Texas Desal

Sept 29, 2015
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Dir Eng.

At the crossroads in Rome
the Trevi Fountain was built,
providing fresh water
to a weary world.

Trevi Systems Intro

• Trevi Systems Inc. is a Petaluma, Calif. developer of Forward Osmosis water purification systems for *desalination of seawater, brackish and produced water, industrial and municipal waste water* .

• Trevi has a patented Forward Osmosis Systems using *ultra low electrical energy* and has demonstrated the Energy savings in a Navy pilot study with 3rd party report available.

• Trevi is piloting a large scale Forward Osmosis systems for sea water desalination in Abu Dhabi, with electrical energy requirements below 1kWh/m3, ¼ that of RO.

• Additional trials are underway in Kuwait, Saudi Arabia and with the US Navy.

• Large scale trial underway in Anaheim California of municipal waste water recycling for potable water use.

• Trial opportunities in inland brackish water are now being sought to demonstrate the technology at large scale.

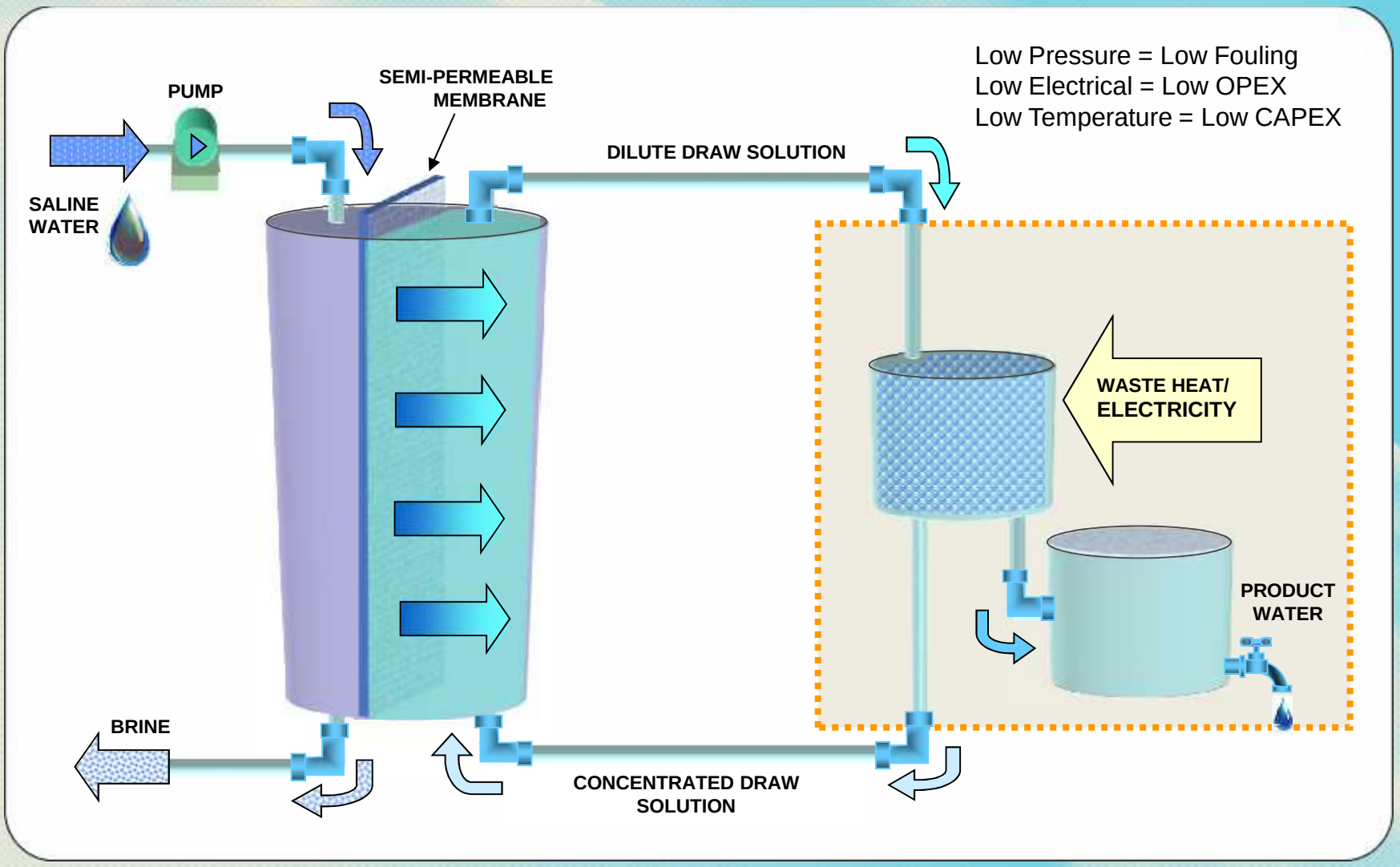
Masdar Abu Dhabi, UAE

Award ceremony in Abu Dhabi, ***Only*** winner in Innovative category out of 80 entrants.

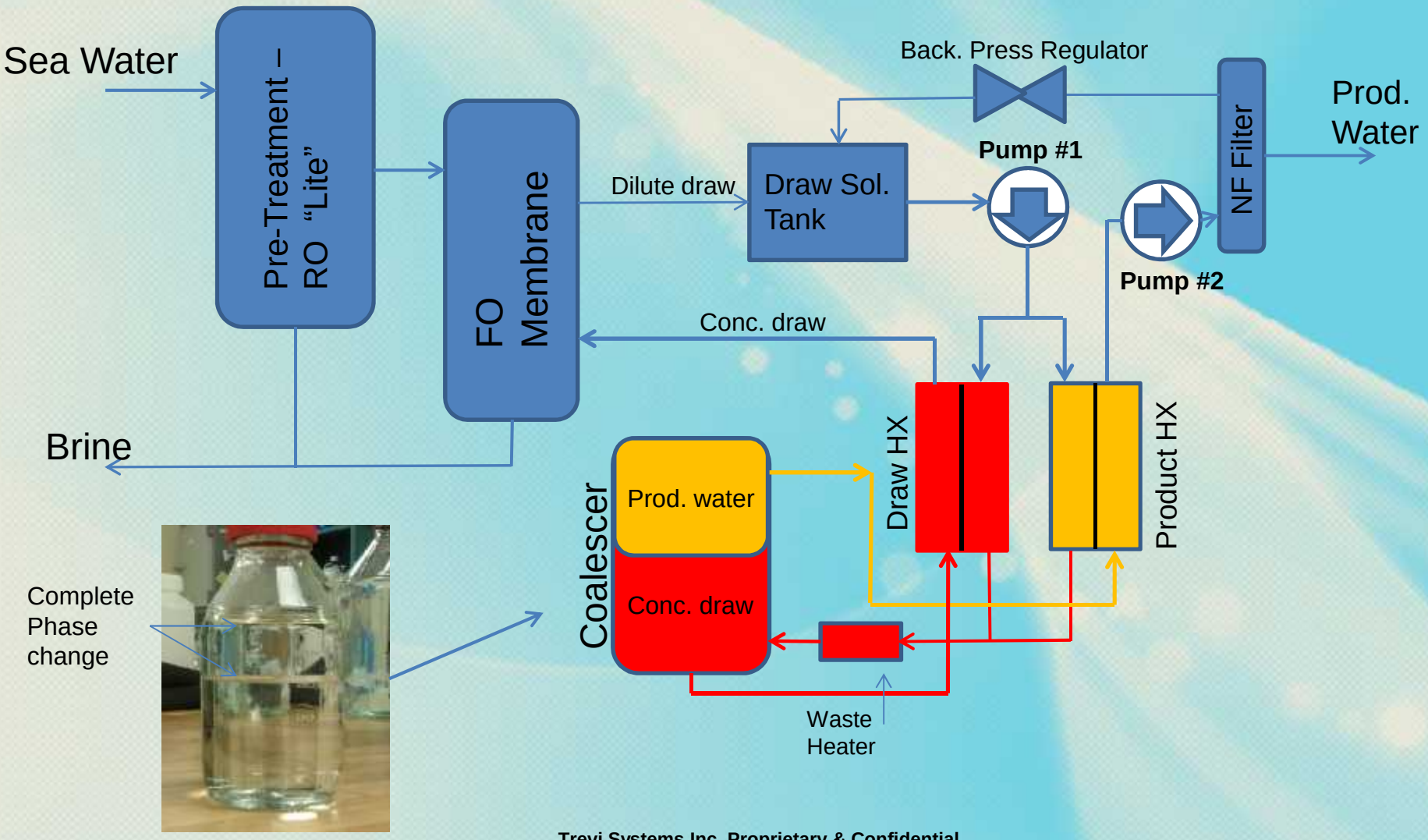
Trial site at Ghantoot

Containers I and II being installed at Ghantoot

Forward Osmosis Desalination
Basic FO Process



Trevi Gen3 Process – Waste Heat



Inland Brackish Water

Desalination of Inland brackish Water:

- Reverse Osmosis is the “gold standard” producing high quality permeate water.
- After desalination of brackish water, ***over 50%*** of the cost of the water is in the brine disposal.
- Another ***20%*** is in the chemical usage and **energy consumption** increase with increasing recovery.
- An increase in the recovery from 80% to 90% decreases brine volume by 50%.
- An increase in the recovery from 80% to 90% doubles the energy consumption.

How do we increase Recovery while still minimizing Energy Consumption?

RO recovery vs. SI

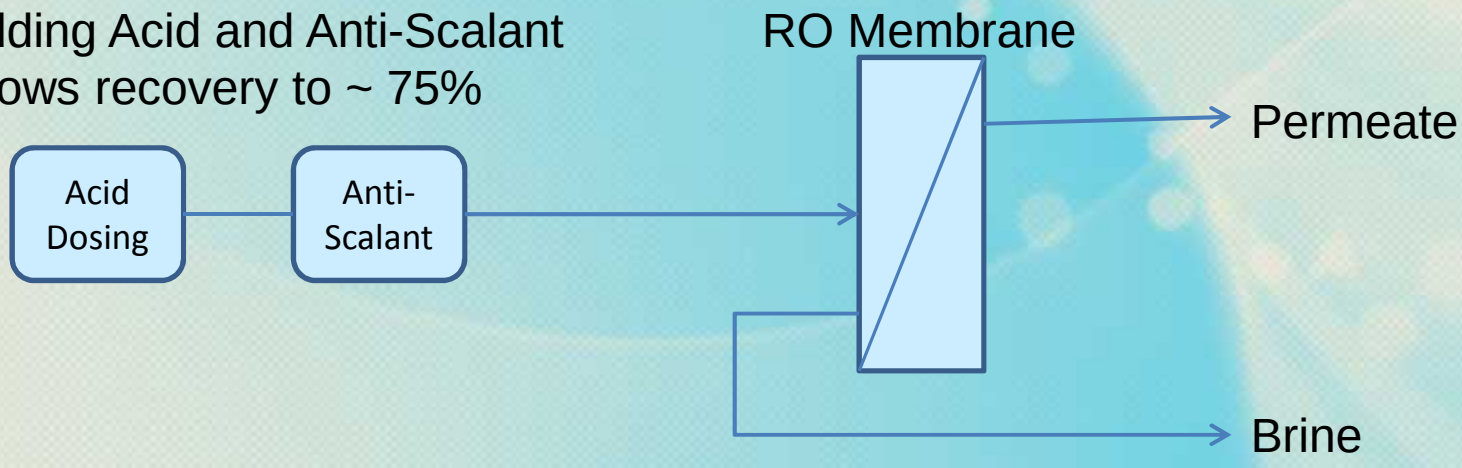
The saturation index (SI) is a standard method to predict scaling in RO systems.

SI looks at Sulfate scaling on the RO membranes, the most common scaling in brackish water, with CaSO4 and BaSO4 the most prevalent scale formers.

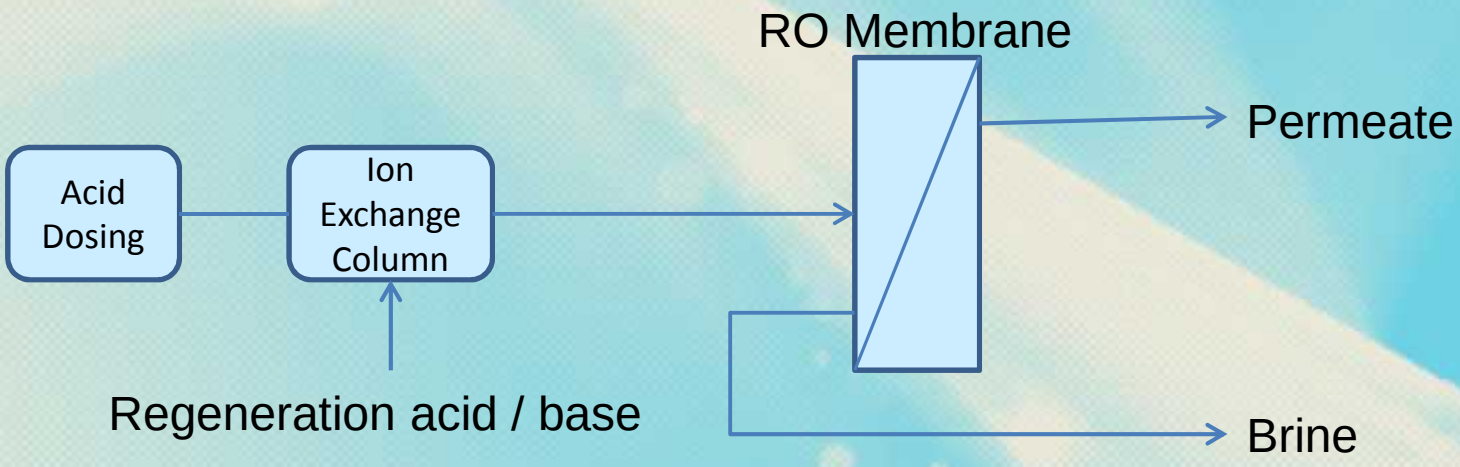
At recoveries >50%, the SI index is typically exceeded, necessitating the use of chemical anti-scalants to be added:

→ Increase in water cost

Adding Acid and Anti-Scalant allows recovery to ~ 75%



RO Recovery >75%



Adding Ion Exchange to remove Ca, Ba using cation exchange columns increases recovery from <75% up to 85%.

How much recovery is enough ?

Brine disposal Ponds:

- Typically require double lined pond to prevent brine leaks with monitoring.
- Require spare capacity to allow for heavy rains and possible overflow of pond
- Bird netting may be needed
- Human safety measures?

- ***Brine ponds are expensive to build and maintain and create a lasting environmental problem.***

Consider a 1000gpm Ag well:

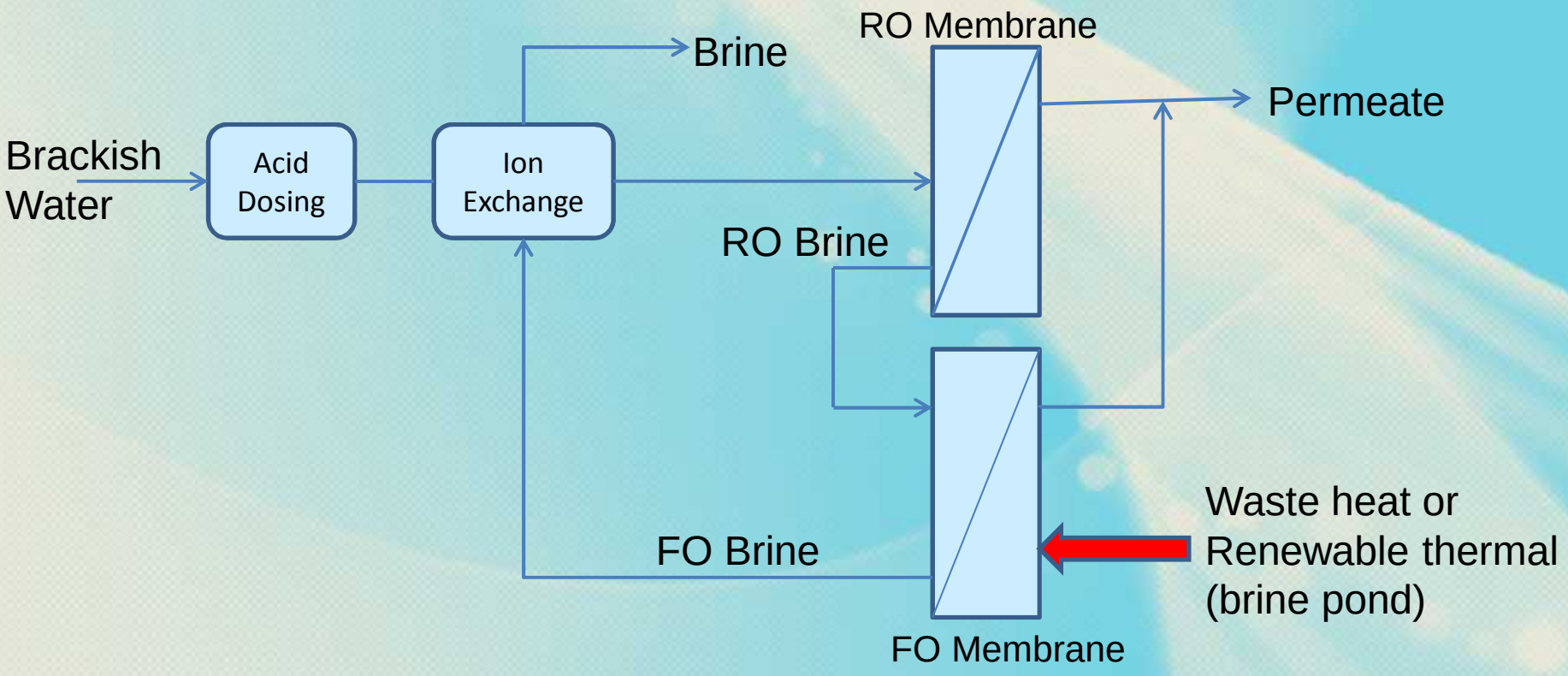
Pond ** Sizing	50% Recovery	75% recovery	85% recovery	95% recovery
Per month	33	16	10	3
Per Season	164	82	49	16

** = number of Olympic sized swimming pools

Ultra High Recovery (>95%)

Increasing Recovery Increases Energy but decreases Pond Size

How do we keep the energy under control with minimum pond size?



System Benefits

Combined RO/FO System:

- Recovery can exceed 95% consistently.
- Brine from FO regenerates anion Ion exchange column, reducing chemical dosing to *acid only*.
- FO system runs on heat gathered by sun shining on brine pond – or can run on other waste heat sources, eliminating the water-energy “nexus’.
- FO system can be used instead of RO in the future but membrane availability currently limits systems to <100gpm.