

# In-land Desalination capability

## Global Water Challenge

Increasing regulatory pressure, growing environmental awareness and more and larger membrane desalination plants are driving the need for better brine minimization – one of the greatest challenges currently facing the water treatment sector. In-land desalination is becoming increasingly important in arid regions around the world, because of population growth, salinity increase and scarcity of water resources, such as Eastern Europe, Eastern/Southern of US, Middle East, Asia and Australia.

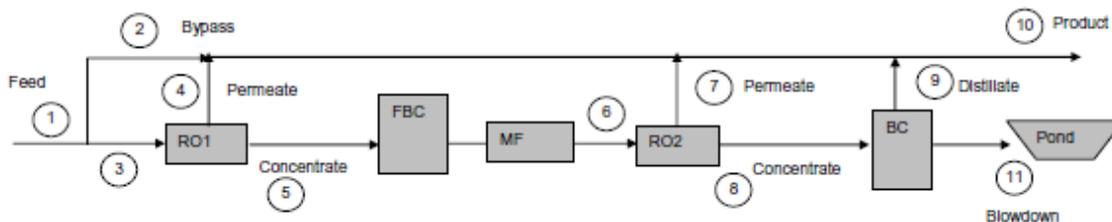
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RO is the state-of-the-art technology for desalination, with a typical recovery limited to 70 to 80%, because of the presence of scaling salts such as calcium carbonate, barium sulphate and silica. AWWA international sponsored research (AwwaRF) on Zero Liquid Discharge for Inland Desalination concluded that the Fluidized Bed Crystallizers (FBC) combination with Reverse Osmosis is the most viable technology.

## FBC Crystalactor Technology

The Crystalactor forms hard-rock limestone pellets and is a proven technology for pre-treating RO feeds, or post-treating primary RO concentrate streams, allowing efficient concentrate treatment in a secondary RO. As calcium carbonate and barium (main case for scaling problems in membranes) is removed before RO, recoveries up to 90% are easily achieved. Advantages:

- ✓ Treatment costs could be reduced by 50 to 67%
- ✓ Potential energy savings up to 75%
- ✓ Significant smaller evaporation ponds
- ✓ FBC can achieve removal of silica as well
- ✓ FBC produces off-take ready pellets (98% dry) in stead of a salty waste



Learn more: [www.crystalactor.com](http://www.crystalactor.com)

## Our Company

Royal HaskoningDHV is an independent, international engineering, consultancy and technology provider with over 135 years of experience. Through innovation, our projects are embedding smart solutions, pioneering technologies, resilience, flexibility and future functionality for businesses and communities across the world. Innovation is a collaborative process, inspiring our clients and other stakeholders. We show leadership in the development and commercialization of Nereda and Crystalactor, which are available to the market through our license partners. We are recognized as technology originator with deepest process and application knowledge of the FBC technology. As FBC in-land desalination market leaders, we have the largest references in the world.

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## Reference in-land desalination projects

Year of completion	Client/location	Project Description
2016	Western Municipal Water District Chino Desalter Authorities (CDA) California US	Chino II Brine Concentrate Reduction Facility. Application of a 10.000 m3/day pellet reactors for softening of concentrate from a primary RO to allow treatment in a secondary RO to increase the water recovery of the total plant. This entire plant \$54M of construction plant was shoehorned into a 1.2-acre site. Royal HaskoningDHV assisted Carollo Engineers on the Crystalactor aspects throughout the project, starting with assistance in the pilot plant trails, continuing with design support and ending with start-up assistance and training of the operators of the plant. CDA has achieved its project goals on the sustainability aspects (create a beneficial byproduct; reduce basin water export; reduce brine line impacts), water supply (provide additional potable supply and reduce groundwater pumping).
2012	Procorp Valencia, US	The Crystalactor softening technology was supplied by our US license partner for the crystallization of calcium carbonate on calcite seeds, reducing the CAPEX for proposed WWTP extension dramatically. Primary RO concentrate continuously flows in an upward direction through the single reactor. The plant has a capacity to treat/soften up to 4300 m3/day and reduce the hardness down to required level. The Crystalactor® produces calcium carbonate pellets (sold at \$20-\$40 per ton) instead of a bulky sludge or brine, which reduces the operational costs for sludge handling significantly. Self-regenerating softeners have been banned and the chloride target in the WWTP effluent is achieved, delivering high-quality water to Santa Clara River for downstream irrigation to cultivate avocado's and strawberries.
2012	MWE / Glacier Technologies Inc Riyad KSA	RHDHV was hired by Metropolitan Water Enterprise KSA to prepare design works for a 400,000 m3/day inland desalination plant for drinking water production in Al-Wasia. RHDHV provided key input to introduce Crystalactor technology to increase the RO recovery. The total project scope includes: Intake well water to site, delivery of the product water to the main reservoir and the concentrated brine to the evaporation ponds.
2007	Black and Veatch US	AwwaRF Research Program into Zero Liquid Discharge for Inland Desalination. Supplying a 50 mm diameter Crystalactor pilot plant to Black & Veatch Advising Black & Veatch, training their personnel in its operation on RO concentrate produced from Lake Mead water, assisting in the analysis of the results and providing input on pellet research for the final report.
2000	Water Corporation of Western Australia Perth, Australia	Aim of the project was to achieve a TDS reduction by removal of calcium carbonate. Design, start-up and staff training of a softening plant in a consortium with Bovis Lend Lease (main contractor) and GHD (design) for a design and build contract for Neerabup Stage 2 Groundwater Treatment Plant near Perth, Western Australia. Revolutionary design incorporating concrete pellet reactors for large scale capacity, dosing lime in the reactors. Plant capacity: 120.000 m3/day

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1998	STEP Belgium Bukayryah KSA	Commissioning of softening reactors Bukayryah in as pretreatment to RO of brackish groundwater for contractor STEP.
1988	Klöckner Industrie Anlagen Unayzah KSA	Commissioning of softening reactors in Unayzah as pretreatment to RO of brackish groundwater for Klöckner Industrie Anlagen
1984	Ministry of Agriculture and Water Bukayryah KSA	<p>The Qasim Region is located 500 km Northwest of Riyadh. Three plants of 50,000 m<sup>3</sup>/day were designed to treat brackish water from the Saq aquifer. The function of the plants was to supply water until the completion of the Jubail-Hail system would supply desalinated seawater to the region. After the completion of this system the plants would become back-up facilities. With a pre-treatment step using the Crystalactor® process, those scaling salts are removed, allowing a recovery of 90%. Vapor compression was selected to recover 90% of the RO concentrate, yielding an overall recovery of 99%.</p> <p>Pre-treatment: Pellet softening by Crystalactor®, sand filtration            Post-treatment: Multiple reverse osmosis stages            Brine treatment: Vapour compression, evaporation ponds.</p> <p>Design of 4 treatment plants (Unayzah, Bukayryah, Al Rass; Riyadh Al Khabra) each for treatment of brackish groundwater. Treatment comprised: softening in a Crystalactor, dual media filtration, RO, brine evaporation, chlorination.</p> <p>Plant capacity: 40.000 m<sup>3</sup>/day</p>

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