

BREAKTHROUGH IN THE FIELD OF DESALINATION OF SEAWATER

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SEAWARDS
GROUPE SEANERGY

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VALUE CREATION



SEAWARDS relies on dual expertise in the fields of thermodynamics and material transformation for :

- Introducing a competitive seawater desalination disruptive technology - alternative to the best technologies in place - without discharge of any pollutants (brine and chemical products)
- Broaden the scope of seawater desalination offer by meeting the expectations of the greatest number of people, thanks to agility and efficiency, which enable to meet the growing needs

SEAWATER DESALINATION



Today, traditional industry mainly uses the reverse osmosis process : seawater is purified through micro-filtered membranes which remove salts and minerals from seawater. Pure water is extracted, and they discharge into the ocean a very high concentration of salt, brine, which is an enemy of the environment

It destroys marine life and creates dead zones at the bottom of the oceans.

SEAWARDS, thanks to its innovative technology, makes it possible to desalinate seawater to generate pure water at a cost much lower than the best current technologies (reverse osmosis) and without producing polluting discharges

MARKET INSIGHT

2.2 billion people currently live in water-scarce areas, where water resources are insufficient to meet the needs of the population during a part of the year. Around half a billion people face water scarcity every day," says Dr Vladimir Smakhtin, co-author of the paper and director of UNU-INWEH, who is actively researching the various sources of water. unconventional water.

Desalination has been a technology primarily deployed in the Middle East, in small island nations that generally lack renewable water resources.

Today, the need extends widely, covering various regions of the world with a wide variety of situations.



MARKET INSIGHT

Almost half of the world's desalination capacity is located in the Middle East and North Africa region, Saudi Arabia (15.5%), the United Arab Emirates (10.1%) and Kuwait (3.7%) being both the main producers in the region and in the World.

The East Asia and Pacific and North America regions produce 18.4% and 11.9% of the world's desalinated water, mainly due to the large capacities of China (7.5%) and the United States (11.2%) respectively.

The widespread use of desalination in Spain (5.7%) accounts for more than half of the total desalination in Western Europe (9.2%). The global share of desalination capacity is lowest in South Asia (3.1%), Eastern Europe and Central Asia (2.4%) and Sub-Saharan Africa (1.9%), where desalination is mainly limited to small installations for private and industrial applications.



MARKET SIZE

Desalination units's growth is showing large digit with 10 to 15% per year since 2010 thanks to different factors :

- Technical solutions leceted : reversal osmosis
- Decrease of the energy cost
- Strong backing from Governments

On a long term basis, a reduction of the energy costs, with a non environemental impact have to be the priority for the new desalination unit's generation

3 BILLIONS IN 2030

2.2 Blns people currently live in areas of physical water scarcity, where water resources are insufficient to meet water demands.

They will be 3 Blns in 2030

55 BLNS DE M3

55 Billions Brine's m³ are discharged every year into Oceans, which would be enough to cover 152,000 km² with 30 cm tall.

THE DISCHARGE OF BRINE IS DEADLY FOR UNDERWATER FAUNA AND FLORA, EVEN CAUSING THE EXTINCTION OF CERTAIN SPECIES



INNOVATION



PATENTED CRYO DESALINATION TECHNOLOGY

Our seawater desalination process is based on the separation of pure water during a cooling cycle. Salt water and pure water subjected to a drop in temperature react differently. Pure water solidifies from zero degree while salted water waits for the temperature to drop to minus two degrees. This feature makes it possible to proceed, during the cooling cycle, to a separation of material which will allow a portion of pure water to be extracted in a solid form while the salt water which is still liquid will be rejected.

This desalination method, unlike competing methods, provides major advantages: no polluting discharges, no use of chemicals contaminating the environment and low energy consumption (around 1.5 kWh/ m³).

INNOVATION

SEAWARDS Patented Cryo-Separation Technology

Seawards has built its technological innovation on the combination of two specific skills in the fields of thermodynamics and material separation

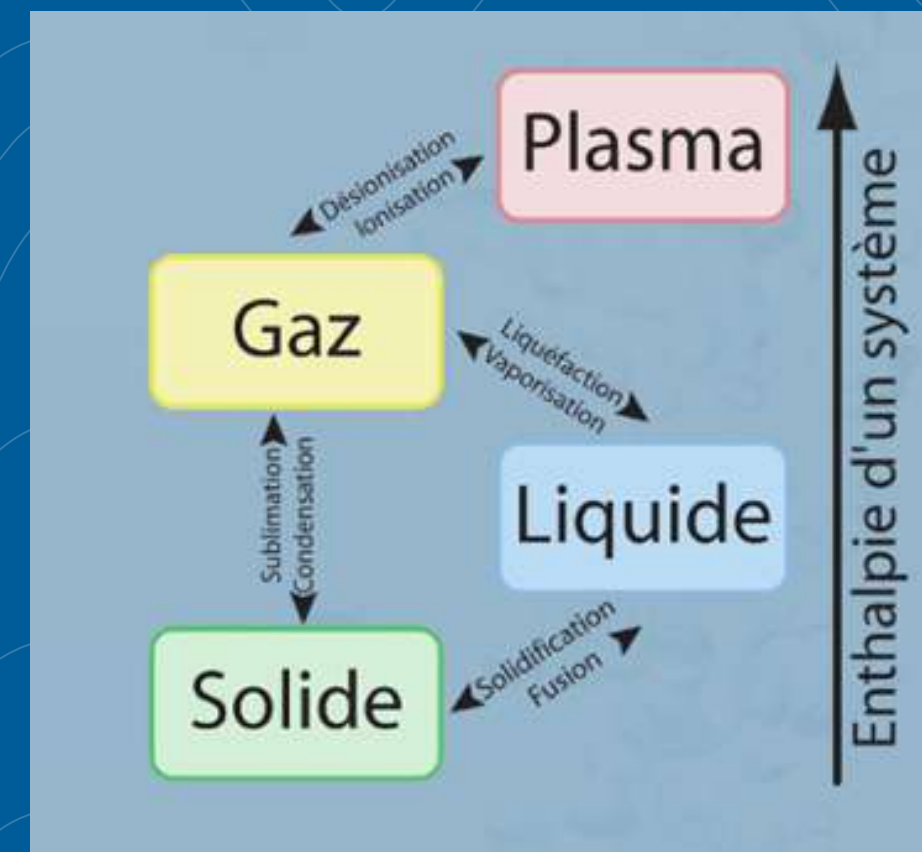
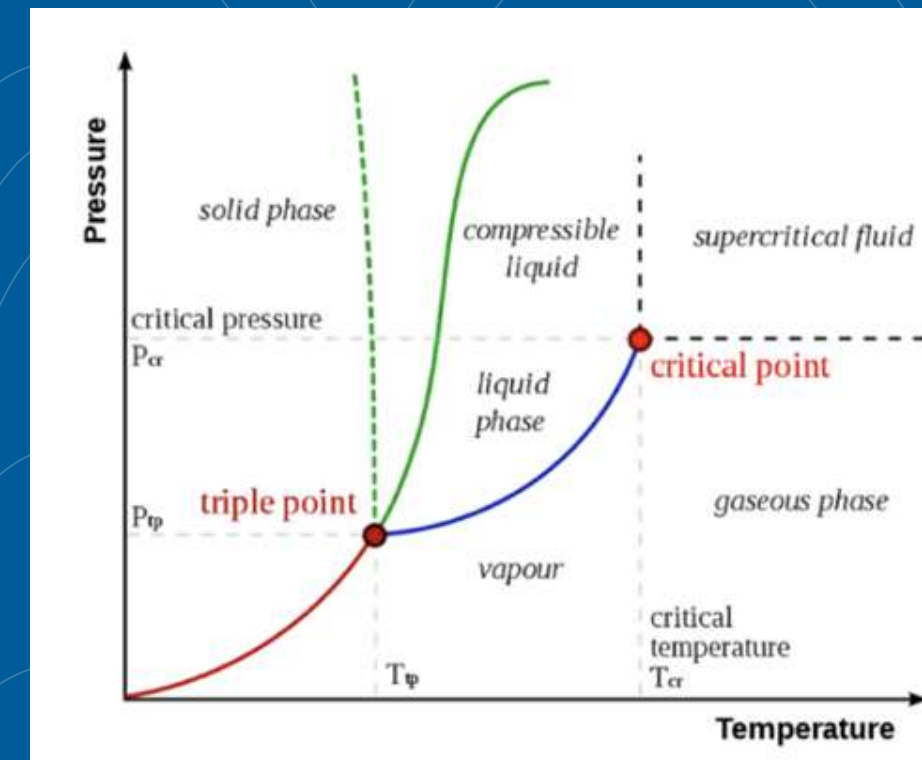


INNOVATION

Thermodynamics allows us to characterize the transformation of the state of a system between an initial time and a final time corresponding to two different equilibrium states.

The enthalpy of the system allows us to measure the thermal changes and allows us to ensure the transformation between the states of equilibrium in a sufficiently slow and stable way so that we can consider the variables of state of the system as evolving in a continuous and homogeneous way in the transformation process.

It is then that the contribution of a specific method of separation of materials, at this stage of the transformation process, based on the difference between the density of pure water ice and sea water at 0°C, allows us to extract the pure water crystals.



COMPETITIVE ADVANTAGES

1/

COMPETITIVE

- Reduction by 50% of the energy consumption : target at 50% of the actual technologies : 1,5kWh/m³
- Light infrastructures
- Easy to maintain
- Great water quality produced : 250ppm

2/

AGILE & EFFICIENT

The agility of SEAWARDS technology allows us to planify an efficient development of our production responding to all kind of local setups, even with important geographical constraints

3/

ENVIRONMENTAL FRIENDLY

- SEAWARDS rejects only a water being slightly saltier (+10% compared to the initial one pumped)
- No brine, no chemical products are rejected
- Target to have no carbon impact

RAISON D'ÊTRE

To democratize the desalination of seawater, in order to extend it to the greatest number of people and thus bring an environmentally friendly response to the increasing number of situations of water shortage for drinking water, industrial water or irrigation of agricultural land

To create a competence and research area with the ambition to offer a competitive solution of storage and transport of renewable energies



REASON TO BELIEVE

Brine management can represent up to 40% of a plant's cost and ranks among the biggest constraints to more widespread development.

"There is an urgent need to make desalination technologies more affordable and expand them to low- and middle-income countries. At the same time, we need to address the potentially serious drawbacks of desalination, namely the harmfulness of brine and chemical pollution to the marine environment and human health."

Dr Vladimir Smakhtin, directeur de l'UNU-INWEH

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ACTION PLAN



CHALLENGES

To democratize the desalination of seawater in order to widen the offer to the greatest number of people in response to the increase in situations of water stress in the world

- To have Competitive CAPEX and OPEX
- To have Agile and Flexible infrastructures
- To produce pure Water in full respect of the environment



TARGETED MARKETS

More than 2.2Blns people affected by water scarcity, they will be nearly 3 Blns in 2030

- 16,000 desalination units in the world today for 95Mlns m³ of fresh water produced daily
- A large number of these facilities are located next to each others in a small number of countries : Israel, Saudi Arabia, Emirates or Qatar and more recently Spain. Worldwide, the supply of fresh water through seawater desalination concerns only 300 million people

With major competitive advantages, Seanergy targets populations who do not yet have access to desalination solutions among these 2.2 billion people, as well as the strong growth of the needs due to the enlarging of the situations of water scarcity as projected by 2030



GO TO MARKET

Development of a Competitive and Economical offer intended for population pools concerned by respect for the environment, and possibly subject to site constraints or smaller populations

- Start by addressing a priority target determined by its strong sensitivity to the specificity of the desalination method:
 - Marine territories and Coastal cities
 - Coastal tourist sites
 - Seaport and Marinas
- To Broaden the proposal with an offer addressing the greatest number



INDUSTRIAL PRODUCTION

In coordination with Regional Economic and Political institutions, SEAWARDS aims to set up a industrial demonstration device with an initial capacity of 10m³ per day.

This pilot site will demonstrate the efficiency of the technology and the performance of the desalination module. It will also make it possible to build a method for evaluating its reliability

Specifications of Pilot Site

Pure water (desalination) :

- 100m³ seawater per day to separate 10m³ of pure water (below 250ppm in term of quality)
- Energy : 1,5 kWh perm³



PILOT PLANT : R&D ET INNOVATIONS

Location :

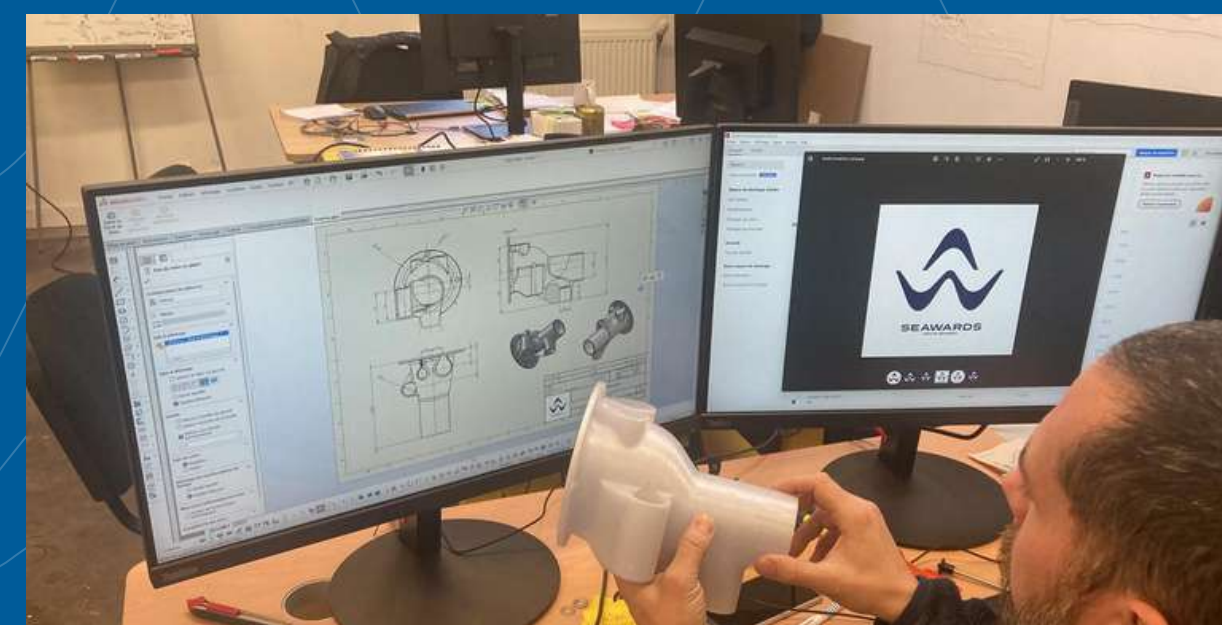
- Ground area of 200 square meters
 - Inside area of 100 square meters
 - Outside area of 100 square meters

Needs:

- 100m³ seawater per day

Materials:

- SEAWARDS desalination prototype unit
- Voltage supply with transformer and Rectifier
- Tanks storage



NEXT STEPS

New Technological developments in different areas :

- **Green Hydrogen**

The combination of two skills (Desalination and Electrolysis), allowing the production of green hydrogen at competitive levels aligned with the challenges of energy transition: coastal regions rich in green energy, new generation of electrolyser membranes)

- **Miniaturisation**

New generation of onboard desalination plant made possible by the miniaturization of the modules



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