**CRYSTALLIZATION**

**Process Description**
Crystallization is an equilibrium-based separation and evaporation technology that uses energy as the separating agent and can be comprised of a combination of treatment processes that are more energy efficient at removing water from lower TDS waters. For instance, RO is commonly used for an initial pass through if TDS levels are sufficiently low. Crystallization processes can then be used to further concentrate the RO concentrate stream by extracting water from the brine solution; the total volume of the liquid concentrate is reduced while the associated TDS increases significantly.

The water (extract phase) can be re-circulated through the RO and concentrate (sludge-water) flows through evaporators. Water is evaporated with heat or pressure differential and the dissolved solids remain in sludge state, which effectively eases the handling and disposal of reduced volume of waste in slurry/sludge form.

**Technical Capabilities**
Crystallization can generate clean water from saturated or even crystallizing brines with total dissolved solids (TDS) at concentrations up to 650,000 mg/L. In a salt crystallizer, typical analysis of the resulting condensate shows a typical content of residual salt not higher than 50 ppm; 95%+ return rates of frac flowback and produced waters can be achieved. This process also efficiently removes sodium and calcium chlorides as well as the heavy metals in the effluent generated in shale gas production.

In commercial salt applications, slurry generated from the crystallization process can be centrifuged to dry for industrial use or heat dried for human or food grade use.

**Technical Limitations**
For economic reasons, crystallizers are seldom applied to low-TDS water sources because of their high operational energy input requirements and subsequent treatment costs. In addition, crystallizers are often non-mobile facilities and require water to be transported to them, which may equate to higher treatment costs relative to other treatment technologies with mobile capabilities.

To minimize the effects of corrosion or scaling, settling or filtration is often required to remove settable solids from the inflow stream.

**Note:** Information is from vendor, however specifications may have changed. Contact vendor for updates.

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**KEY CONSIDERATIONS**
- Crystallization can generate clean water from saturated brines with TDS at concentrations up to 650,000 mg/L.
- Crystallization is often paired with other treatment processes that are more energy efficient at removing lower TDS concentrations in water.
- Crystallizers are seldom applied to low-TDS water sources because of their high operational energy input requirements and subsequent treatment costs.

![Intevras evaporative reduction and solidification (EVRAS) system](image-url)
Costs
Cost information associated with crystallization was not reported by the major treatment vendors. However, cost considerations for use of this treatment technology will include: feed water quality versus target TDS concentrations, a factor that can dictate the number of evaporation steps; Zero Liquid Discharge objectives, high energy input, limited non-mobile facilities; and disposal of solid waste.

References


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