

CASE STUDY: High Recovery Brackish Water Treatment

At a Glance

Industry:
Municipal, Industrial

Wastewater:
Highly scaling brackish water

Treatment Requirements:
High recovery, low volume brine, remove need for chemical softening

Product:
Flex EDR-RO hybrid

Results:
Flex EDR-RO removed chemical softening. Brine discharge volumes reduced by 50%

Economics:
Total cost of ownership (CapEx + OpEx) estimated at \$1-3/m³ depending on water chemistry, plant capacity, and site conditions

Challenge

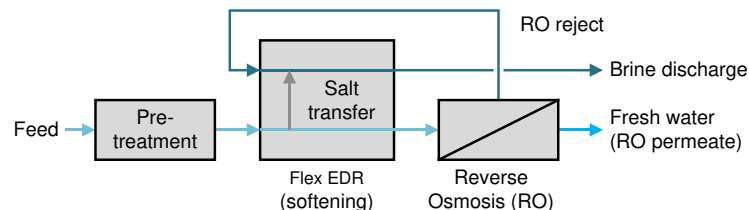
Reverse osmosis recovery of 60-70% is achievable for desalination of “typical” inland brackish water. However, brine volume equates to 30-40% of inlet volume. Higher concentration, lower volume brines reduce the capacity of more expensive downstream brine management options while maximizing source water productivity. Reverse osmosis recovery is often limited by either source water silica or hardness. Anti-scalants can be used for silica. Conventional chemical softening and ion exchange (IX) is often used for hardness removal. Chemical softening results in costs associated with chemical procurement and handling and added safety liabilities. Also, waste streams from the chemical softening, sludge and IX regeneration wastewater require management and disposal adding more cost.

Solution

Saltworks’ Flex EDR –RO hybrid can achieve 80-90% recovery, without chemical softening or IX, resulting in a 50% reduction in brine volume – and 50% less waste to dispose of. Flex EDR is an advanced electro dialysis reversal (EDR) technology that is highly effective in softening and simultaneously concentrating RO brine reject. This offers two benefits: higher system recovery and removing troublesome chemical softening steps.

Flex EDR utilizes a modular stack comprised of IonFlux anion and cation exchange membranes, embedded in a system with electrode fouling protection and automated self-cleaning capabilities. The modular stack design allows for easy maintenance and capacity expansion. Flex EDR also uses a novel stack configuration that enables operation at extremely high concentration gradients and with the ability to produce a brine discharge up to 125,000 mg/L, depending on specific water chemistry.

An electrical current fluxes ions through IonFlux membranes to desalt the brackish water and concentrate a low-volume brine reject stream. As Flex EDR is not fluxing water through the membranes there is no pressure difference across the membranes so Flex EDR is far more tolerant to inorganic scaling and organic fouling than RO. IonFlux membranes have high divalent ion transference making them effective at softening brackish water while also desalinating RO feed and concentrating brine.

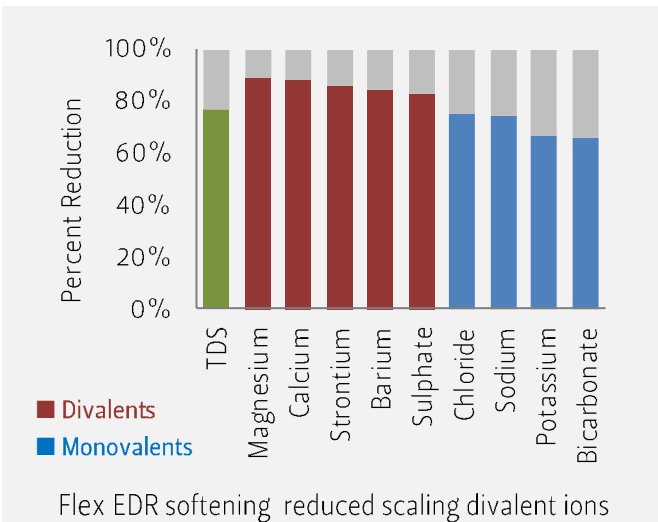
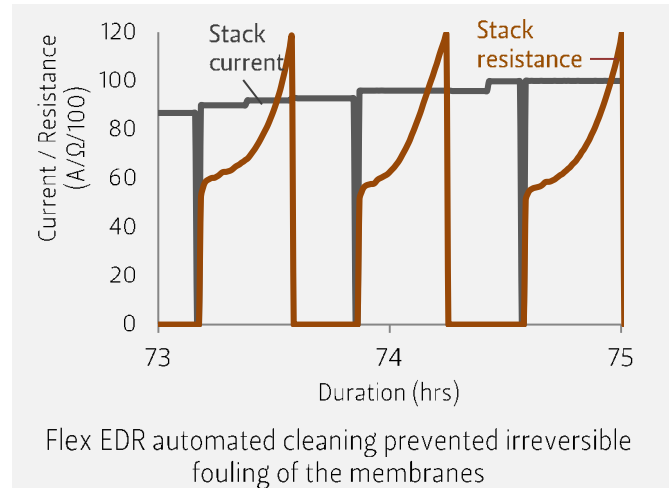
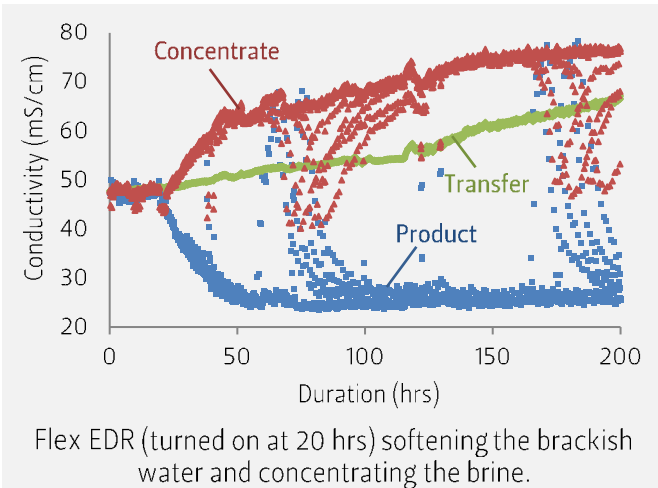


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Results

A 50 m³/day Flex EDR-RO hybrid plant was operated on scaling brackish water with the following results:

- 80% recovery (20% higher than a chemical softening-RO system operating on the same brackish water)
- Brine concentrated from 22,100 to 106,500 mg/L TDS resulting in half the brine discharge volume.
- Effective softening of the brackish water while simultaneously concentrating the brine.
- Automated self cleaning prevented irreversible fouling of the IonFlux membranes.



Parameter (mg/L)	Raw brackish water	Softened RO feed	RO permeate	Brine discharge
pH (pH Units)	8.41	8.50	7.23	8.49
TDS	22,100	5,180	223	106,800
TOC	25.3	23.0	1.2	74.0
Bicarbonate (as CaCO ₃)	2,480	855	30	3,330
Barium	2.71	0.4336	0.0006	1.2
Boron	4.3	18.3	1.5	13.2
Calcium	177	21.24	<0.05	685
Chloride	12,400	3,100	182	63,300
Lithium	2.25	0.80	0.02	9.05
Magnesium	241	27	0	747
Nitrate-N	16.2	4.1	0.006	10.7
Potassium	66	22	1	311
Silica (Reactive)	4.51	16.2	<0.5	6.1
Sodium	8,200	2,132	70	41,300
Strontium	13.8	1.9	0.0	6.5
Sulphate	16	3	<0.5	57

Summary

Flex EDR-RO hybrid can effectively increase water recovery over conventional chemical softening-RO systems. This results in a low volume highly concentrated brine and eliminates chemical requirements and the associated sludge and acid regen wastewater management. The total cost of ownership (CapEx and OpEx) ranges from \$1-3/m³ depending on water chemistry. Saltworks would be pleased to complete an Flex EDR-RO hybrid performance and economic assessment of your brackish water treatment project. Please contact projects@saltworkstech.com. Lease and pilot plants are available.