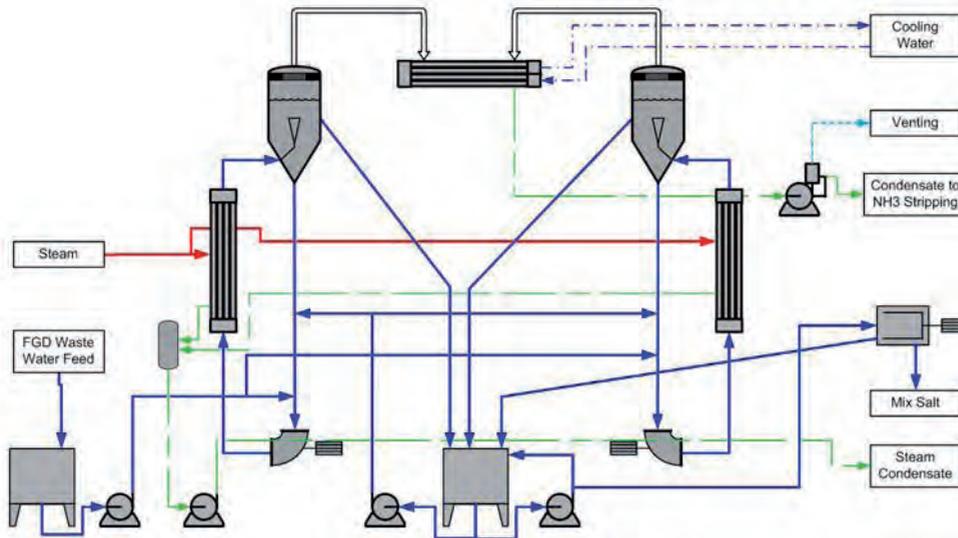


**Zero Liquid Discharge System**  
**Flue Gas Scrubber Wastewater Treatment System**  
N.V. Slibverwerking Noord-Brabant, Netherlands  
Reliable, Proven Technology, Experienced





#### Customer Benefits

- Robust FC crystallizer design inhibiting surface scaling of heat exchanges
- Redundant FC crystallizer trains allowing for continuous operation with limited to no down-time
- FC Design for temporary double capacity
- FC Crystallizer operated under vacuum for corrosion control

#### Background

In 1995, N.V. SNB constructed a municipal sewage treatment sludge waste-to-energy powered plant near Moerdijk, Netherlands. In support of this project, GEA Messo PT provided a Zero Liquid Discharge System. The waste generated by the system (salt crystals) is utilized for the mandatory stabilization of underground salt mines in Germany.

#### GEA's Solution (see Block Diagram)

GEA's solution for the 13.5 gpm (3m<sup>3</sup>/hr) FGD scrubber blow-down is a Forced Circulation (FC) Crystallizer System consisting of two (2) 100% FC Crystallizers. This system needs to concentrate and to crystallize the solute of a wastewater consisting of the following main characteristics:

Temperature	°F	85 -175	Chloride	mg/kg	7,490
Calcium	mg/kg	410	Sulfite	mg/kg	3,080
Sodium	mg/kg	19,550	Sulfate	mg/kg	34,300
Ammonium	mg/kg	1,729	Fluoride	mg/kg	700



The blow down enters an Equalization/Forward Feed Tank from where it is pumped into the recirculation line of the FC Crystallizer and gets concentrated by evaporation (FC crystallizer identical to a FC evaporator). The heating system condenses in the shell side of the tube and shell heat exchanger and transfers its energy by increasing the re-circulated suspension temperature. By leaving the central funnel in the crystallizer head, it starts to adiabatically flash/evaporate. This evaporation causes a supersaturation of the dissolved salts, thus causing crystallization to occur in the crystallizer vessel. The evolved vapors are condensed in a shell and tube condenser operated with cooling water. The concentrated suspension is removed from the crystallizer and processed through a centrifuge where a mixed salt predominantly Na<sub>2</sub>SO<sub>4</sub> crystals are dewatered and removed. The centrate is recycled to the crystallizer for evaporation to dryness.

#### Operating Parameters

- Steam Consumption – 2.8 tons/hr
- Salt (Na<sub>2</sub>SO<sub>4</sub>) Crystal Production - 1,500 tons/year
- 70 Tons/Day of water evaporated (approx.)

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