

Implementing an Evaporator Crystallizer Plant: What Sets the SaltMaker Apart?

The SaltMaker evaporator crystallizer is a one-step brine treatment plant for volume minimization and zero liquid discharge (ZLD) applications. Its unique evaporative crystallizer design is built to treat the toughest waters and to simplify your brine treatment project.

The SaltMaker overcomes challenges that face conventional crystallizers:

- **Reliable Solids Production:** A circulating slurry continuously forms and grows crystals. Solid salt is discharged to an automated bagging or binning system.
- **One Step Treatment:** No pre-treatment required. For ZLD applications, solids are produced without the need for extra process equipment, such as centrifuges or filter presses.
- **Resists Corrosion, Plugging, and Scaling:** High circulation rates, constantly changing saturation gradients, and non-corroding, non-stick wetted surfaces prevent reliability challenges that plague conventional crystallizers
- **Intelligent Automation and Self-Cleaning:** The plant has automated start, stop, and hibernate for immediate ramping from 0 to 25% capacity in one step. It operates at any capacity between 25% to 100% in dynamic capacity control mode and will detect and initiate cleaning cycles.
- **No Single Point of Failure:** The SaltMaker is built from redundant process sets, unlike MVR evaporators that rely on a single vapour compressor inhaling moisture into a high-speed rotating machine. Even with the loss of one process set during maintenance, the plant keeps running at 92% capacity.
- **Modular Build and Scale Up:** The plant is built around ISO container frame modules, for ease of delivery, installation, and expansion to suit growing project capacity needs by adding process blocks.
- **Low Temperature Air Humidification Dehumidification:** The SaltMaker operates with an air cycle humidification dehumidification process (< 90°C), which avoids the use of pressure vessels and enables its construction from fiber reinforced plastics that withstand severely corrosive fluids. Multiple effects efficiently recycle thermal energy, opening a wide range of waste heat energy source options.

Reliable Solids Production and Extraction

The SaltMaker produces solids by circulating a brine slurry to continuously form and grow crystals. Salts preferentially grow on suspended seed crystal nucleation sites rather than on heat transfer surfaces. The larger crystals settle and are discharged to a Solids Management System for automated bagging or binning. Concentrated liquor, including smaller salt seeds, is recycled back to the SaltMaker while solid salts remain behind in the bags or bins. The system notifies the operators when the bags are full and ready to be transported to a drainage rack by forklift.

The solids are then drained and pass the paint filter test, often within 24 hours of draining. Afterwards the bag can be sent for disposal or re-use depending on the application. The Solids Management System takes the guess work out of management and improves reliability. The plant flushes and purges slurry lines to prevent clogging, discharges thick slurry to the bags only when necessary, and automatically recycles rich liquor brine and notifies operators when to change bags.



Automated Bagging System



Bag Removed by
Forklift

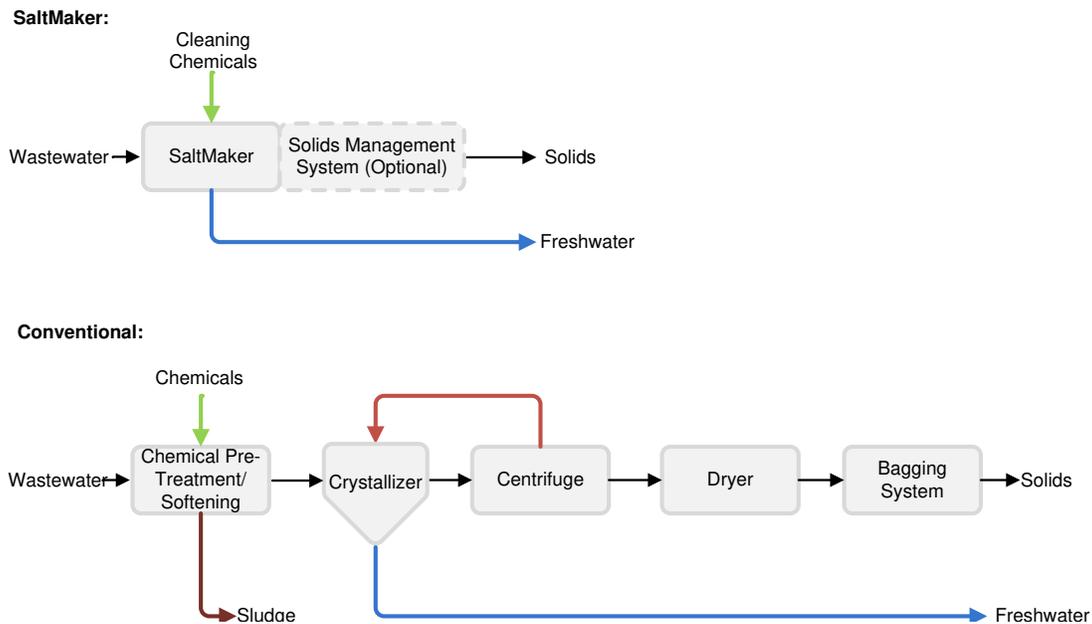


Bag of Solids

One Step Treatment

Traditional treatment technology requires multiple steps with different technologies to treat wastewater with high salinity levels. This includes separate systems for pretreatment, evaporation, crystallization, solids production and dewatering. The SaltMaker combines these steps into a single system that requires no pretreatment. It can be fed water at any salinity and almost any water chemistry. Expensive chemicals that increase solids load such as soda ash are avoided on front end.

For ZLD applications, the Solids Management System can be added to the SaltMaker. Brine enters the plant, which produces freshwater and solids in bags or bins. No extra processing equipment, such as centrifuges or filter presses, is required. A simplified process flow diagram comparing the SaltMaker and a conventional process used to achieve ZLD is provided below.



Built to Resist Corrosion, Plugging, and Scaling

The SaltMaker is predominantly built from plastics – namely gel-coated, fibre-reinforced plastics – with low surface energy that provides resistance to corrosion and scale. The plant also operates with high circulation rates to provide scouring flows and all wetted surfaces are exposed to continuous dynamic salinity gradients for salt saturation relief. Combined with sound engineering design, the SaltMaker prevents plugging and reliability challenges that frequently affect conventional evaporators and crystallizers.



Pipework
UPVC and CPVC



Pumps
Engineered
Plastics



Modules and Tanks
Fiber Reinforced
Plastics



Heat Exchanger
Titanium
(non-boiling)

Intelligent Automated Operation and Cleaning

The SaltMaker has intelligent automated operations and self-cleaning processes. The plant can automatically (1) start; (2) stop and flush; and (3) hibernate in circulation mode and ramps to 25% capacity in one step. Dynamic capacity control allows the SaltMaker to operate anywhere from 25% to 100% of rated capacity while being remotely managed via a secure internet connection.

The plant's self-cleaning modes prevent irreversible scaling or fouling by regularly monitoring key performance metrics. It will then automatically trigger the appropriate level of cleaning, from 'light rinse' to 'heavy scrub'. The SaltMaker uses distilled water as the cleaning fluid, which can be chemically augmented based on the type of scaling compounds and foulants in the brine. The wash solution is reused multiple times before being fed back to the SaltMaker for treatment once it has been spent.

No Single Point of Failure

Unlike mechanical vapor recompression (MVR) technologies, where 100% plant capacity is lost when the vapour compressor goes offline, the SaltMaker has no single point of failure. The plant is built with repeatable and redundant evaporation-condensation process sets. If a process set is down for maintenance, the plant continues to run at 92% capacity.

Evaporation
Module



Fan
Module



Radiator Module



An Evaporation-Condensation Process Set
There are Multiple Process Sets in an Effect



An Effect
There are Multiple Effects in a SaltMaker



A S100 SaltMaker with Four Effects

Modular Build and Scale Up

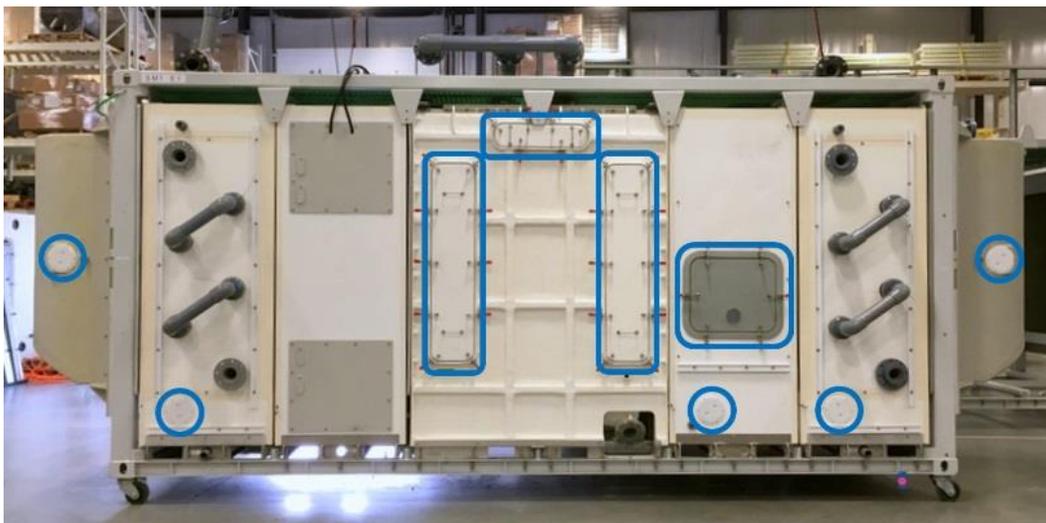
The SaltMaker is built into standard ISO container frames. These modules enable factory assured quality production, ease of shipment-installation, and future expansion. The open concept design also allows easy access to processing equipment, such as pumps, for inspection and routine maintenance, without the need for any confined space entry.



Modular SaltMaker Plant Built into Standard ISO Frames



Easy Access to Process Equipment



Effect with Multiple Inspection Hatches and Ports (highlighted in blue)

Multiple inspection ports in each effect allows convenient monitoring for scaling and fouling. Process set modules slide in and out. Cleaning is done with a power washer.

The modular design simplifies transport and assembly; the SaltMaker is sent by standard freight without any permits of oversized loads and assembled by crane on-site.



SaltMakers are built to standardized plant sizes that can be added together to expand capacity as your project grows. The models and their capacities are listed below.

Model	Capacity Based on Freshwater Removed*			
	m ³ /day	Gallons per Day	Gallons per Minute	Barrels per Day
S30	30	7900	5.5	188
S66	66	17400	12	415
S100	100	26400	18	630
S125	125	33000	23	790

* Capacity derated by 20% to produce a 450,000 mg/L total solids slurry and by 40% to produce solids.



S100 SaltMaker Plant

100 m³/day freshwater removed capacity



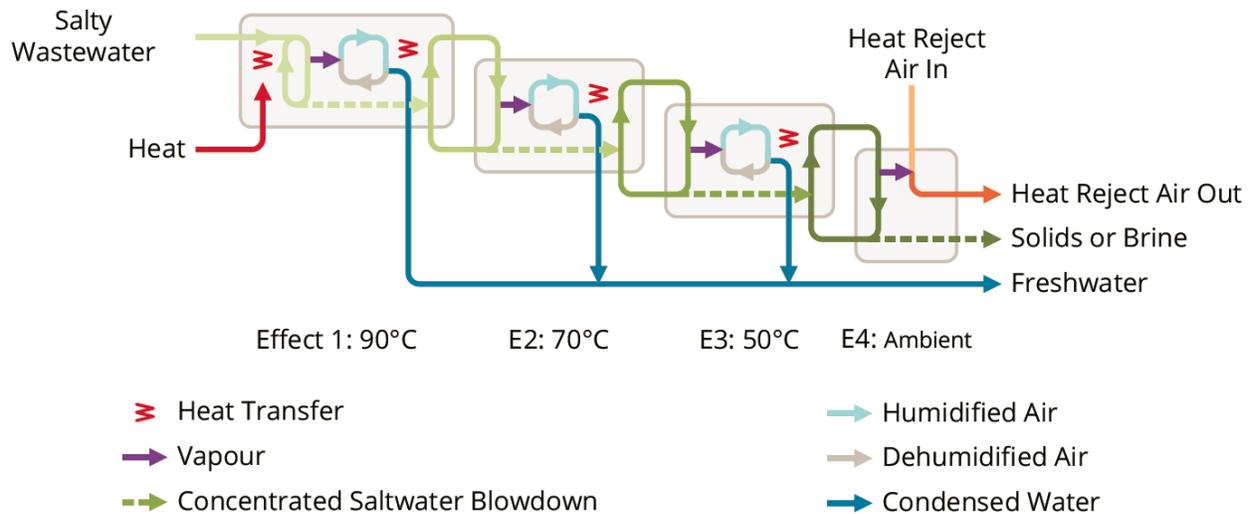
S100 + S125 SaltMaker Plants

Capacity Increased by adding a S125 plant block
 100 m³/day + 125 m³/ day = 225 m³/day freshwater removed capacity

Low Temperature Air Humidification- Dehumidification

The SaltMaker is a multiple effect, thermally-driven evaporator crystallizer. It can use a variety of thermal sources: steam, low grade waste heat, and gas or liquid fuel fired low pressure water heaters. It operates at atmospheric pressure and temperatures less than 90°C, employing humidification dehumidification air cycles that do not require a vacuum, pressure, or boiling water on any heat transfer surfaces. Steam ticketed operators or pressure vessel certifications are not required.

In each of the effects, thermal energy is recycled, brine is concentrated, and freshwater is produced. Initial heat input to the plant at for example 92°C, is used to evaporate and condense water in multiple effects, with the temperature being downgraded in each effect while the heat is recycled. This multiple effect process enables one unit of heat to produce four units of volume reduction as shown the process diagram below.



Warm brine flows at high volumetric velocities through the system, and is sprayed into non-stick packing material of the evaporator modules. Approximately 1-2% of each droplet is evaporated to become freshwater vapour, while the droplet is concentrated and cooled. The droplet is pumped through the system again to recapture heat and further evaporate.

Air is the vapour carrier with the fan module providing the motive force. Water vapor condenses into freshwater liquid at the radiator modules, which also transfer the latent heat of condensation to the next effect for energy efficiency. The final effect can be open or closed to atmosphere, providing cooling and heat rejection.

As water is evaporated, the brine is concentrated. Solid salts form on smaller salt seeds as saturation is exceeded. The smaller salt seeds are recycled from the Solids Management System (SMS) described above, with larger crystals forming and then discharged back to the SMS. This continuous cycling enables salt crystal growth and prevents the need for complex multi-step processes. The SMS is seamlessly integrated into the SaltMaker process, controls, and modular skids so a single package can be delivered and operated.

Contact us to see how the SaltMaker fits into your project:

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