

Depth Exposed Membrane for Water Extraction

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DXV Water Technologies has designed a novel membrane system that uses natural pressure, a very low recovery rate and gravity flow of feedwater past the membrane surface, resulting in an elegant, efficient system. Since the invention of the reverse-osmosis (RO) membrane researchers have tried to harness natural water-pressure, but past attempts mimic onshore processes with their configuration, recovery and flux.

DEMWAX™ cartridges are arrays of vertical membrane pockets spaced to allow gravity and natural dispersion to move the feedwater away from the membrane surface and down the channel, drawing more feedwater from above. Such spacing keeps the water between the membrane elements from concentrating more than a few percent, minimizing the osmotic pressure requirement. The result is extremely low recovery of 2-3%.

When operating at relatively low flux (2-5 Lmh), the velocity required is approximately 0.5-1.0 m/min. Laboratory tests have confirmed that even small concentration differentials produce velocities of this magnitude.

A breathing tube communicates atmospheric pressure to the inside of the membrane pockets to achieve the required differential. A permeate collection channel perpendicular to the membrane sheets transfers the water to the wet well where a standard submersible well pump conveys the water to the point of use.

The energy required to move the product water to shore (assumes 10 km) from the design depth of the seawater RO DEMWAX is approximately 1.1 kWh/m³.

This low-flux low-recovery process will require more membrane than traditional systems; however, the elimination of intakes, outfalls, pre-treatment, pressure vessels and piping, energy recovery devices and coastal land will result in a water cost that is below many traditional sources.

Biofouling and its mitigation are continuing areas of study. Membrane cleaning cycles will be extended by in-place ultrasonic vibration and antifouling coatings resulting in less frequent out-of-water servicing. In seawater, the lack of light at the

design depths and low turbidity of feedwater will also extend this cleaning interval.

The concept is applicable to any body of water by using different flat-sheet membrane, from microfiltration to SWRO. This allows for customization based on source water and desired permeate quality.

For example, the fresh surface water DEMWAX can be configured with a microfiltration or ultrafiltration membrane, but a small increase in depth allows the use of nanofiltration membrane that enhances water quality.

In addition to substantial energy savings, environmental and economic benefits that the DEMWAX system offers include:

Mitigation of 'Brine' Disposal – the extremely low-recovery operation results in 'brine' at approximately 2-3% more concentrated than the surrounding ocean

Mitigation of Impingement and Entrainment – the intake velocity is several orders of magnitude less than typical intakes, virtually eliminating impingement and entrainment.

Scalability – the system can be readily expanded with the addition of cartridges and pumps.

As DXV develops pilot installations it is apparent that the simplicity, flexibility and minimal environmental impact of DEMWAX™ demonstrate considerable potential for many water treatment applications.