Zero liquid discharge

Reduce end-of-pipe streams
Increase values

GEA engineering for a better world

gea.com

Zero liquid discharge: An environmental necessity

Sustainable development

Earth's water resources are scarce. Only 2.5% of the planet's water is fresh, non-saline, and the global demand for high quality water — driven by a growing population, higher levels of urbanization and ecological change — is increasing.

The worldwide recognition of these facts has resulted in a greater environmental awareness of water quality and availability. And, as a direct consequence, regulations concerning the use and discharge of industrial wastewater have been both implemented and made more stringent.
Water use and conservation is a key consideration for the global processing industries, particularly those affected by the scarcity of available water sources or suitable wastewater recipients.

For the production of domestic water, complex dewatering and seawater desalination processes

are used to ensure that water quality standards are maintained in a cost-effective manner. As such, implementing zero liquid discharge (ZLD) solutions can play a key role in the preservation of our water resources, protecting our environment and securing the economic future of our industries.

GEA is a single-source supplier of cost-effective, energy efficient and reliable wastewater treatment systems and emission control solutions.

Minimize liquid disposal, maximize product recovery

Proven performance and reliable technology

Factors such as environmental guidelines, stringent legislation, a lack of available water and wastewater disposal options are driving many industrial facilities to implement zero liquid discharge (ZLD) systems as a solution.
GEA provides a comprehensive portfolio of thermal and non-thermal technologies for ZLD applications, including centrifugal separation equipment, brine membrane concentrators, effluent evaporators, crystallizers and industrial dryers.

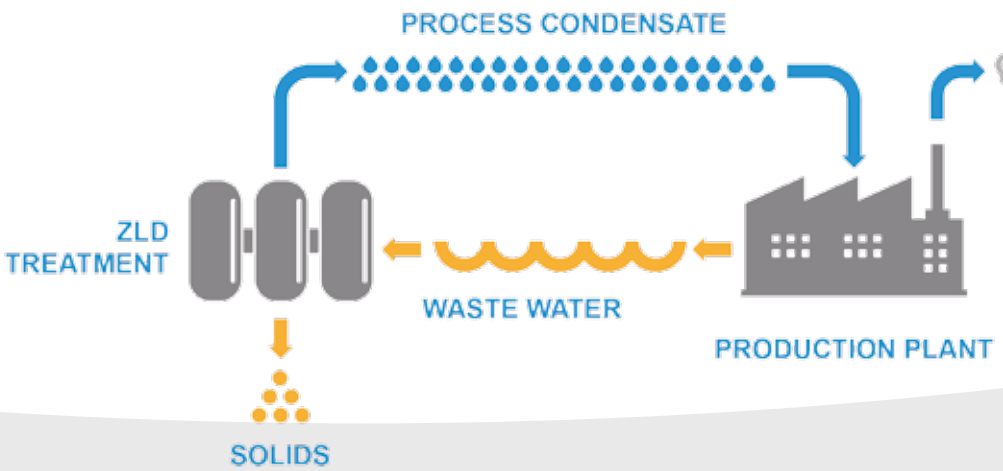
Cost-effective and energy efficient

Our aim is to offer innovative and creative solutions that meet and exceed your product recovery requirements with the lowest possible energy consumption. In doing so, we help our clients to protect the environment, eliminate liquid waste streams and generate high purity water for reuse.

1 Centrifugal separation

2 Membrane filtration

3 Evaporation



ZERO LIQUID DISCHARGE (ZLD)

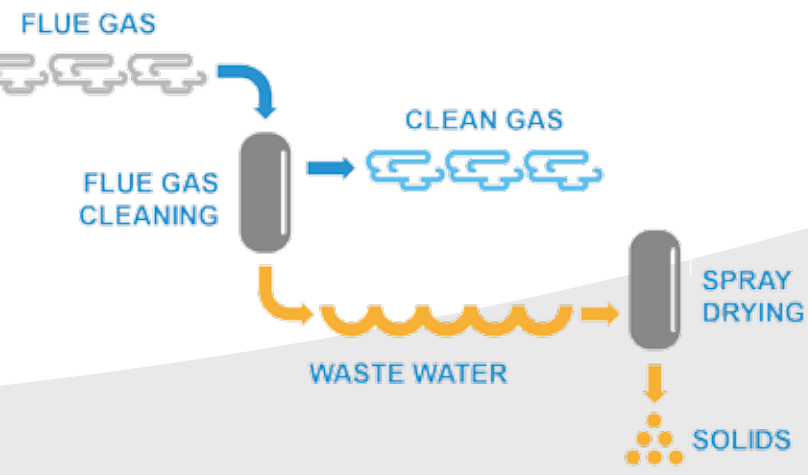
ZLD is beneficial to the environment by minimizing wastewater discharge, increasing water reuse and recycling valuable products.

Based on decades of product testing experience and offering increased cost-effectiveness (CAPEX-OPEX) and long-term reliability, our systems provide the following benefits:

- Energy-efficient operation
- Corrosion-resistant materials
- Variable waste flows
- Limited cleaning requirements
- Advanced automation systems

4 Crystallization

5 Spray drying



Putting our expertise to work

With a proven track record in evaporation, crystallization and energy recovery systems, GEA offers a complete portfolio of technological solutions for a wide variety of applications.

Based on our high level of material and corrosion expertise, and an industrial pilot facility, we can supply a custom-designed system that is both efficient and technologically advanced.

Agrochemicals:

- Fertilizer
- Leachate and sewage water effluent
- Vinasse-derived potassium sulfate

Oil & Gas

- Oil & gas refining
- Synfuel production (GTL, CTL, BTL)
- SAGD-produced water
- Oil & gas field water

Chemicals

- Waste acid
- Pulp & paper wastewater
- PVC
- RO reject
- Organic-loaded wastewater
- Softener waste

Our worldwide project management experience, the reliability of our supply chain and our commitment to delivering the highest quality service at the best price make GEA the ideal long-term partner for your business.

Environment

- Brine from drinking water plant
- Industrial liquid waste
- Wet scrubber effluent
- Landfill leachate
- Biomethanization digestate
- Ion exchange eluate

Power Generation

- Cooling tower blowdown
- Ion exchange eluate
- CCPP and IGCC wastewater
- Flue gas scrubber effluent
- Lithium battery manufacturing
- Cogeneration effluent

Mining & Minerals

- Alumina processing
- Steel processing
- Non-ferrous (nickel, copper, aluminum) effluent
- Coal mining
- Mine drainage
- By-product recovery (Na_2SO_4)

Pure products, clean water and zero liquid discharge

By reducing your carbon footprint, recovering high purity water for reuse and creating a positive public perception, GEA's proven ZLD solutions can help you to meet even the most demanding environmental requirements.

Recover chemicals from waste streams

GEA's specialized evaporation and crystallization technologies are custom designed to meet the unique needs of our industrial process customers and facilitates the use of complementary operations such as precipitation, centrifugal clarification and thickening, membrane filtration and drying.
From concentrating caustic soda to recovering sodium chloride, GEA provides advanced mechanical and thermal technology solutions, including:

- Decanters and separators
- Micro-, nano-, ultra-filtration and reverse osmosis
- Falling film evaporators
- Forced circulation evaporators and crystallizers
- Controlled suspension crystallizers
- Draft tube baffle crystallizers
- Mmechanical vapor recompression systems

From wastewater to solids

Zero liquid discharge (ZLD) technology provides an efficient and environmentally friendly effluent processing system that improves in-plant water reuse, enhances product recovery and converts a fluid discharge to non-liquid waste.
GEA can supply complete ZLD lines comprising the key elements of centrifugal separation, membrane filtration, evaporation and crystallization technologies, offering the following benefits:

- Meet stringent discharge regulations
- Treat and recover valuable product from waste streams
- Better management of internal process water streams
- Reduces the need to draw fresh water
- Minimizes energy consumption

GEA's dewatering decanters are continuously operating, horizontal solid-wall bowl centrifuges. Meeting maximum dewatering requirements for salt crystals and municipal/industrial wastewater sludge, the open frame design offers either gravity or pressure-based discharge of the clarified phase.

Optimized dewatering reduces sludge disposal costs

Optimal and economical sludge dewatering is a fundamental requirement, which is why GEA decanters offer high separation efficiencies and optimum torque regulation.

A greater solids concentration means lower incineration and transportation costs, and less landfill. Centrifugal force is most commonly used to increase the sedimentation rate of solid sludge particles.
The addition of polymers improves the dewatering process by promoting the agglomeration of fine particles, which increases production rates without affecting the quality of the centrate.

For clear clarification and dewatering the GEA waterMaster is used in chemical processing applications and can be supplied in various materials, including Hastelloy C276.
The GEA dryMaster decanter has been customized for low energy consumption and is available as a stationary or mobile unit.

Fully integrated and customized systems

A hybrid ZLD process was developed for a molybdenum production facility effluent containing various sulfates and sodium chloride. With a wastewater capacity of up to 110 m^3/h, the process consists of a brine purification pretreatment section followed by a RO pre-concentration and subsequent concentration in an MVR-driven falling film evaporator.

Crystallization and solid separation completes the process, which produces pure water for reuse in the production facility under ZLD conditions. Running successfully and showing excellent results, critical compound concentrations (fouling and incrustation forming components such as colloidal SiO_2, Mn and Fe) have been reduced to below critical limits.

For small-scale applications, a skid-mounted modular concept has been developed to recover high quality process condensates and separated (disposable) solids, meeting the critical reliability and availability requirements of a power plant.

An advanced ZLD system with chemical pretreatment at a molybdenum mine.

Competence to take you further

Recycling waste and saving both resources and energy are an essential part of GEA's engineering focus and competence. In this way, we help our customers to minimize their environmental impact and maintain a competitive edge.

Clean water evaporator

During the production of medium- and high-density fiberboard, cleaning the wood chips results in a large volume of surplus washing water. The challenge was to develop a wastewater treatment plant with no liquid discharge that provided an adequate supply of steam for the defibration process.

To address the issue, GEA delivered a wastewater treatment plant comprising a mechanical separation system for insoluble components, an evaporator to concentrate the pretreated wastewater and a turbine exhaust steam converter for generation of process steam.

The special advantage of this solution is the reuse of the cleaning effluents. No other waste is generated in this system and there is no liquid discharge. Wood oils are separately discharged and neither charge the steam converter with incrustations nor affect the water balance.

Advanced FGD wastewater treatment

GEA has installed a ZLD system for flue gas desulfurization (FGD) wastewater at a large power plant in North Carolina, USA. GEA's tailor-made solution consists of a falling film evaporator combined with a forced circulation evaporator to significantly reduce the FGD blowdown volume. The resulting brine is mixed with fly ash and disposed as on-site landfill with leachate control. The distillate water is used in-plant to reduce the overall water demand.

The system, designed and supplied by GEA, supports the customer's commitment to providing safe, reliable and environmentally friendly energy generation.

Added to their existing FGD scrubber, the ZLD solution ensures compliance with National Pollutant Discharge Elimination System (NPDES) wastewater discharge regulations.

As an integrated component of the power station, the FGD ZLD solution had to reclaim water resources and reject waste. GEA designed and built a process system using centrifugal separation, membrane filtration, evaporation and crystallization technologies, enabling the efficient removal of contaminants and high quality water to be recycled back into the process.

Spray drying waste streams

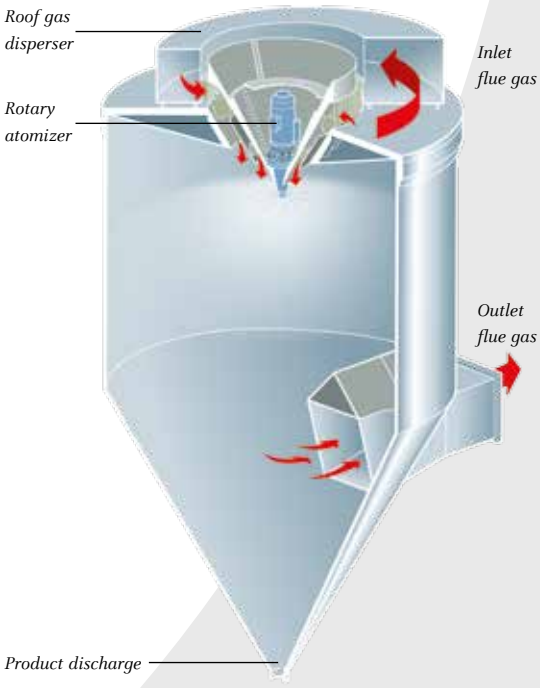
The incineration of municipal/industrial solid waste offers the added benefit of producing steam-generated electricity and heating. As such, it reduces both waste volumes and landfill. Incineration facilities must, however, comply with environmental safeguards by using the best available technology.
A cost-effective solution to this challenge is the use of GEA spray drying technology.

AGR Herten is a waste-to-energy facility that burns both hazardous and municipal solid waste. The combined heat and power (CHP) plants consist of six separate incineration lines, each using wet flue gas desulphurization (FGD) cleaning systems.

ZLD was successfully introduced in 2008 by using GEA spray drying technology to evaporate the wet FGD effluent on two new 111,000 Nm^3/h lines. Subsequently, two older 120,000 Nm^3/h lines were refurbished to the same system. Additionally, the two further lines have been equipped with brine concentrator systems, including GEA evaporators and crystallizers.

The four lines at Herten feature spray drying chambers (10 m diameter) that are equipped with GEA gas dispersers and F-100 atomizers. The two new lines have downstream GEA ECOpulse jet fabric filters, and the older ones use Electrostatic precipitators. The wastewater feed rate is 4.2 m^3/h with a chloride content up to 16%.

Spray drying absorption (SDA) is a well-established process for the control of acid gas and hazardous air pollutant (HAP) emissions in coal-fired boiler applications. Often used in European waste-to-energy facilities, it can be enhanced by the addition of dry hydrated lime as a peak control process.



engineering for
a better world

We live our values.

Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA Group is a global engineering company with multi-billion euro sales and operations in more than 50 countries. Founded in 1881, the company is one of the largest providers of innovative equipment and process technology. GEA Group is listed in the STOXX® Europe 600 Index.

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