

CFRO For alkaLi

CFRO is an award-winning technology foundational to alkaLi's differentiated performance in the CONCENTRATE process stage. Gradient developed CFRO as a premier solution for complex resource recovery and water and wastewater challenges.

Overview of the Solution

CFRO deploys patented membrane brine concentration technology to enable affordable brine concentration and minimization with RO membranes. The CFRO process uses hydraulic pressure to drive water across a semi-permeable membrane, filtering out dissolved salts. What makes the CFRO process uniquely different is its ability to achieve concentration to salt saturation limits, 260,000 mg/L TDS (as NaCl), while producing high-quality permeate. In contrast, conventional RO concentration is limited to ~80K mg/l. Even more remarkable is that CFRO achieves this at reduced operating pressures, which requires less pumping energy, translating to lower energy costs and fewer membrane replacements over the system's

lifetime. This industry-leading performance is the result of innovative process design and permselectivity of membranes for a broad range of salt types that permits a controlled salt passage, reducing the osmotic pressure barrier, and enabling the operation to be carried out at 69 bar (1,000 psi) or less.

alkaLi exploits CFRO's benefits to optimize the CONCENTRATE stage in lithium and other critical mineral flowsheets. Borne from Gradient Labs, the patented design and membrane technology enables 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 reach the highest saturation limits with the lowest capital investment, operational complexity, and energy usage.

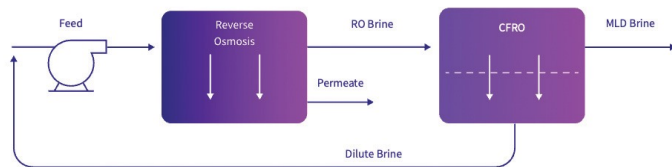


Table 1	UHPRO	Evaporator	CFRO
Treatment Brine TDS (mg/L)	<130,000	<260,000	<260,000
Treatment Capability (TDS)	Brackish, Seawater	Brackish, Hypersaline	Brackish, Hypersaline
Capital Expense	Medium	Very High	Low-Medium
O&M Complexity	Medium	Complex	Simple
Energy Consumption	Medium	Very High	Medium

Maximize production

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

Minimize capital and operating costs

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

Maximize system availability

SmartOps AI supercharges RO Infinity systems to accommodate varying EXTRACT quality and operating conditions. alkaLi designs service programs to operate flawlessly under variable conditions to ensure less fouling, longer membrane lifetime, and improved energy efficiency.