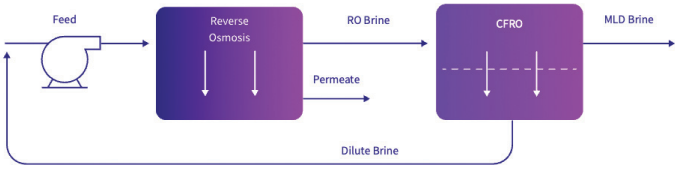
Technology Profile

RO INFINITY WITH CFRO

Many of today's water and wastewaters cannot be efficiently treated with conventional membrane or thermal technologies. Gradiant has developed RO Infinity with CFRO, an advanced platform of membrane-based solutions for complex water and wastewater challenges, that combines our patented Counterflow Reverse Osmosis (CFRO) technology with innovative reverse osmosis (RO) membrane processes. RO Infinity solutions enable customers around the world to achieve desalination, brine concentration and sustainability goals.

Overview of the Solution

CFRO is Gradiant's patented membrane brine concentration technology. The CFRO process was developed to enable affordable brine concentration and minimization with RO membranes. Like conventional RO, the CFRO process uses hydraulic pressure to drive water across a semi-permeable membrane, filtering out dissolved salts. What makes the CFRO process unique is the innovative process design and the customizable membranes employed to target various salts selectively. The osmotic pressure barrier is reduced by the controlled salt passage, which in turn reduces operating pressures to 69 bar (1,000 psi) or less. Arranged in a multi-stage cascade, the CFRO process can achieve final brine concentrations of up to 260,000 mg/L TDS (as NaCl) while producing high-quality permeate.



CFRO is used in desalination and brine minimization applications, including lithium extraction and ZLD flowsheets. Its unmatched design and exclusive membrane technology enable substantial cost savings and lower complexity than other approaches, such as Evaporator and Ultrahigh Pressure Reverse Osmosis (UHPRO) systems. Table 1 below compares these approaches, highlighting that CFRO can not only reach saturation limits but also do so with low capital investment, less complex operations, and more efficient energy use.

TABLE 1

	UHPRO	Evaporator	CFRO
Treatment Brine TDS (mg/L)	<130,000	<260,000	<260,000
Treatment Capability (TDS)	Brackish, Seawater	Brackish, Hypersaline	Brackish, Hypersaline
Capital Expense	Medium	Very High	Low-Medium
O&M Complexity	Medium	Complex	Simple
Energy Consumption	Medium	Very High	Medium

For sites evaluating water recycling to improve sustainability, the approach can provide equivalent water recovery for 60% savings versus conventional seawater RO (SWRO) systems, as shown in Figure 1. Because CFRO operates at substantially lower pressures than UHPRO, it directly impacts lower capital and operating costs for these systems. As shown in Figure 2, the total lifecycle cost difference can be as high as 10-15% lower per unit volume of water treated.

Key Benefits

MAXIMIZE PRODUCTION

Extract more fresh water, recover higher concentrations of valuable resources, and minimize waste disposal — all at lower pressures and energy use which reduces the total water cost.

MINIMIZE CAPITAL AND OPERATING COSTS

Recovers up to 99% final brine concentrations to the saturation limits of salt (TDS up to 260,000 mg/L NaCl).

MAXIMIZE SYSTEM AVAILABILITY

RO Infinity systems leverage SmartOps AI to adjust for varying feedwater and operating conditions. CURE Anticsalant chemistries are precisely designed to tolerate these variable conditions to ensure less fouling, longer membrane lifetime, and improved energy efficiency.

Core Capabilities that Set Gradiant Apart

INNOVATION

Award winning, patented technologies with industry leading performance.

AI AND MACHINE LEARNING

Machine learning AI algorithms deliver immediate cost and performance improvements.

PROJECT DELIVERY

A range of contract models that are adaptable to the unique situation and needs of our customers.

CURE CHEMICALS

Custom formulae, developed in-house to meet the high-performance specifications our technologies demand.

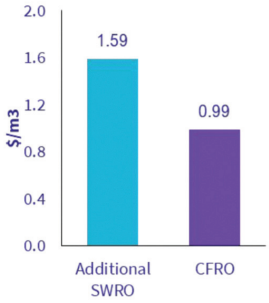


Figure 1: Cost to Expand Fresh Water Production for SWRO desalination

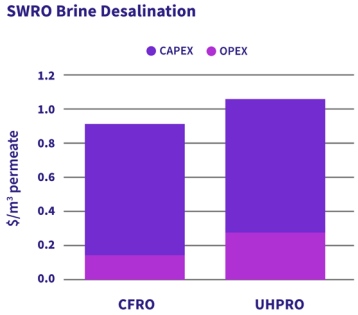


Figure 2: CAPEX and OPEX Cost Comparison for SWRO Brine Desalination

Featured Success Stories

Confidential Client, Australia

A municipality was able to improve overall water recovery from <75% to 98% and eliminate off-site disposal of brine by adopting CFRO in its treatment scheme for saline groundwater.

SLB (formerly Schlumberger), United States

SLB is now able to maximize lithium recovery in their innovative DLE flowsheet, achieving 15X concentration and benchmark recovery rates. A second CFRO system is also able to provide up to 100% of process freshwater needs at this remote and arid site.

SAWACO, Saudi Arabia

As a leading provider of potable water in the Kingdom of Saudi Arabia, SAWACO has been able to achieve an overall recovery rate of 69%, doubling its previous capacity without additional feedwater or pretreatment requirements.

Gradiant's Innovation Culture

Our award-winning commercial innovation sets us apart in the industry. We rapidly translate innovations from bench scale to commercialization that support our mission to deliver water treatment solutions that meet the evolving needs of our customers. Our R&D advancements, whether equipment or chemical, are thoroughly validated in Gradiant's global laboratories and field-tested before deployment. Customized bench- and pilot-scale testing is used to demonstrate proof-of-concept and cost optimization — by the same teams that develop our leading-edge commercial technologies.

CONTACT US

Learn more about our technology at www.gradiant.com/technologies/ro-infinity
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