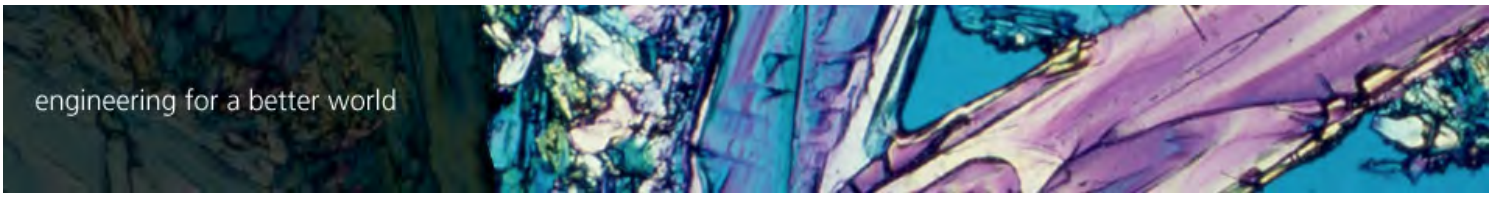
GEA Process Engineering Inc.



GEA Zero Liquid Discharge (ZLD) Solutions

- Evaporation / Crystallization
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- Evaporation Systems
- Evaporation Applications
- Crystallization
- Crystallizer Applications
- Distillation Applications
- Energy Management / Energy Optimization
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The implementation of strict environmental regulations, rigorous permitting processes, lack of water availability, and the economic benefits of water reuse have many industrial facilities implementing Zero Liquid Discharge (ZLD) systems. ZLD systems eliminate or reduce wastewater effluent into neighboring waterways or waste water treatment facilities from the customer's plant, achieving environmental compliance, and producing highly pure water for reuse. In some cases, valuable by-products can be recovered from these streams.

GEA Process Engineering offers a wide variety of process solutions, from basic engineering to supplying completely integrated plants, including plant periphery.

Steps for Zero Liquid Discharge

The ZLD System removes dissolved solids from the wastewater and returns distilled water to the process. Reverse osmosis (membrane filtration) may be used to concentrate a portion of the waste stream and return the clean permeate to the process. In this case, a much smaller volume (the reject) will require evaporation, thus enhancing performance and reducing power consumption. In many cases, falling film evaporation is used to further concentrate the brine prior to crystallization. These crystals are removed and dewatered. The water vapor from evaporation is condensed and returned to the process. Under certain conditions, a "polishing" step for example reverse osmosis may be desirable to remove any trace components (e.g. organics) from the condensate. Mechanical vapor recompression systems for energy efficient solutions are considered in GEA Process Engineering's evaluation process and utilized were possible.

1. Pretreatment - remove contaminants prior to further processing step filtration/evaporation/crystallization

2. Membrane Filtration, Cross-flow membrane filtration - may be applied to waste streams for a range of desired outcomes using a variety of membrane formats and plant configurations. Reverse Osmosis (RO) can be used to concentrate a wastewater stream. The permeate (clean water) is reused in the process and the reject/concentrate is sent on to evaporation. Nanofiltration may be applied to separate organic solutes from dissolved minerals. Ultrafiltration and/or Microfiltration may be applied to separation of colloidal or suspended materials from dissolved solutes. One or more of these membrane filtration technologies can be applied to bulk waste streams or to individual point-source streams for recovery and recycle of specific compounds.

3. Evaporation - pre-concentration in a falling film evaporator (in some industries also called Brine concentrator) is the most efficient solution to evaporate a significant amount of water prior to the crystallization step. These evaporators require less heat/power per unit of water evaporated.

4. Crystallization - forced-circulation crystallizers are used to evaporate the water past the crystallization point. Crystals are dewatered and the resulting filtrate/centrate is returned to the crystallizer. Crystallization can be achieved by spray driers to overcome high solubility of certain salts. The clean condensate is returned to the process for reuse and the dewatered crystals are transported off-site for reuse or disposal

5. Solids - Sludge from pretreatment is generally mechanically dewatered in a plate-and-frame filter press. The filtrate is simply recycled back to the beginning of the pretreatment system. The crystals from the crystallization process can also be mechanically dewatered, but corrosion resistant materials are usually necessary due to the high salt concentrations present. The crystals can be dewatered in a filter press or centrifuge allowing much higher solids concentrations as a result. The filtrate (or concentrate) is then returned to the crystallizer.

Working in close cooperation with GEA Process Engineering, ensures a seamless integration with the customer's plant. All of our ZLD solutions are specifically tailored to each customer's requirement. Depending on the system and quantity of wastewater, an Evaporator/Spray dryer may be utilized.

Further Information

Please contact us for more information.

Contact form

Case studies
- Altamonte Power Plant, Italy (PDF)
- Herten Waste Incineration Plant, Germany (PDF)
- Flue Gas Scrubber Wastewater Treatement System, Netherlands (PDF)
- Flue Gas Scrubber Wastewater Treatement System, Germany (PDF)

Related Pages
- Sustainable Process Solutions
- Wastewater (Effluent) Evaporators
- Sustainable packaging solutions
- Energy management / energy optimization of evaporators, crystallizers, and distillation plants
- Sanitary sound attenuators - SOUNDCIP™ for spray dryers and fluid bed dryers
- Heat Recuperators for spray drying plants (PDF)
- Zero Liquid Discharge (ZLD) - a primary necessity for our environment (PDF)
- Industrial and Environmental Membrane Filtration Applications
- Emission control

Evaporator/Spray dryer - An evaporator combined with a spray dryer is an ideal solution for small quantities of wastewater. The wastewater is typically (but not necessarily) concentrated in a vapor recompression evaporator. The concentrated brine is fed directly into a spray dryer. During spray drying, an enormous heat and mass transfer takes place within a fraction of time. It starts with the atomization of a liquid feedstock into a spray of droplets. The small droplets are created by an atomizer - either a rotary wheel or a high pressure nozzle (normally the GEA Niro patented wear-resistant wheel design, WEARSERT™, rotating atomizer will be selected for ZLD applications due to the often viscous, crystalline, harsh and corrosive nature of the feed). The droplets are introduced into a hot airstream, which is cooled down due to the evaporation of the water from the concentrate. This now colder and humid air is discharged from the dryer through a cyclone, bag filter or a combination of the two. After separation of the now dry particles, the air is discharged into the atmosphere and the dry particles (solids) can be cooled and landfilled.

Numerous tailor-made ZLD treatment systems have been developed, designed and supplied to help comply with regulations particularly for coal-fired power plants and waste incinerators. These systems employ heavy metals precipitation, evaporation with seeding (as an anti-scaling measure) and crystallization. Many years of experience handling calcium, magnesium and sodium chloride solutions (contaminated with halides like bromine and iodine, or their salts) has provided GEA Process Engineering with valuable experience on corrosion resistant materials for such applications. For further information about our seeded evaporation technology see the note at the bottom of the page.**

Industries

GEA Process Engineering has employed its broad expertise in evaporation and crystallization technology in a wide variety of industrial and environmental wastewater applications. From skid mounted options for smaller capacities to large industrial scale, we work with our customers to provide a solution to fit the specific needs with regards to capital expenditures (CAPEX) and operational expenditures balance (OPEX).

These processes include upstream treatment plants, like gypsum removal and heavy metals precipitation, and they operate in a range of end targets, from volume reduction to Zero Liquid Discharge.

Some examples of primary users of this technology are:

Metals & Mining
Location wastewater, Zinc oxide wastewater treatment plants, Hydrogen chloride (HCl) or Sulfuric Acid (H_2SO_4) recovery from pickling liquors, concentration of $AlCl_3$ from metallurgical wastes with or without recovery of valuable chemicals, and from non-ferrous metallurgical units

Power Generation
FGD blow down waste treatment systems, Radioactive waste evaporation/crystallization (Nuclear), Cooling water blow down systems

Waste management
Zero Liquid Discharge, Slag recovery, Pickling bath recovery, Leachate treatment (ZLD), Concentration of liquid waste prior to incineration

Oil & Gas
Brine concentration and ZLD systems for wastewaters stemming from gas drilling (especial the frac water from hydraulic fracturing in the shale gas plays)
Fluid bed desorber to recover drilling fluids for re-use while eliminating the costs for drill mu disposal and the associated liabilities

Alumina Industry
Elimination of the sodium carbonate from the Bayer liquor, salting-out and liquor-burning high concentration evaporators.

Environment
Concentration to dryness of incinerators liquid purges, recovery of valuable chemicals from reaction effluents.

Fertilizer production
Ammonium nitrate residual condensates treatment, recovery of HNO_3 in effluents, recovery of H_2SiF_6 from phosphoric acid concentration units.

Hydrocarbon Processing
Textiles
Waste H_2SO_4 concentration, Sodium thiocyanate (NaSCN) concentration, Sodium Chlorid (NaCl) and Sodium Sulfate (Na_2SO_4) recovery by crystallization

Pulp and Paper
Black liquor concentration before burning, bleaching effluents concentration and up-gradin stripping of process condensates, recovery of Na_2SO_4 from incineration residues.

Chemical Processing
Recovery of salts such as NaCl, Na_2SO_4, etc from organic synthesis, recovery and purification of acidic synthesis effluents such as HCl, H_2SO_4.

Food & Pharmaceutical
Citric acid effluents concentration and up-grading, sulphuric acid concentration from ethanc

production plants, elimination of inorganic chemicals from specific wastes, food grade phosphoric acid.

Dairy and Beverage

Numerous dairy, food, and beverage applications including complete whey processing facilities. Whey originates as a by-product from cheese production using milk as raw material. Whey still contains many valuable components that have a wide utilization if treated properly in an appropriate process - such as simple evaporation, drying, or fractionation by ultrafiltration followed by other processes, usually also evaporation and drying. For further information about our whey processing capabilities please access these pages: Whey Powder Processing and Whey Membrane Filtration Applications

GEA Process Engineering is your partner for all of your Zero Liquid Discharge needs, by owning numerous Laboratory facilities to simulate in bench scale or pilot plants to verify and optimize the design we are able to develop a custom Zero Liquid Discharge process for your specific waste water.

GEA Process Engineering business groups and companies involved in Zero Liquid Discharge: GEA Messo, GEA Kestner, GEA Wiegand, GEA Filtration, GEA Bischoff, GEA Niro, and GEA Barr-Rosin.

**Seeded Evaporator a.k.a. "Seeded system"
Power plant wastewaters are often saturated with calcium sulfate (gypsum) and silica which are difficult to evaporate as they are already at the scaling point. However, adding calcium sulfate "seeds" to the saturated wastewater, give the precipitating salts a place to adhere and remain in suspension (prevent the deposition of low-solubility calcium salts on the tube surfaces).
Seeding alone is not sufficient enough to prevent scaling. Additional contributing factors include: temperature; pH; residence time; system volume and evaporation rate; crystal size, composition and concentration; as well as the equipment design.
Seeded brine concentrators are used in many wastewater applications including: cooling tower blowdown, SAGD produced water, frac water (from hydraulic fracturing), FGD purge water, IGCC wastewater, chlor-alkali wastewater, acid mine and landfill drainage, RO reject, etc.

Click here to request more information

Other GEA Process Engineering Websites:

Select sales company

Select technology company

A company of the GEA Group

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