

Maintain Constant Evaporation Capacity



Self-cleaning Evaporator

Application: Flue Gas Desulfurization (FGD)

Product: Self-cleaning Evaporator for FGD Wastewater Treatment Plants

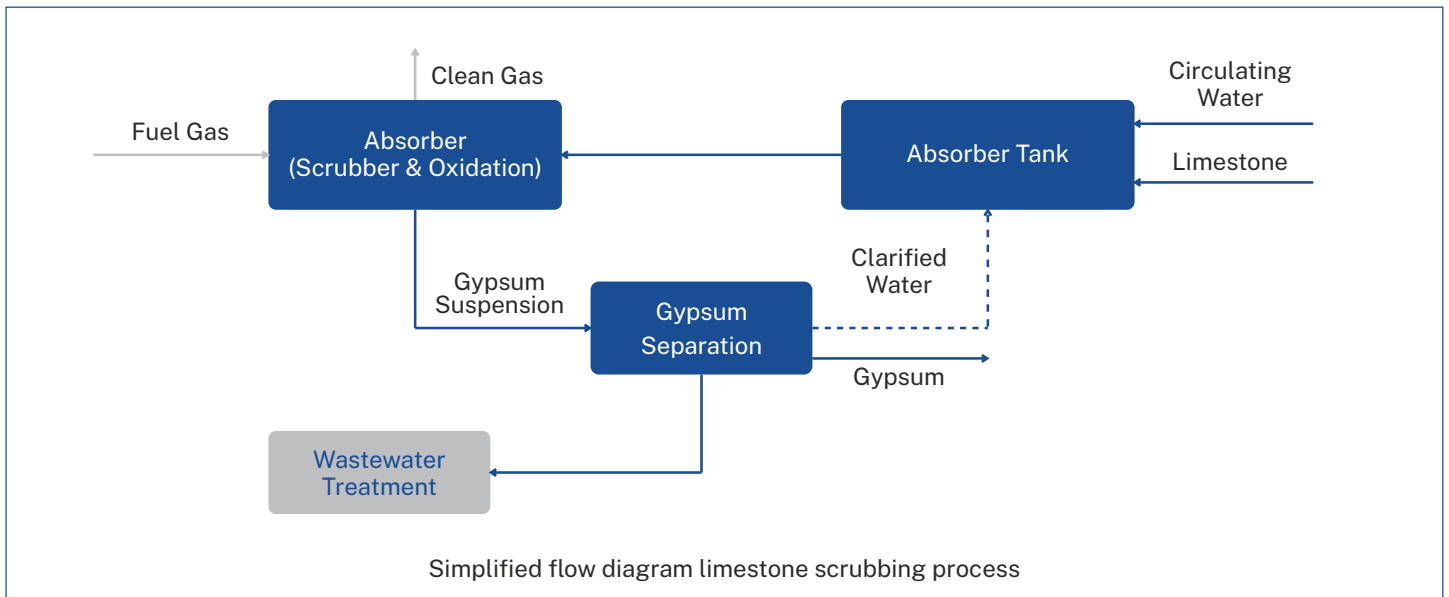


Minimize Maintenance Costs



Enhance Productivity

The combustion of coal in power generation facilities produces sulphur dioxide SO_2 that is emitted to the atmosphere. Flue Gas Desulfurization (FGD) is widely used in power plants and industrial facilities to mitigate the environmental impact of SO_2 emissions. SO_2 is a major contributor to air pollution and acid rain, and its removal is imperative for meeting stringent environmental regulations. The FGD process involves the removal of sulphur compounds from the flue gas generated during the combustion of fossil fuels.



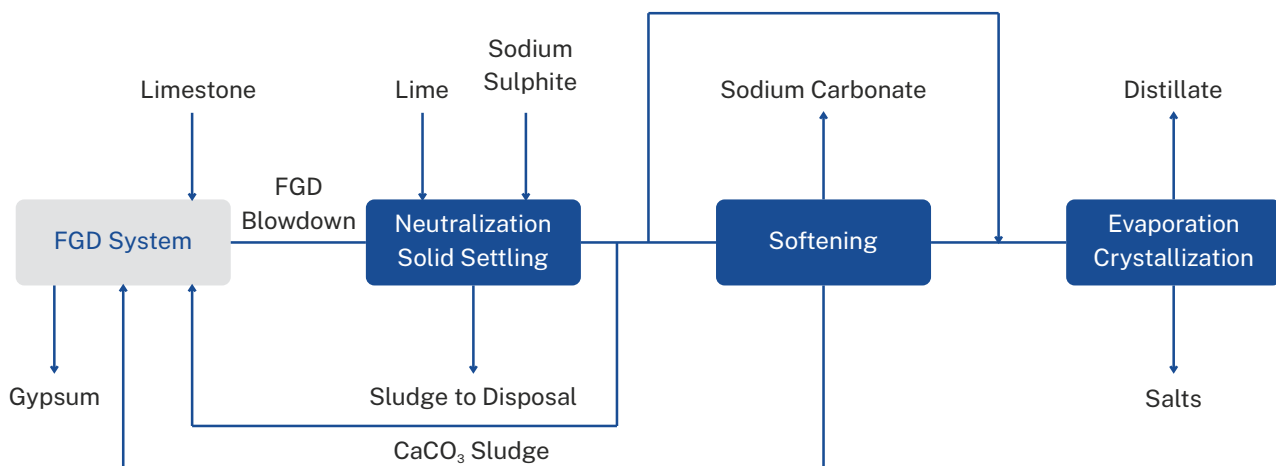
There are various methods for implementing FGD, but one of the most common technologies is wet scrubbing by limestone. In this process, the flue gas is passed through a liquid solution, typically a limestone slurry. The sulphur dioxide reacts with the calcium-based reagent to form calcium sulphite (CaSO_3) or calcium sulphate (CaSO_4) compounds, which are then separated from the liquid solution and further processed. These calcium-based compounds are usually converted into gypsum (calcium sulphate dihydrate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), a valuable by-product that can be used in various applications such as wallboard manufacturing and agricultural amendments.

While FGD effectively reduces air emissions, it generates wastewater containing dissolved pollutants and heavy metals, which require proper treatment before discharge. The FGD wastewater is characterized by its high Total Dissolved Solids (TDS) concentration and has very high levels of chlorides (up to 20,000 mg/L), trace concentrations of heavy metals (e.g. chromium, mercury, and selenium), high levels of nitrates (up to 700 mg/L) and very high levels of total dissolved solids (up to 60,000 mg/L). The treatment of FGD wastewater is a critical aspect of ensuring the overall environmental sustainability of the FGD process.



Traditionally, FGD wastewater has been treated using coagulation and precipitation. However, with the enforcement of Zero Liquid Discharge (ZLD), the conventional technologies are no longer sufficient for the treatment. The following treatment steps can be found in FGD effluent ZLD treatment plants:

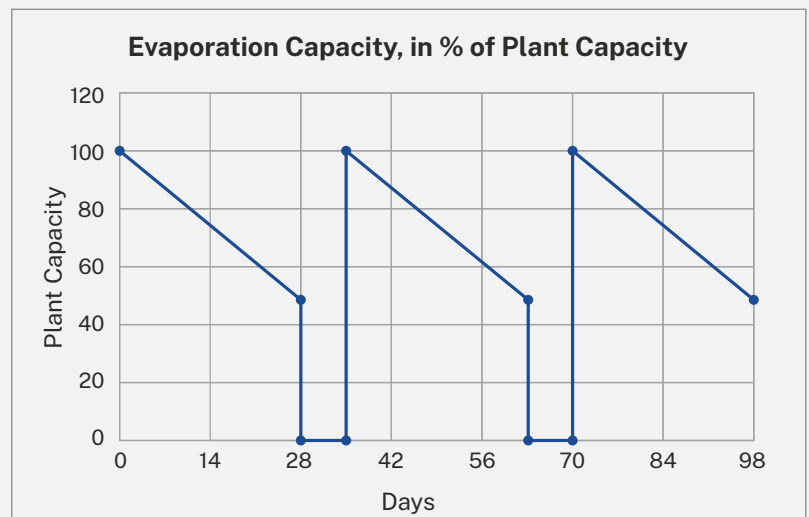
1. Pre-treatment, using Neutralization, Sedimentation, Flocculation to reduce Suspended Solids, Ca^{2+} and Mg^{2+} in the effluent;
2. Concentration and Volume Reduce, using Evaporator or Membrane;
3. Crystallization.



Simplified Example FGD Effluent ZLD Treatment Process

Say **NO** to Fouling with the KLAREN Self-cleaning Technology for Evaporator Systems

Evaporation is a common method for treating FGD wastewater, which reduces its volume and facilitates subsequent treatment processes. However, fouling of evaporators is a major concern in the treatment of the FGD wastewater. Calcium sulphate, silicon and ash are the three main reasons for the fouling issue in these evaporators.



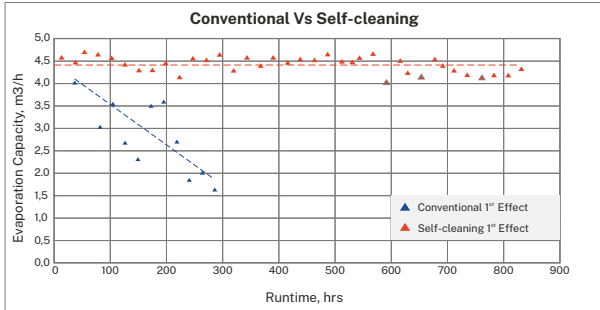
Scaling, fouling, and other contaminants can hinder the evaporator's performance, leading to increased energy consumption and decreased production capacity. As a result, regular cleaning and maintenance are necessary to ensure efficient and desired operation of evaporators.

With the KLAREN Self-cleaning Evaporators, fouling can be prevented, and efficiency and performance of evaporation systems can be enhanced.



Gypsum

Advantages of the KLAREN Self-cleaning Evaporators



- **Enhanced Efficiency:** KLAREN Technology optimizes the heat transfer process, ensuring consistently high heat transfer coefficients. This results in constant evaporation rates and reduced energy consumption.
- **Continuous Operation:** No downtime caused by manual cleaning. Self-cleaning Evaporators can operate continuously without interruptions, maximizing your production throughput.
- **Reduced Maintenance Costs:** With online and inline continuous cleaning processes, the need for frequent manual cleaning and maintenance is significantly reduced, saving time and operational expenses.
- **Longer Equipment Lifespan:** Self-cleaning Technology helps prevent the build-up of scale and fouling, which can lead to equipment degradation. This extends the lifespan of your evaporators, providing a higher return on investment.

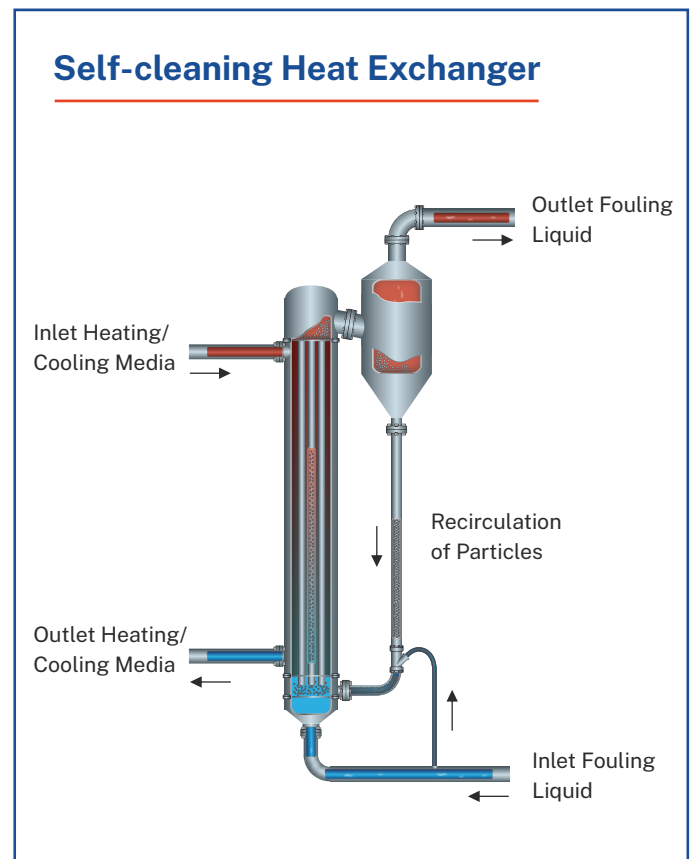
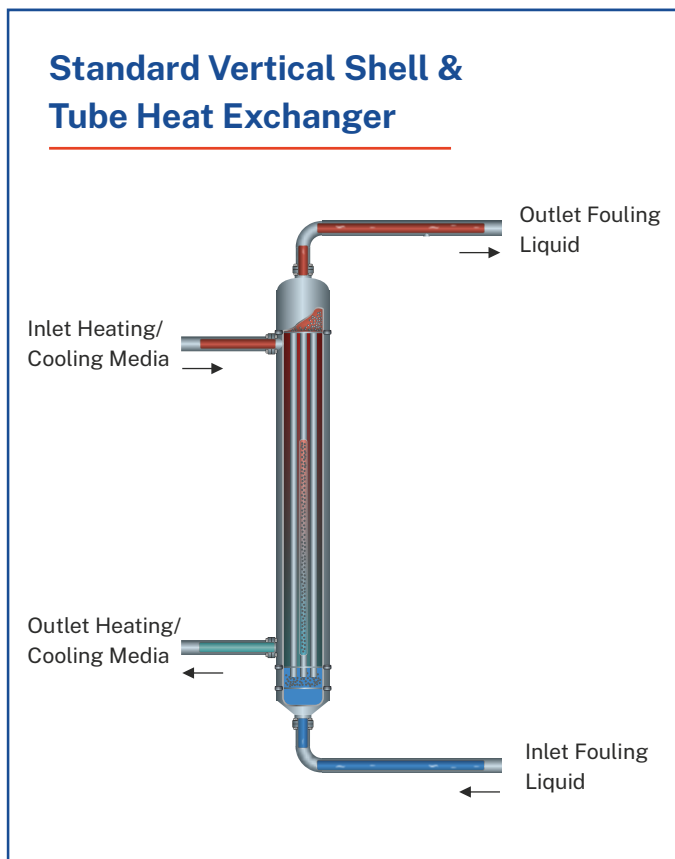
- **Environmentally Friendly:** By reducing the use of harsh chemicals and water consumption associated with manual cleaning, Self-cleaning Evaporators promote a more sustainable and eco-friendly approach to evaporation processes.
- **Easy Integration:** Whether you have an existing MEE or MVR evaporator system or are planning to invest in new equipment, our Self-cleaning Technology can be seamlessly integrated, ensuring a smooth and hassle-free transition.

	Conventional Evaporator	VS	Self-cleaning Evaporator
Scaling/Fouling in Tubes	Occurs		Does not occur
Water Evaporation Capacity	Average 60% on design capacity		100% on design capacity
CIP (Cleaning in Place)	Once a few weeks		Not required
Plant Design	Oversized		Compact (constant heat transfer, no over-dimensioning is required)
Hydro-jetting	Once every three months		Not required

KLAREN Self-cleaning Technology for Evaporators

The Self-cleaning Technology for Evaporators is developed for operation up to zero-fouling. In the Self-cleaning Evaporator, a fluidized bed of solid particles is used at the tube side of the heat exchanger where the fouling liquid flows through. The solid particles create a scouring effect on the tube wall surface which removes the developing fouling layer. In this way severe fouling is prevented.

With the KLAREN Technology, fouling of heat exchangers can be prevented or minimized. The fluidized bed effectively handles many types of fouling including scaling, whether hard or soft, originating from biological, crystallization, chemical or particulate fouling mechanism, or a combination of these. A wide variety of fluids can be handled ranging from aqueous solutions to oils and slurries.

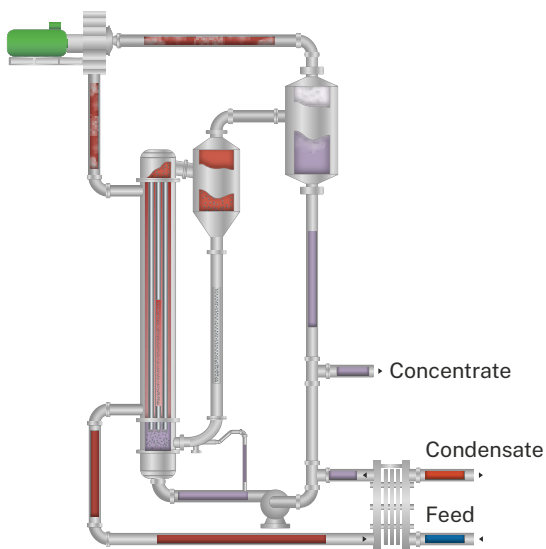


Apply KLAREN Technology in a New-built or Existing Evaporator

Whether you have an existing Multi-effect Evaporator (MEE) or Mechanical Vapour Recompression Evaporator (MVRE) System, KLAREN Self-cleaning Technology can be efficiently retrofitted, tailored to your specific requirements.

For new installations, TAPROGGE's expert team ensures seamless integration, ensuring that plant operations benefit from the advantages of Self-cleaning Evaporators from day one.

Mechanical Vapour Recompression Evaporator (MVRE)

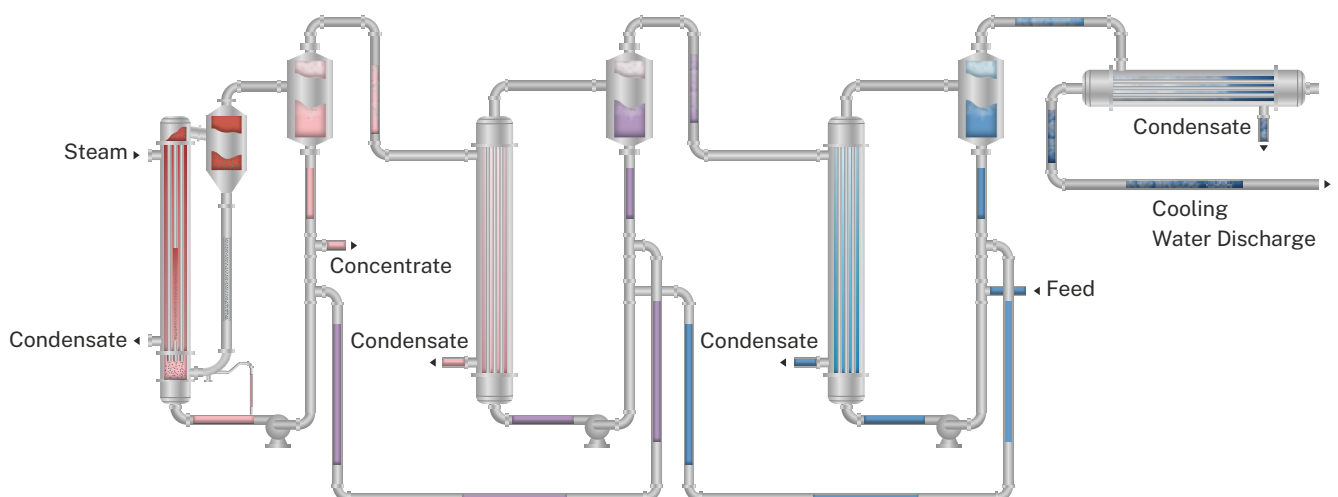


Embrace the Future of Evaporation

Upgrade your MEE and MVR evaporator systems with the advanced Self-cleaning Technology and embrace a new era of efficiency, sustainability, and convenience.

Revolutionize your evaporator operations and propel your business to greater heights.

Multi-effect Evaporator (MEE)



Operational Experiences



Revamp of forced circulation evaporator for wastewater of Dyes Producer (Asia)

- Forced circulation evaporator with 900 m³/h recirculation flow
- 373 tubes of 6 m length
- Evaporation capacity total plant was kept at 100%



Wastewater treatment plant - Shochu Distillery (Asia)

- 30 ton/day feed, Evaporator
- Concentration of Vinasse up to 40% solids from Shochu plant
- Tube length 6 m
- >20 years of operation; cleaning every 5 years



Wastewater Treatment Plant Dyes Producer (Asia)

- 4-stages or 4-effect MEE plant with 2 stages or 2-effects self-cleaning
- 16 m³/h wastewater feed containing both organic and inorganic substances
- Concentration up to 35%
- In operation since 2021



MEE for Sodium Sulphate Recovery (Asia)

- MEE for Sodium Sulphate Recovery
- Revamp of 1st Effect Forced Circulation Evaporator
- 830 tubes (25.4 mm OD) of 7.5 m length, flow = 850 m³/h
- Total plant output increased with 10-15%
- 1st Effect: no cleaning required



TAPROGGE's KLAREN Technology

TAPROGGE is a global cleantech specialist. The company provides the market with tailor-made solutions which maximize efficiency and improve the availability of water and thermal circulating systems. TAPROGGE is now among the world's leading companies that offer energy saving solutions which also cut CO₂ emissions.

KLAREN Technology is a competence brand of TAPROGGE. With KLAREN Technology continuous cleaning solutions are offered for either new or existing heat exchangers.

The self-cleaning fluidized bed heat exchanger technology can be applied in heaters, coolers, evaporators, crystallizers, reboilers and condensers.



Benefits of the Self-cleaning Heat Exchanger

-  Improve Energy Efficiency
-  Minimize Maintenance Costs
-  Enhance Productivity
-  Environmental Friendly
-  Compact Design

Headquarters

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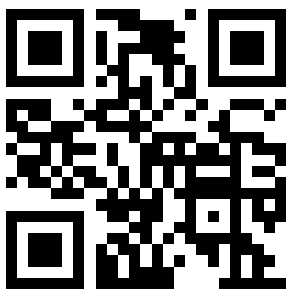
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Competence Center

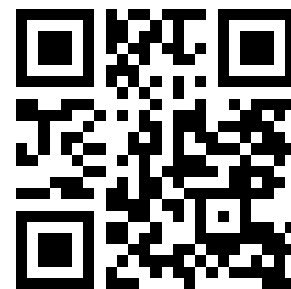
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