the DuPont logo or the DuPont logo only, including the DuPont logo, and all trademarks and service marks identified with "™" or "®" are used by DuPont de Nemours, Inc. without otherwise noted. © 2022 DuPont. Form No. 4500205-0001 (CEP) Rev. 1 August 2022

FilmTec™ Seamaxx™

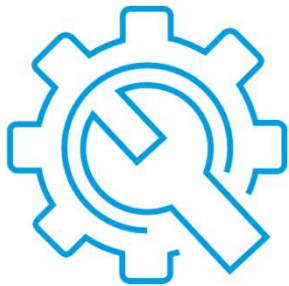
- Offer 5% energy savings
- Useful for installations with:
 - High energy consumption, low temperature
 - High electricity cost ($> \$0.15$ USD/kWh)
 - No or low efficiency energy recovery systems

Energy Recovery Device



Dry Seawater Membranes

- Delivered without preservative solution



Safer installation
due to 4 kg less weight

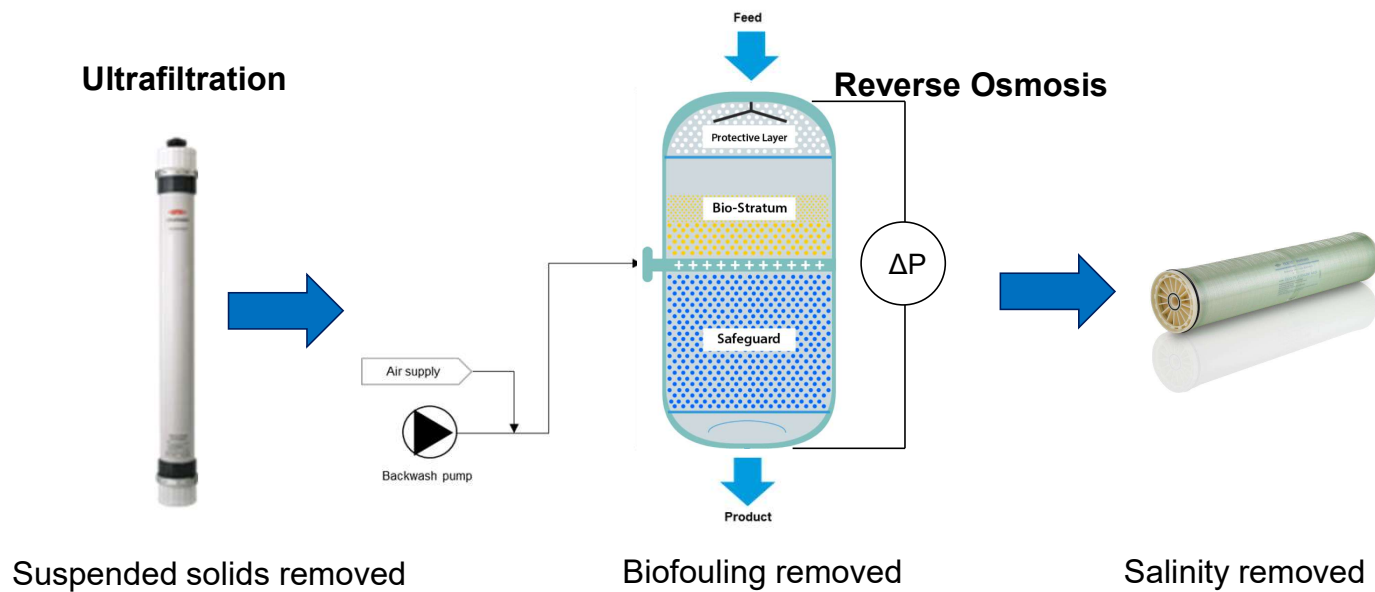


Longer Storage



DuPont™ B-Free™

- Protects Reverse Osmosis membranes from biological fouling



With B-Free™

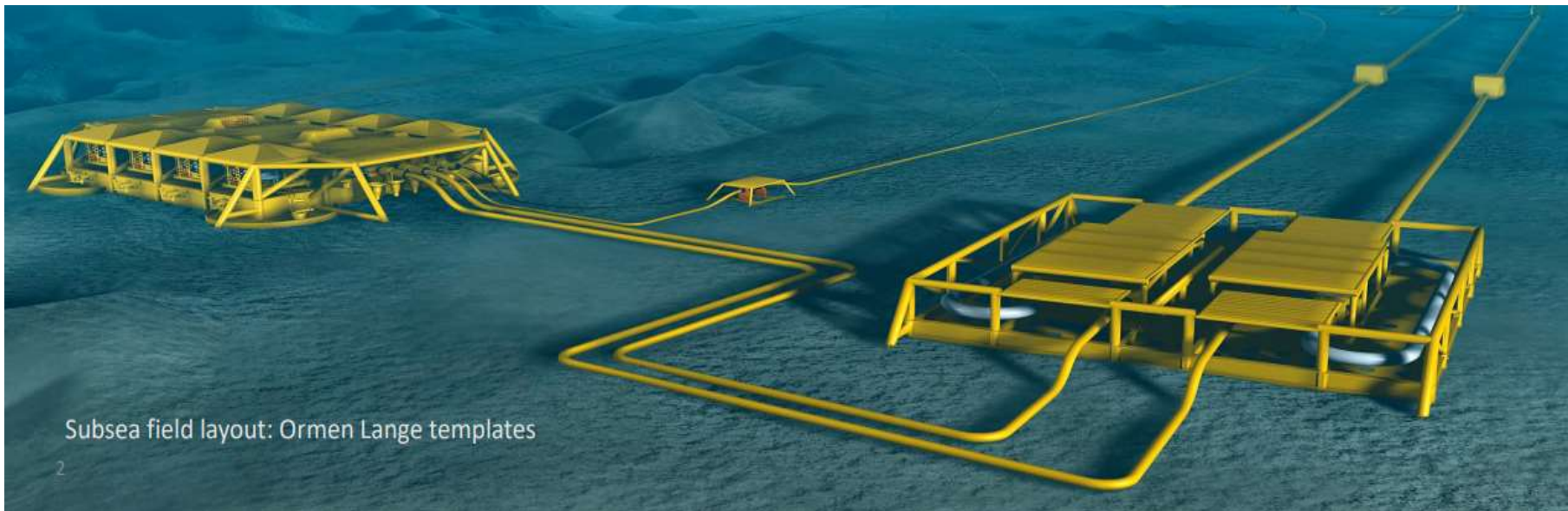


Without B-Free™



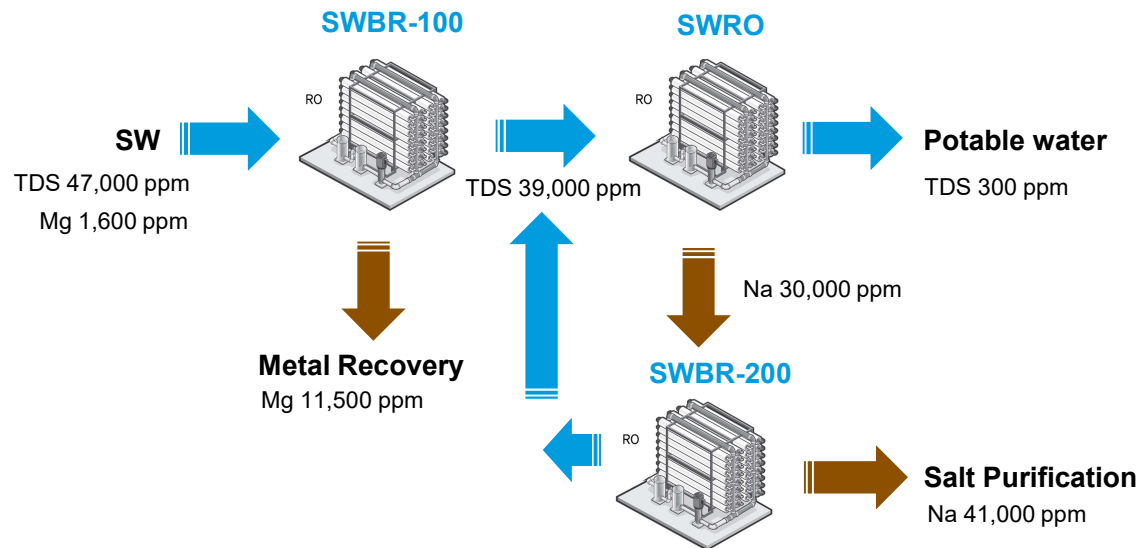
Subsea Desalination

- Uses the hydrostatic pressure of 400 m below sea to save 30% energy



Brine Recovery

FilmTec™ Desal SWBR-100 & SWBR-200 enables customer to effectively up-concentrate and valorize magnesium hydroxide and sodium chloride respectively, as well as producing drinking water from seawater.



DuPont Selective Desalination

valorizing what matters™



Water footprint

- The International Desalination Society (IDA) is working on a mechanism to establish water credits (like carbon credits) to allow companies to become water neutral in terms of water footprint



140 L/day



130 L
(20,000 L/kg)



4,000 L

NET ZERO =

**WATER POSITIVE
IMPACTS**

Water Recharge
Water Purification

**NEGATIVE
WATER IMPACTS**

Water Withdrawals
Water Pollution / Discharge

Aligned with United Nations (UN) Sustainable Development Goals (SDG)



Tarragona Global Water Technology Center

Accelerated product launches

- 16 new products since 2011
- Time to launch a product 10 times faster

Enhanced R&D pipeline

- 25 R&D projects per year

Customer collaboration

- 150 customer projects per year
- More than 3,000 visitors







© 2023 DuPont. All rights reserved. DuPont™, the DuPont Oval Logo, and all trademarks and service marks denoted with ™, ™ or ® are owned by affiliates of DuPont de Nemours, Inc. unless otherwise noted. Nothing contained herein shall be construed as a representation that any recommendations, use or resale of the product or process described herein is permitted and complies with the rules or regulations of any countries, regions, localities, etc., or does not infringe upon patents or other intellectual property rights of third parties.

The information provided herein is based on data DuPont believes to be reliable, to the best of its knowledge and is provided at the request of and without charge to our customers.

Accordingly,

DuPont does not guarantee or warrant such information and assumes no liability for its use. If this product literature is translated, the original English version will control and DuPont hereby disclaims responsibility for any errors caused by translation. This document is subject to change without further notice.

