Innovative desalination technology

In recent decades, over-exploitation, pollution and climate change have led to severe water stress across the world. Desalination could help resolve this, but large-scale desalination technologies are energy intensive. Fresh Water Nature (FWN) is a clean-tech company specializing in green water treatment with a low-impact, low-carbon desalination technology called Cool Steam.

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A look inside the operational demonstration plant in Barcelona.

Desalination projects with widespread use

Since 2015, SWEP has been providing heat exchangers and technical support to Spanish based Fresh Water Nature. (FWN) FWN's key application is a low-carbon and low-impact desalination technology called Cool Steam.

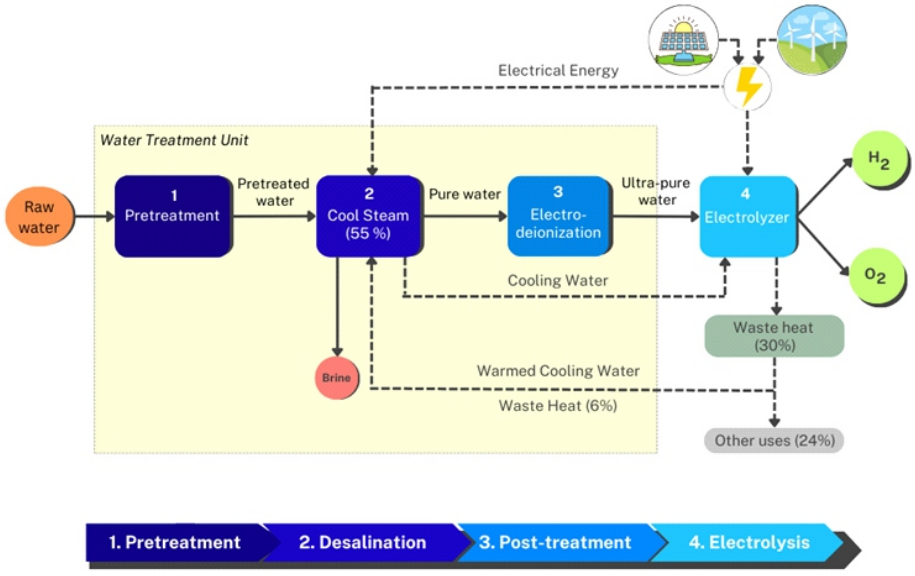
Based on once-through multi-stage low-temperature vacuum distillation, Cool Steam has several advantages over today's most common desalination method (reverse osmosis). Firstly, it consumes approximately half the electrical energy (and thus CO_2 emissions) per m^3 of desalinated water. It also produces significantly purer water than reverse osmosis. This water can then be used – without additional processing – in demanding applications in, for example, the pharmaceutical industry. In addition, Cool Steam neutralizes the marine impact of brine by its previous costless dilution.

Thermal energy gains from heat exchangers

The thermal energy that Cool Steam requires can be taken from renewable sources or other industrial processes. This is where brazed plate heat exchanger technology plays a role. Thermal energy from low-grade heat sources is both harvested and dissipated by SWEP heat exchangers to drive water evaporation and condensation in various stages of Cool Steam.

At the start of the project, compact heat exchangers from SWEPs B-range were used (B3 and B25 units), performing phase change under vacuum conditions. Over time, larger heat exchangers have been put in place.

FWN has chosen SWEP products for Cool Steam because of their quality and reliability, advantages that reduce operating costs. There is an operational demonstration unit at the Barcelona Desalination Plant, which can be transported by truck or ship to clients' facilities for field pilot testing. These transportable and fully automated plants produce fresh water with a conductivity as low as 10 µS/cm and 55% conversion rate. The minimum activation point for these devices is set up at just 60 °C. There are plans for Cool Steam to be implemented in more sites both in Spain and in India.



How Cool Steam desalination supports green hydrogen generation.

From desalination to green hydrogen

Cool Steam desalination technology can also support cost-effective green hydrogen production. Water electrolysis is potentially an emission-free way of producing hydrogen, but it normally requires large quantities of water for cooling, as well as ultra-pure water as a raw material.

Cool Steam itself cools electrolysers, thus reducing their operational expenses. It also supplies ultra-pure water after an additional processing stage (electrodeionization), lowering the cost of raw materials. This results in a water positive process.

Electrolysis releases waste heat which, with the help of SWEP heat exchangers, can be used as an input to the desalination process.

Combining Cool Steam desalination with electrolysis means that surplus outputs are transformed into useful inputs throughout the process, bringing us closer to a completely circular solution.

This system has been successfully validated at pilot scale at a LNG Regasification Plant. Electrolysis in this plant makes use of the water from the Cool Steam process, while Cool Steam utilizes the released waste heat from the electrolysis.

Cool Steam pilot testing for green hydrogen production by electrolysis.

Role of SWEP

In addition to supplying heat exchangers, SWEP's Iberian staff supported with technical knowledge in innovative ways to support the customer. As Engineer Naeria Navarro at FWN explains: "SWEP had an important role in this project as technological adviser. SWEP engineer Giancarlo Soler Zabala was helpfully involved with heat exchange system design and sizing, as well as the integration of all components within the overall system."

Three heat exchangers were used in the electrolysis part of the process, for stack cooling, oxygen recovery and hydrogen recovery. Other three heat exchangers were used in the desalination process, for heating, cooling and cryogenic temperature cushioning. SWEP also has a key role in other Cool Steam applications in agriculture, food, cosmetics, and zero liquid discharge (ZLD) processes.

Researchers work on Cool Steam at the Oceanic Platform of the Canary Islands (PLOCAN).

Who is Fresh Water Nature?

The Fresh Water Nature (FWN) story begins with the International Center for Numerical Methods in Engineering (CIMNE). CIMNE is a research center that originated from a consortium involving the Government of Catalonia and BarcelonaTech (also known as the Technical University of Catalonia). More than a dozen companies have emerged from CIMNE as spin-offs and start-ups, working in areas as diverse as civil engineering, robotics, data analysis, meta-materials and inflatable structures.

FWN was founded in 2013 to work on the final development phase and market transfer of desalination and water treatment technologies developed in CIMNE, bridging the gap between academic research and commercially viable applications.

SWEP is one of the world's leading suppliers of Brazed Plate Heat Exchangers (BPHEs). World-leading within the field of heat transfer, SWEP constantly advances the front line in order to supply the latest technology to the market. SWEP's goal is to offer its customers excellent performance, economy and service. SWEP was established in 1983 by small group of pioneers in thermal engineering who were among the first to commercialize the BPHE technology. SWEP is close to its customers, with representation in more than 50 countries and its own dedicated sales force in more than 20 countries. Production units in Sweden, Switzerland, USA, Malaysia, Slovakia and China make it possible to serve customers all over the world. The company is part of the global Dover Corporation.

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