

Treatment of CAUSTIC SCRUBBER effluent

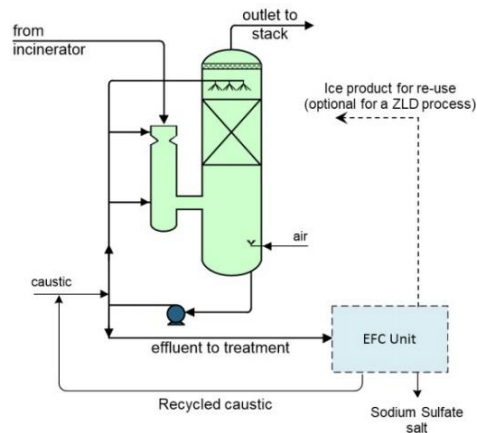
Advisian
Worley Group

Together with Advisian, Cool Separations offers the Eutectic Freeze Crystallization (EFC) process for treating caustic scrubber effluent from Sulfur Recovery Units (SRU).

EFC is a solution economically competitive and environmentally advantageous towards ZLD (zero liquid discharge).

LOWER CAPEX & OPEX UP TO 50% COMPARED TO EVAPORATOR CRYSTALLIZERS

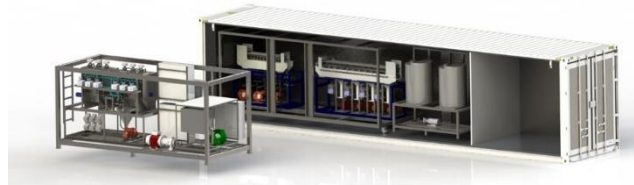
Integrated into the SRU, it removes sulfates in the form of pure salt from the scrubber effluent, whereby caustic is recycled. This leads to **potential savings on fresh caustic of up to 20%**.



PURE ICE & PURE SALT RECOVER

- Feed flow to the EFC plant is 1.5 m³/h
- Energy consumption <15 kWh/ton effluent
- Process water, <5 m³/h, can be recycled to a cooling tower
- Pressurized air, 5 bar.

COOL SEPARATIONS brings to the market the **Eutectic Freeze Crystallization (EFC)** process as an **ENERGY EFFICIENT** method to concentrate aqueous process streams and produce clean water (ice) and pure salt.



- All modular and skid mounted
- Each module can handle ca. 2-4m³/h feed
- Intake volume between 1-50 m³/h of high salinity brine



COOLSEPARATIONS
The experts in low temperature crystallization

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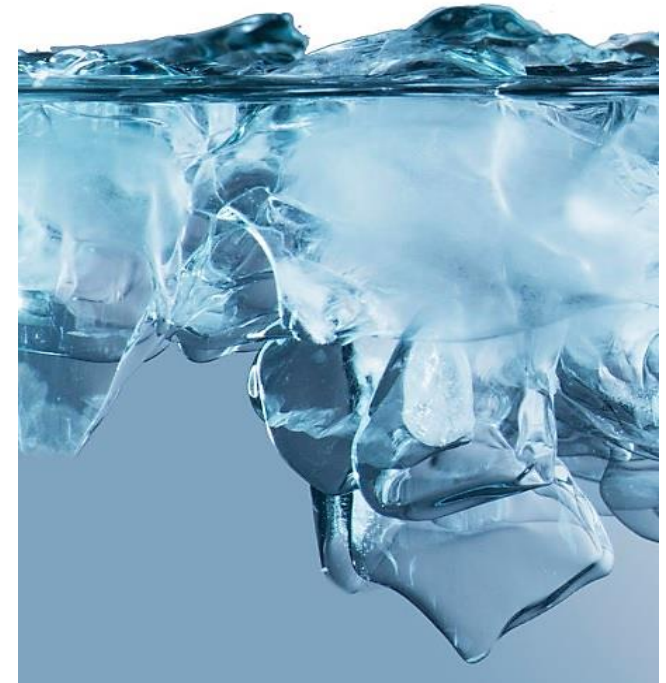
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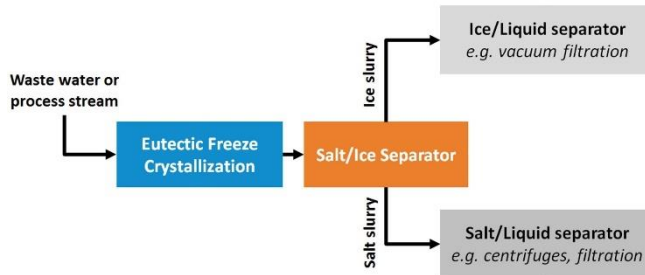
COOL SEPARATIONS

The experts in low temperature crystallization

- Brine management
- Resource recovery
- Dehydration of heat sensitive components

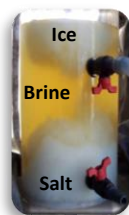
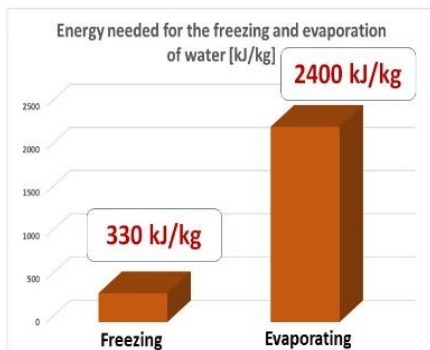
EUTECTIC FREEZE CRYSTALLIZATION (EFC)

is a technology that makes use of the existence of the **eutectic point** in solutions to separate the solute and the solvent simultaneously.



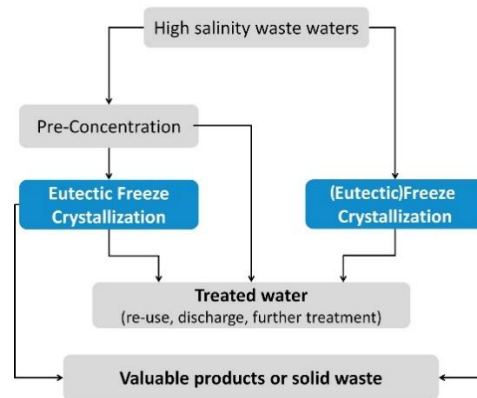
EFFICIENT, SAFE AND BETTER THAN EVAPOTRANSPIRATION

- ❄ Lower energy consumption
- ❄ No corrosion → No need for special materials for construction
- ❄ Chemicals free processing
- ❄ No scaling issues
- ❄ No maximum TDS limit at inlet
- ❄ No thermal degradation of the products
- ❄ Sub-zero temperatures and ambient pressures → Safe operation



Treatment of HIGH SALINITY Wastewater and brines

- EFC is applicable to a broad range of (high) salinity water streams
- Modular process design for easy scale-up
- Proven and standard equipment is used as much as possible
- Pilot test available at 400 kg/h continuous operation



❄ Water treatment

- Ion exchange regenerates for zero liquid discharge;
- RO concentrates.

❄ Oil & gas industry

- Flowback water from shale gas fracking;
- Oil co-produced water.

❄ Agriculture

- Ammonia scrubber effluent;
- Freeze concentration of RO concentrates from liquid manure.

❄ Chemical industry

- Various salt containing waste streams (Soda, Na₂SO₄, etc);
- Organic acids separation from fermentation broths.

❄ Metal processing & recycling industry

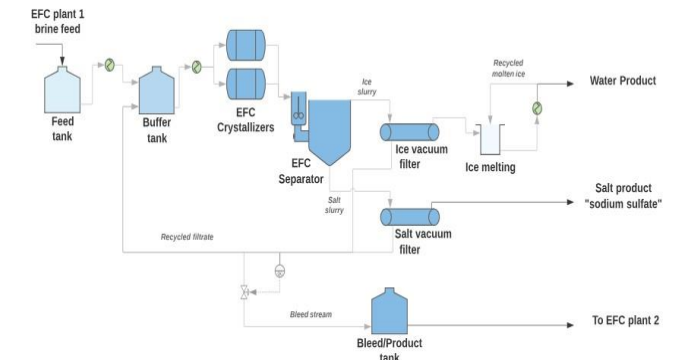
- Various metal salts (NiSO₄, ZnSO₄);
- Regeneration of pickling liquors.

❄ Mining industry

- EFC for acid mine drainage.

Treatment of ACID MINE DRAINAGE

The EFC process integrated with a full mine drainage treatment plant **converts the mine brine into pure salt(s) and clean water** that is suitable for reuse.



- Feed flow to the EFC plants is 122 t/day
- Water production from both plants is 65 t/day

Production of Na₂SO₄·10H₂O is 6.4 t/day (>99% pure)
Production of MgSO₄·11H₂O is 15.4 t/day (>88% pure)

- Energy consumption <40 kWh/ton feed
- Process water of 35 m³/h @ 3 bar and 15°C (This water is used for the cooling installation and recycled within the plant without treatment, including the cold recovery)
- Pressurized air of 4 m³/h @ 6 bar

EFC plants feed stream composition

Na (wt%)	Mg (wt%)	Ca (wt%)	K (wt%)	SO ₄ (wt%)	Cl (wt%)	TDS (wt%)
1.2%	1.7%	0.01%	0.34%	6.5%	2.4%	12.2%

EFFICIENT AND MAXIMUM SEPARATION

between: - magnesium and sodium sulfate salts.
- common chloride and sulfate salts.

- ❄ The recovered salts are of high purity, minimizing the disposal costs significantly.
- ❄ High purity water is produced with less than 1-wt% TDS. Further purification is easily achieved by integration with (existing) RO units.