

Brine Concentration

The need for brine concentration has never been greater with increased focus on waste minimisation, increased water recycling and requirements for zero liquid discharge (ZLD). Traditional brine concentration may use a combination of reverse osmosis, followed by thermal brine concentration and finally thermal brine crystallisation for ZLD. The integration of Modern Water's brine concentration technologies substantially reduce both the capital and, in particular, the operating costs.

The main issues with the conventional approach to ZLD, relate to the thermal brine concentrator and separate crystalliser, in that they are expensive to buy and maintain because of the materials of construction and their complexity, with particularly high operating costs primarily due to energy consumption. Modern Water's brine concentration technologies can either eliminate or substantially reduce the size of a thermal brine concentrator and crystalliser as part of a brine concentration or ZLD treatment process.

Modern Water has two different patented and proprietary processes for brine concentration, developed from our extensive knowledge of forward osmosis and osmotically driven membrane processes. These were developed to meet the needs of generating very high osmotic pressure solutions for use in forward osmosis type applications and more specifically brine concentration. These processes only use electrical energy for pumping - being pressure driven. Operating with hydraulic pressures similar to conventional seawater reverse osmosis, yet can easily produce brine concentrations in excess of 160,000 mg/l as NaCl equivalent.

- Ability to operate in high salinity waters
- Low power consumption
- Eliminates the need for thermal energy
- Reduces the size of expensive brine concentrators/crystallisers
- Simplicity of operation



MODERNWATER



Process explained

The processes work using a multi-passed array of specialised semi-permeable membranes and incorporate forward osmosis depending on the application. Energy recovery of some of the pressure energy used can be recovered,

if required. The processes are subject to patent applications and proprietary so they are not shown diagrammatically here.

Diagram I: Brine concentration technologies (Adapted from GWI Produced Water report, 2011)

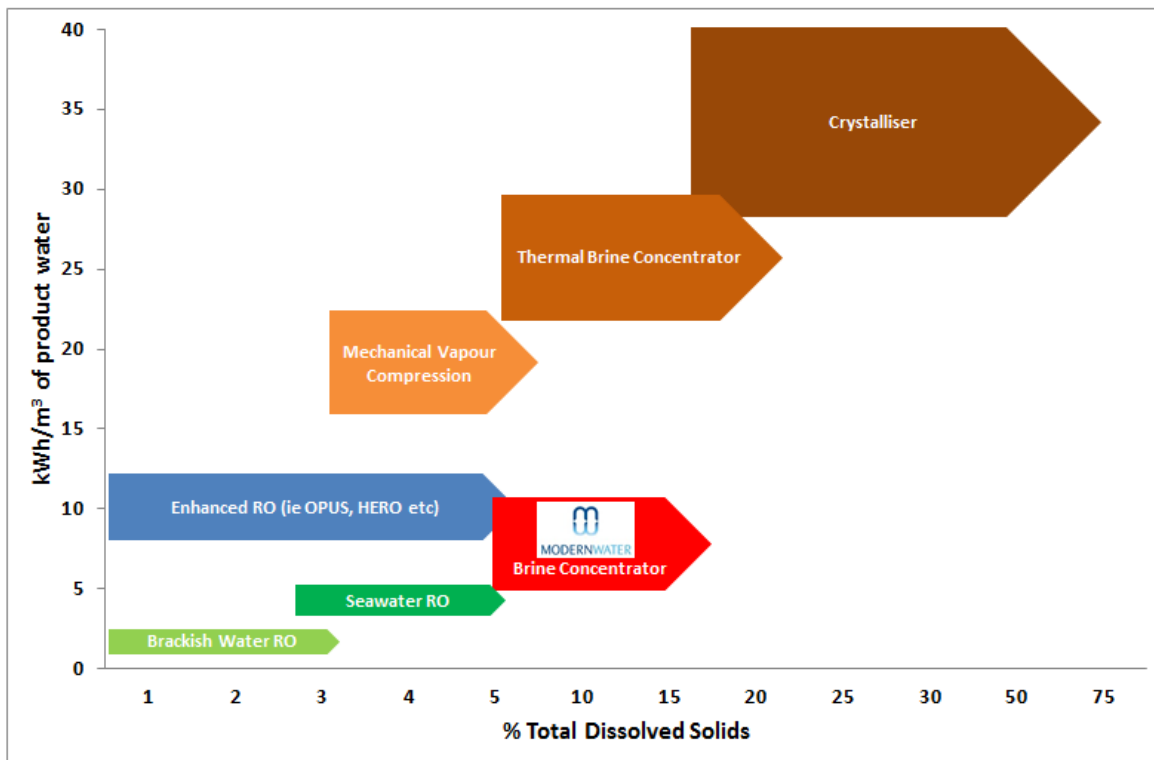


Diagram I illustrates where Modern Water's brine concentration system fits within the broad spectrum of processes for brine concentration and in particular energy consumption. These processes can be used for brine concentration either on their own or in combination.

By way of example, if we consider a seawater reverse osmosis plant operating with 'standard' seawater at 35,000 mg/l TDS and a recovery of 50% this would give a brine stream of

approximately 70,000 mg/l. Table 1, summarises some examples of what can be achieved for the process excluding any particular pre-treatment requirements. Concentrator Type 1 is less complex than Type 2, whereas Type 2 incorporates a number of energy recovery features, with the selection criteria depending on Client requirements. The product water quality can be improved further if required.

Diagram 2: Modern Water brine concentrator indicative performance

Concentrator type	Feed water TDS (mg/l as NaCl)	Brine TDS (mg/l as NaCl)	Concentration factor	Product water TDS (mg/l as NaCl)	Energy consumption kWh/m ³ of product water
Type 1 (2 stage)	70,000	128,000	1.83	250	10.5
Type 1 (3 stage)	70,000	165,000	2.36	350	14.7
Type 2 (2 stage)	70,000	128,000	1.83	250	6.8
Type 2 (3 stage)	70,000	165,000	2.36	350	11.3

Summary

Modern Water's All Membrane Brine Concentrator (AMBC) can:

- Operate on high salinity waters that are beyond the reach of common reverse osmosis
- Create a high dissolved solids output, up to 165,000 mg/l of total dissolved solids
- Uses low power consumption compared to other competing processes
- Simplicity of operation and high reliability
- Utilises electrical power, eliminating the use of thermal energy and the complexities common to other brine concentration approaches
- Reduce the size of expensive, high maintenance and complex thermal brine concentrators and crystallisers by significantly reducing the feed fluid volume

We would welcome discussing your particular requirements and how our products can reduce the overall capital and operational expenditure of your brine concentration application.

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