# Introducing the AirBreather: Lower Cost Evaporator Crystallizer

## Key Takeaways:

- A lower cost evaporator crystallizer has emerged - the SaltMaker AirBreather. It is based on the robust backbone of its closest relative - the SaltMaker MultiEffect.
- It offers four times the capacity, at four times higher thermal energy load vs the MultiEffect; it is best suited where thermal energy costs are < $5/GJ (or $5/MMBTU).
- The AirBreather evaporates water to atmosphere but first extracts volatile organic compounds (VOCs) so only clean vapor is released.
- It can concentrate to any point, including making solids and achieving true zero liquid discharge
- It cleans itself while it operates, and is built from non-corroding, non-scaling, modular components, well suited for remote dispatch.

*Figure 1: The SaltMaker AirBreather*



 

# The Origins of the AirBreather

Saltworks originally developed the SaltMaker MultiEffect – the AirBreathers' older 'cousin' - in partnership with Canadian oil sands companies. They were seeking to use waste heat thermal energy to treat challenging heavy oil blowdown water. The industrial end users set out the following criteria:

1. Build the most reliable and cost effective evaporative-crystallizer, re-engineering from the ground-up to be suited for oil and gas.
2. Remove boiling on heat transfer surfaces, which is the origin of most scale.
3. Develop a new solids management system, removing the challenges of centrifuges and driers, while producing automated bagged solids suitable for landfill disposal
4. Deliver a modular expandable plant, that can be serviced without confined spaces.
5. Remove single point of failures, such as the vapor compressor in MVR systems.
6. Employ 60-80 deg C waste heat, which is abundant in oil sands.

Saltworks answered this challenge with the SaltMaker MultiEffect. It replaced steam and scaling heat transfer surfaces with an air humidification dehumidification cycle, which evaporates and condenses water in successive effects. Clean water is produced by each effect, with the final effect open to atmosphere to cool the plant. The machine is designed to remain scale-free.

*Figure 2: The SaltMaker MultiEffect*



 

After having completed shale field pilots of the SaltMaker MultiEffect, the team realized that a better configuration existed for shale: leveraging waste thermal energy with an open to atmosphere evaporator that can manage volatile risk. Capacity improved four times per unit of equipment. However, thermal energy also increased four times. As engine jacket cooling water or low-cost gas may be available, this is less of a barrier in shale.

## What do I need to know about Open Evaporators?

Open evaporators release water vapor to atmosphere, so there is no condensed water to manage. However, evaporating water requires a lot of energy: 2400 MJ per tonne. In addition, produced water includes more than just water. It includes salt that can scale and corrode the plant, and toxic volatiles such as benzene or ammonia that can pollute the atmosphere or cause health problems. The AirBreather overcomes both challenges through innovation.

Up until recently, most open evaporators were of the submerged combustion type. Combustible gas and compressed air are injected into a large "kettle boiler." Combustion occurs underwater and heat is transferred directly to the salty water. Water is concentrated, and vapor is released, often resulting in a tall plume rising through the sky. These large kettles must be metallic to withstand combustion temperatures, while also made of exotic materials to reduce corrosion risk related to high salinity. Emissions must also be managed since combustion is involved.

Open evaporation however does not require submerged combustion. The AirBreather overcomes this by borrowing from the most widely used evaporation technology: the cooling tower. In cooling towers, warm water drips through a packing material, evaporating to air and producing either a non-visible vapor or smaller cloud that dissipates. Cooling towers however cannot manage the scaling compounds and salinity encountered in shale waters.

Saltworks hybridized the cooling tower with its SaltMaker technology, to deliver the next generation of open to atmosphere evaporation. We did so in a way that packs extremely high evaporation capacity into a small module package through optimized thermos-



 

psychometric design. Every AirBreather AB-300 consists of 8 evaporation modules, packaged into ISO container frames. The entire plant is built around ISO container frame modules, for ease of delivery, installation, and expansion to suit project needs. The "300" in AB-300 stands for 300 tonnes/day of clean water evaporation capacity. Larger plants can be built by simply adding AB-300s, allowing customers to grow their evaporation capacity over time.

*Figure 3 Effect Module: Built for modular dispatch to minimize site work*



 

*Figure 4: Franklin Evaporator Module, the 'lungs' of the AirBreather*

Evaporating water is easy, however managing volatiles and achieving extremely high brine concentration or solids production to realize zero liquid discharge presents new challenges.

**Volatiles:** wastewaters can contain low boiling point substances that will evaporate with water. Examples include ammonia or volatile organic compounds (VOCs) including methanol, BTEX, and others. Odor may also impact neighbours. The AirBreather comes with an optional and proprietary "Volatile Management System", which selectively removes the volatiles so that only safe clean low temperature water vapor emerges. Our pilot plants are outfitted with this same system, including emissions monitoring technology to prove the safety of our system at your site.

**Zero Liquid Discharge (ZLD):** as saltwater is concentrated, scale can precipitate, solid salt plugs can form, and high chloride levels will corrode metallic parts. The SaltMaker AirBreather borrows SaltMaker MultiEffect technology to overcome these challenges and result in the first open to atmosphere evaporator that squeezes every last drop of liquid waste down to a solid by-product or achieve any desired brine concentration along the way. This is achieved by:



 

- **Corrosion, Plugging, and Scaling Resistance:** High circulation rates, constantly changing saturation gradients, and non-corroding, non-stick wetted surfaces prevent reliability challenges that plague conventional crystallizers.
- **Reliable Solids Production or Slurry Brine:** A circulating slurry continuously forms and grows crystals. Solid salt is discharged to an automated bagging or binning system. Alternatively, one may choose to extract the slurry brine at any pre-determined concentration.
- **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.
- **One Step Treatment:** No pre-treatment is required. For ZLD applications, solids are produced without the need for extra process equipment, such as centrifuges or filter presses.

*Figure 5: Samples of solids produced and discharged to automated bagging systems*

Want to know if the AirBreather is right for your project? Saltworks hosts a fleet of pilots, ready to test your water for feasibility. Pilots can help test water quality, by-products, and scale issues as well as site performance. Contact us at projects@saltworkstech.com

 