PROJECT PROFILE SERIES # 51

ENEL Power, Italy – Brindisi Project – ZLD Plant for FGD Wastewater Treatment

The Facility

The Brindisi Sud Power Plant is equipped with four coal-fired units each of 660 Mwe capacities. These units normally fire imported coal with < 1% Sulphur. The flue gases are treated sequentially by SCR-DeNOx with ammonia as reagent, High efficiency ESP to remove fly ash and wet limestone gypsum forced oxidation DeSOx. Each unit is equipped with a 2 x 50% DeSOx lines each with a prescrubber for final dedusting and gas saturation and an absorber. The blow down from both prescrubber and absorber along with other wastewaters are sent to a wastewater treatment plant. In the first stage lime and sodium sulfide are added to remove metals. In the second stage ferric chloride is added to remove suspended solids and in third stage hydrogen peroxide is added to remove oxidizing agents. The prescrubbers are fed with seawater and at the WWTP; the brine was treated and discharged into the Adreatic Sea.

The Problem

Wastewaters from the FGD treatment plant can no longer be discharged into the sea due to tough Italian and EU environmental regulations. In order to overcome this major environmental problem, ENEL decided to feed the prescrubbers with fresh and recirculated waters and install the Zero Liquid Discharge (ZLD) plant. This is so that no industrial wastewater discharges are allowed by the entire power plant.

The Solution

To overcome the problem, ENEL selected the Softening –Evaporation – Crystallization (SEC) process to treat the wastewaters and reuse/conserve fresh waters. Aquatech supplied, installed, and commissioned the ZLD plant as an EPC contractor with local associates.

The SEC plant comprises of 2 x 50% Softener Clarifiers (calcium reduction by soda ash dosing), 2 x 50% Falling Film type Brine Concentrators (each equipped with two Vapor Compressors operating in series), 1 x 100% Crystallizer (equipped with Thermocompressors) and 2 x 50% Belt Filter Presses. The plant also includes several chemical dosing systems, storage tanks, pumping systems, electrical works (MCC, cable trays, cabling etc), and controls & instrumentation.

The Zero Liquid Discharge (ZLD) plant is a fully integrated automated system. The Brine Concentrators operate in seeded slurry mode. Each Brine Concentrator is equipped with external mist eliminator for ease in maintenance. The Crystallizer operates in a forced circulation method.

The industrial grade soft water and high purity distillate produced in the system will be used in the main power plant.

Aquatech

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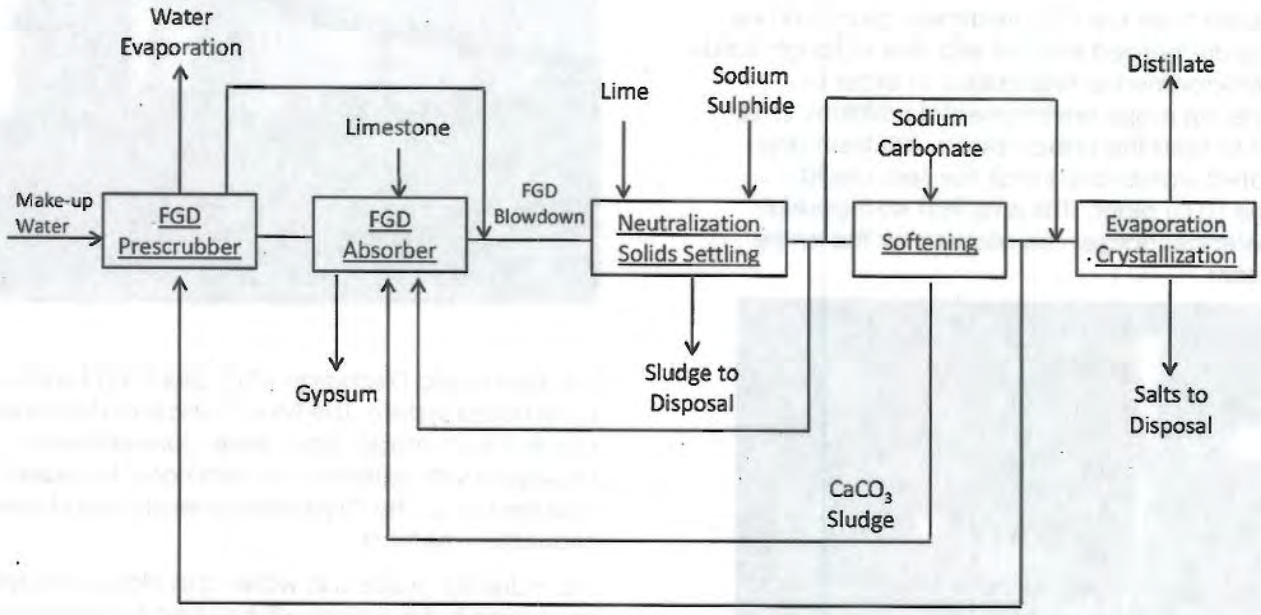
PROJECT PROFILE SERIES # 51

DESIGN FGD WASTEWATER ANALYSIS

Design Flow ..... 140 m_3/hr (PT Plant)

Calcium	**4200 ppm**
Magnesium	**200 to 250 ppm**
Potassium	**Balance**
Sodium	**1757 ppm**
TSS	**80 ppm**
pH	**9.5 to 10**
Bicarbonate	**80 ppm**
Phosphates	**25 ppm**
Chlorides	**22800 ppm**
Nitrates	**300 ppm**
Sulfate	**1700 ppm**
SiO_2	**10 ppm**

PROCESS FLOW DIAGRAM



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PROJECT PROFILE SERIES # 52

ENEL Power, Italy – Fusina Project – ZLD Plant for FGD Wastewater Treatment

The Facility

The Fusina Power Plant is equipped with four coal-fired units with a total capacity of 975 MW capacity (1 x 165 MW + 1 x 170 MW + 2 x 320 MW). The Environmental Refurbishment (Flue Gas Desulpharization, (FGD)) project includes a new DeSOx system for common for units #1 & 2; two DeNOx systems, one each for unit #1 & 2. Units #3 & 4 are already equipped with DeSOx and DeNOx systems.

For units #1 & 2, Industrial grade water is used as FGD make-up. Flue gases in the FGD are treated with limestone in the scrubber. The FGD blow down wastewaters are treated in the dealkalizer clarifier with lime treatment.

For units #3 & 4, the flue gases are treated sequentially by SCR-DeNOx with ammonia as reagent, high efficiency ESP to remove fly ash and wet limestone gypsum forced oxidation DeSOx. Each unit is equipped with DeSOx system with a prescrubber for final dedusting and gas saturation and an absorber. The FGD blow down wastewaters along with units #1 & 2 are treated in the dealkalizer clarifier with lime treatment and being discharged into the surface waters.

The Problem

Wastewaters from FGD treatment plant can no longer be discharged into the sea due to tough Italian and EU environmental regulations. In order to overcome this problem, ENEL decided to install the Zero Liquid Discharge (ZLD) plant so that no industrial wastewater discharges are allowed.

The Solution

To overcome the problem, ENEL selected the Softening – Evaporation – Crystallization (SEC) process to treat the wastewaters and reuse/conserve fresh waters. Aquatech supplied, installed, commissioned the ZLD plant as an EPC contractor with local associates.

The SEC plant comprises of 2 X 50% Softener Clarifiers (calcium reduction by soda ash dosing), 2 x 50% Falling Film type Brine Concentrators (each equipped Vapor Compressor), 1 x 100% Crystallizer (equipped with Thermocompressors) and 2 x 50% Belt Filter Presses. The plant also includes several chemical dosing systems, storage tanks, pumping systems, electrical works (MCC, cable trays, cabling etc), controls & instrumentation. The ZLD plant is a fully integrated automated system. The Brine Concentrators operate in seeded slurry mode. Each Brine Concentrator is equipped with internal mist eliminator. The Crystallizer operates in forced circulation method.

The industrial grade soft water and high purity distillate produced in the system will be used in the main power plant.

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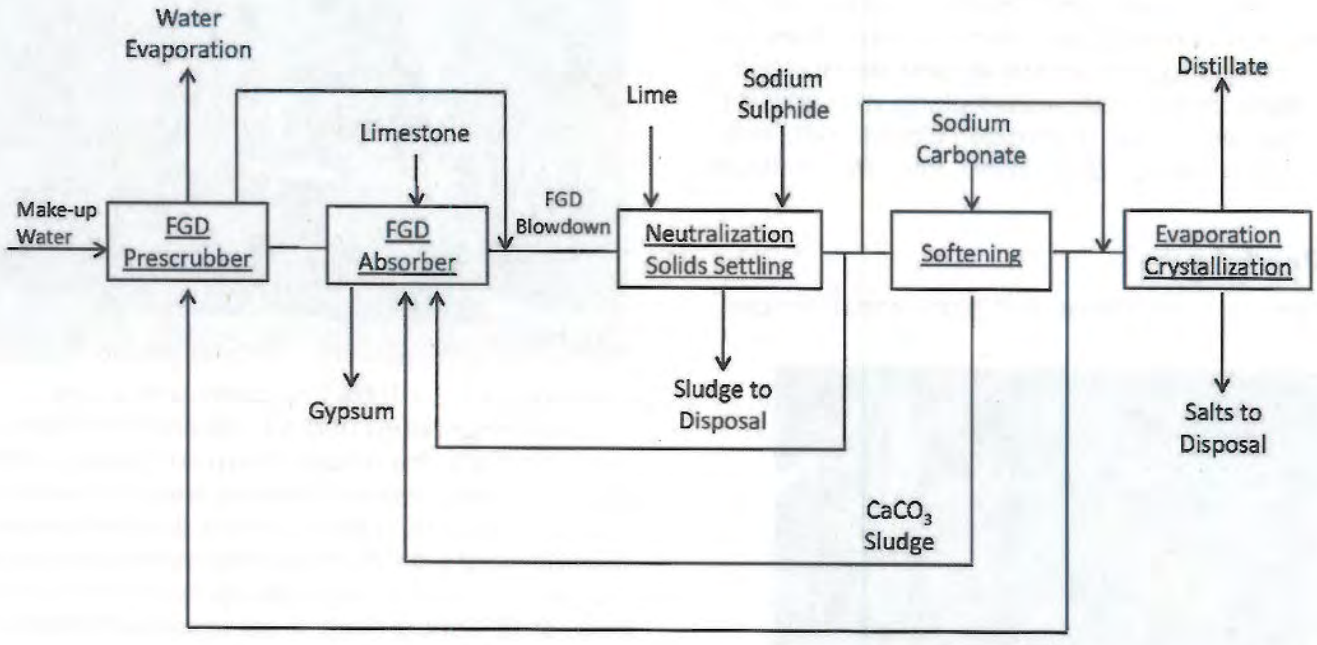
PROJECT PROFILE SERIES # 52

DESIGN FGD WASTEWATER ANALYSIS

Design Flow.....70M3/hr (PT Plant)

Calcium	8400 ppm
Magnesium	1700 ppm
Sodium	Balance
TSS	80 ppm
pH	9.5 to 10
Chlorides	25000 ppm
Nitrates	300 ppm
Sulfate	1200 ppm

PROCESS FLOW DIAGRAM



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PROJECT PROFILE SERIES # 54

ENEL Power, Italy – Sulcis Project – ZLD Plant for FGD Wastewater Treatment

The Facility

The Sulcis Power Plant is equipped with 1 x 345 MW fluidized bed boiler and 1 x 240 MW conventional boiler. This coal-fired power plant is located in Sardinia Island and has a total of 585 Mwe capacity. The units normally fire imported coal with < 1% Sulphur. The flue gases are treated sequentially by SCR-DeNOx with ammonia as the reagent. This is followed by a high efficiency ESP to remove fly ash and wet limestone gypsum forced oxidation DeSOx. Each unit is equipped with a 1 x 100% DeSOx line with a prescrubber for final dedusting and gas saturation and an absorber. The blow down from both the prescrubber and absorber along with other wastewaters are sent to an existing wastewater treatment plant where heavy metals and suspended solids only are removed. In the first stage lime and sodium sulfide are added to remove metals; in the second stage ferric chloride is added to remove suspended solids and in third stage hydrogen peroxide is added to remove oxidizing agents. The Unit 3 prescrubber is fed with seawater and at the WWTP the brine was treated and discharged into the Adreatic Sea.

The Problem

Wastewaters from FGD treatment plant can no longer be discharged into the sea due to tough Italian and EU environmental regulations. In order to overcome this major environmental problem, ENEL decided to feed the prescrubber with fresh and recirculated waters and install the Zero Liquid Discharge (ZLD) plant so that no industrial wastewater discharges are allowed by the entire power plant.

The Solution

To overcome the problem, ENEL selected the Softening – Evaporation – Crystallization (SEC) process to treat the wastewaters and reuse/conserve fresh waters. Aquatech supplied, installed, commissioned the ZLD plant as an EPC contractor with local associates.

The SEC plant comprises of 1 x 100% Softener Clarifier (calcium reduction by soda ash dosing), 1 x 100% Falling Film type Brine Concentrators (equipped with two Vapor Compressors operating in series), 1 x 100% Crystallizer (equipped with Thermocompressors) and 2 x 50% Belt Filter Presses. The plant also includes several chemical dosing systems, storage tanks, pumping systems, electrical works (MCC, cable trays, cabling etc), controls & instrumentation.

The ZLD plant is a fully integrated automated system. The Brine Concentrator operates in seeded slurry mode. The Brine Concentrator is equipped with external mist eliminator for ease in maintenance. The Crystallizer operates in forced circulation method.

The industrial grade soft water and high purity distillate produced in the system will be used in the main power plant.

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PROJECT PROFILE SERIES # 54

DESIGN FGD WASTEWATER ANALYSIS

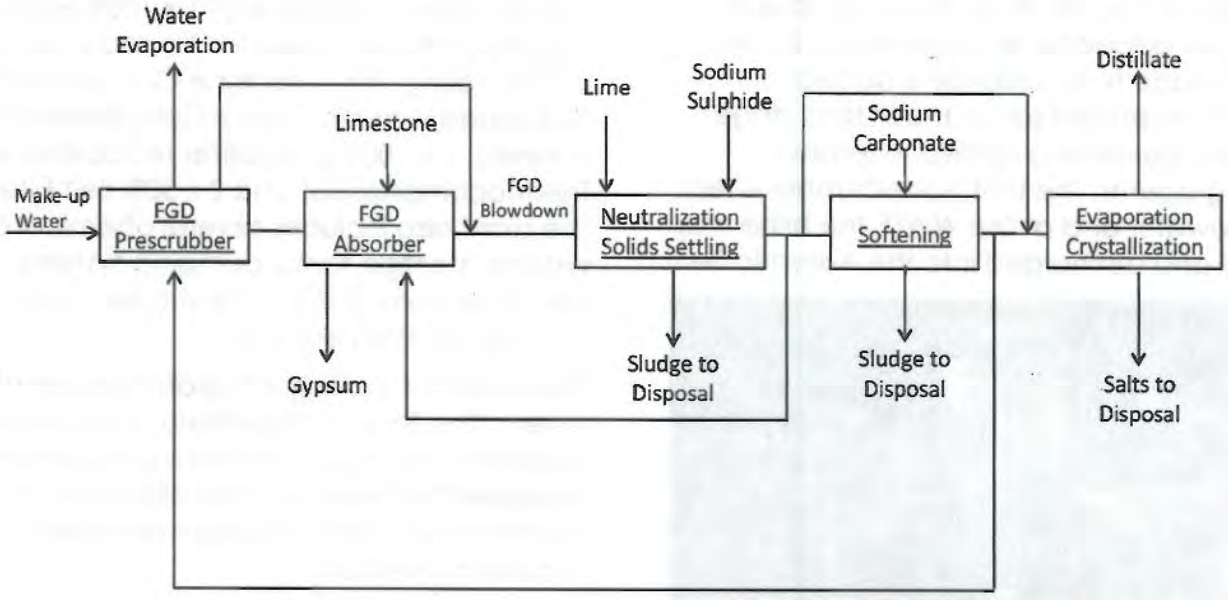
Design Flow.....45 m_3/hr (PT Plant)

Calcium.....1200 ppm
Magnesium.....1200 ppm
Sodium + Potassium.....Balance

TSS.....80 ppm
pH.....9.0

Bicarbonate.....80 ppm
Phosphates.....25 ppm
Chlorides.....22800 ppm
Nitrates.....300 ppm
Sulfate.....1700 ppm
SiO_2 .....10 ppm

PROCESS FLOW DIAGRAM



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PROJECT PROFILE SERIES # 55

ENEL Power, Italy – Torrevaldaliga Project – ZLD Plant for FGD Wastewater Treatment

The Facility

The Torrevaldaliga Nord Power Plant is being converted (torn down and rebuilt) to three coal-fired units each of 660 Mwe capacity. The plant is equipped with fabric filters for flue gas dust removal, DeNOx system (for flue gas denitrification), FGD systems for sulphur oxides removal. The FGD system is equipped with a common wet limestone milling, three limestone-gypsum forced oxidation absorbers and a common gypsum dewatering system of three hydro cyclone-vacuum belt filter configuration.

The Problem

Wastewaters from FGD treatment plants can no longer be discharged into the sea due to tough Italian and EU environmental regulations. In order to overcome this major environmental problem, ENEL decided to install the Zero Liquid Discharge (ZLD) plant so that no industrial wastewater discharges are allowed by the entire power plant.

The Solution

To overcome the problem, ENEL selected the Softening – Evaporation – Crystallization (SEC) process to treat the wastewaters and reuse/conserve fresh waters. Aquatech supplied, installed, commissioned the ZLD plant as an EPC contractor with local associates.

The SEC plant comprises of 1 x 100% Softener Clarifier for removal of suspended solids, temporary hardness, and precipitation of metal hydroxides. This is followed by 1 x 100% Softener Clarifier (calcium reduction by soda ash dosing) for removal of permanent hardness, 2 x 50% Falling Film type Brine Concentrators (each equipped with two Vapor Compressors operating in series), 2 x 50% Crystallizer (equipped with Thermocompressors) and 2 x 50% Belt Filter Presses. The plant also includes several chemical dosing systems, storage tanks, pumping systems, electrical works (MCC, cable trays, cabling etc), controls & Instrumentation.

The ZLD plant is a fully integrated automated system. The Brine Concentrators operate in seeded slurry mode. Each Brine Concentrator is equipped with external mist eliminator for ease in maintenance. The Crystallizer operates in forced circulation method.

The industrial grade soft water and high purity distillate produced in the system will be used in the main power plant.

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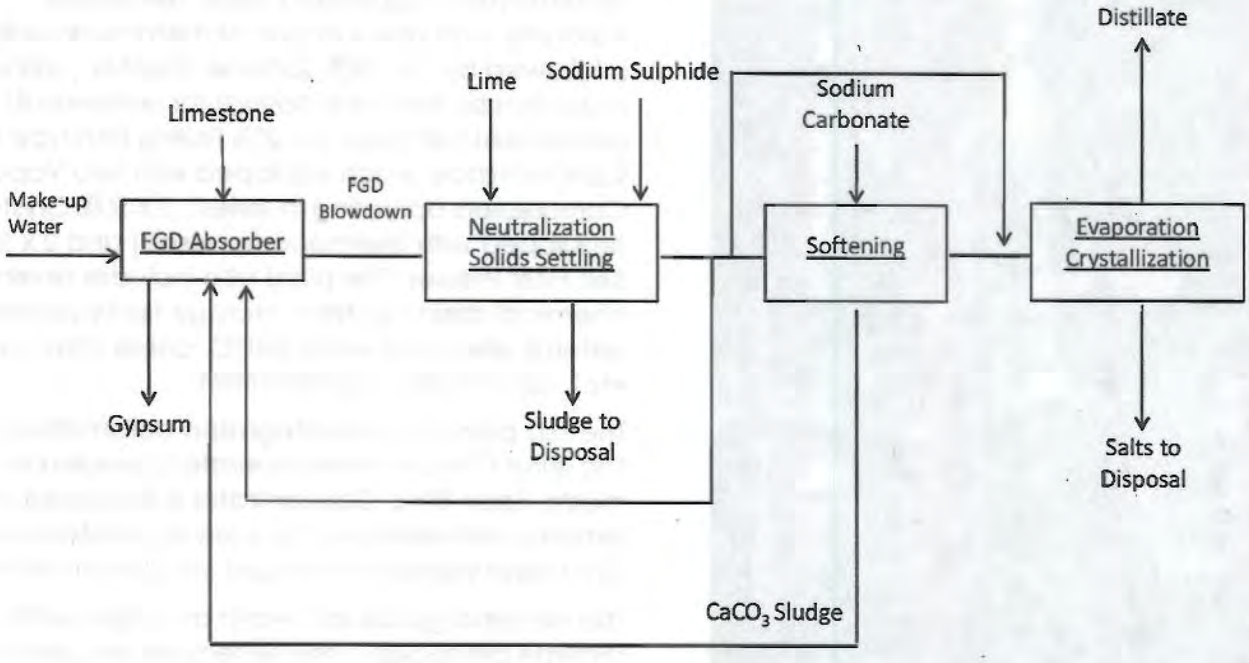
PROJECT PROFILE SERIES # 55

DESIGN FGD WASTEWATER ANALYSIS

Design Flow ....50 m_3/hr (PT Plant)	**Sulfate.....17700 ppm**
Calcium.....12000 ppm	**SiO_2.....20 ppm**
Magnesium.....2350 ppm	**Boron.....500 ppm**
Sodium + Potassium.....Balance	**Ammonia.....75 ppm**
TSS.....80 ppm	**Iron**
pH.....3 to 6	**Aluminum.....10 ppm**
Bicarbonate.....600 ppm	**Vanadium.....10 ppm**
Phosphates.....25 ppm	**Arsenic.....10 ppm**
Chlorides.....30000 ppm	**Manganese.....10 ppm**
Nitrates.....300 ppm	

PROCESS FLOW DIAGRAM



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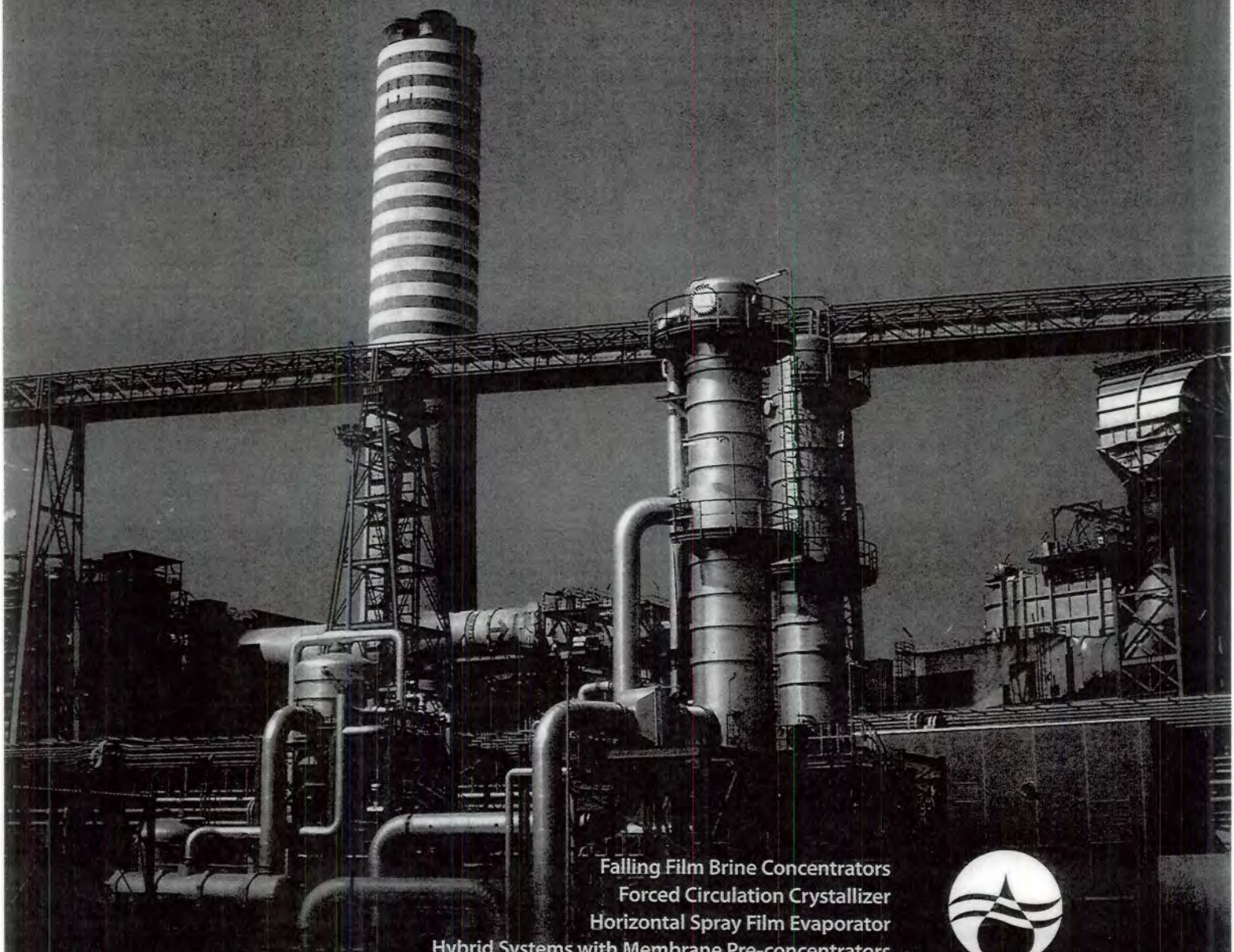
ZERO LIQUID DISCHARGE

Technologies that eliminate liquid waste discharge and recover water for re-use



Falling Film Brine Concentrators
Forced Circulation Crystallizer
Horizontal Spray Film Evaporator
Hybrid Systems with Membrane Pre-concentrators

Aquatech

GREEN TECHNOLOGY, YES.

DIRTY PLANET, NO.

Today's strict discharge requirements demand cost-effective, energy-efficient and reliable wastewater treatment solutions.

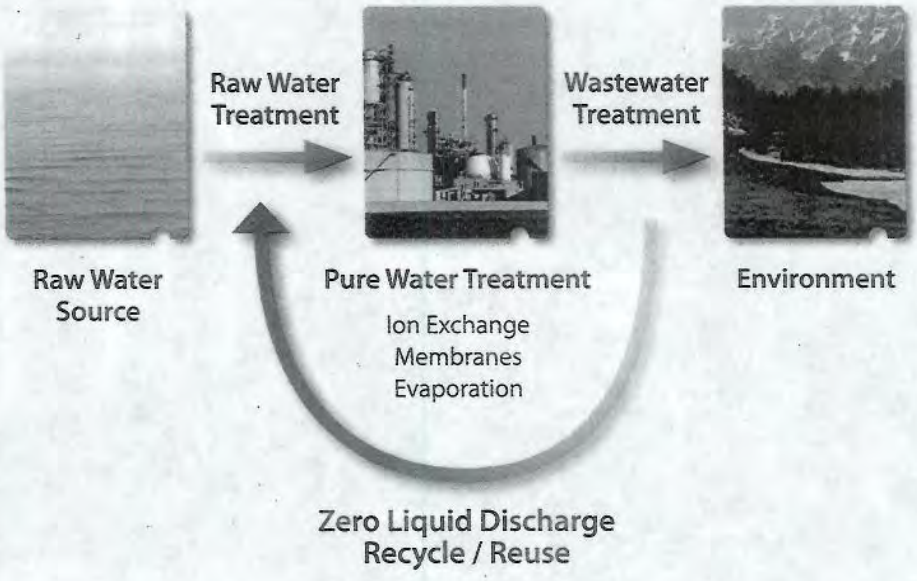
More and more, industries are prohibited from discharging any liquid waste originating from their facilities. Whether to meet regulations – for difficult-to-treat wastewaters – or for situations where scarcity of water demands water recovery (recycle/reuse) – Aquatech's innovative Zero Liquid Discharge (ZLD) technologies help you achieve environmental compliance, reduce your carbon footprint, create positive public perception, and recover high purity water for reuse.

Our proven ZLD technology eliminates liquid waste by converting it into disposable dry solids. Aquatech has extensive experience treating a wide variety of industrial wastewaters from various industries such as power, petrochemical, and oil & gas with our revolutionary technology.

Truly in line with the "green movement," Aquatech ZLD systems are environmentally friendly and highly reliable.

To meet strict environmental discharge guidelines and provide effective treatment with the lowest possible life-cycle costs, we offer integrated, site-specific ZLD solutions. These are based on standalone thermal/evaporative processes, membrane processes, or a combination of the two, namely, hybrid systems resulting in added value, ease of operation and reduced operating costs.

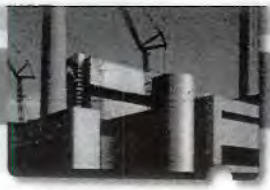
Integrated Systems Capabilities




Hydrocarbon Processing


Oil & Gas


Food & Pharmaceutical


Power Generation


Chemical Processing

Applications, Technologies, and Industries

APPLICATIONS

- Cooling tower blowdown
- Produced water
- FGD purge wastewater
- IGCC wastewater
- Reverse osmosis reject
- Demineralization regeneration wastewater
- Other complex industrial wastewaters

TECHNOLOGIES

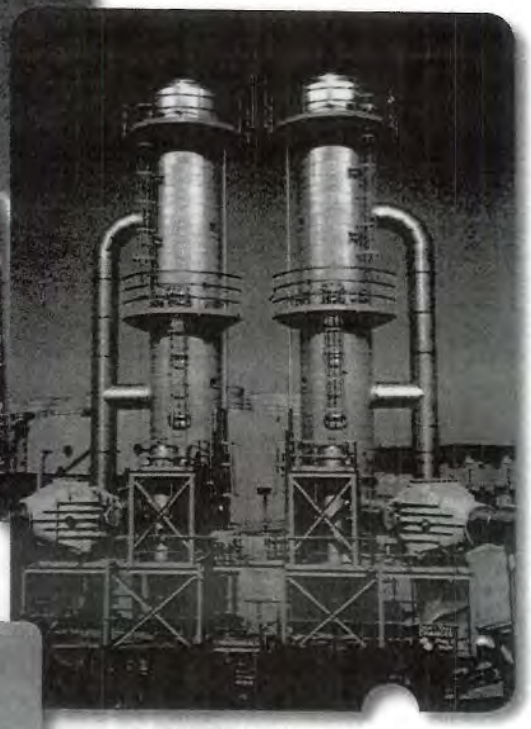
Thermal/Evaporative ZLD:

- Vertical tube falling film evaporators
  - Seeded slurry (brine concentrators)
  - Non-seeded evaporators
- Forced circulation crystallizers
- Sludge dewatering
  - Filter press
  - Centrifuge
  - Drum dryers

Hybrid ZLD:

- An integrated automated system incorporating a membrane pre-concentrator or HERO™ technology, followed by the thermal/evaporative technologies above


FGD Waste ZLD System


Cooling Tower Blowdown, Brine Concentrator


World's Largest Produced Water Evaporator System

INDUSTRIES

- Power Generation
- Oil & Gas
- Hydrocarbon Processing
- Chemical Processing
- Metals & Mining
- Food & Pharmaceutical

Want to know more about Aquatech ZLD? E-mail us at: **zld@aquatech.com**


Oman, Middle East


Nevada, USA


Alberta, Canada


Brindisi, Italy

FROM INNOVATION FLOWS LEADERSHIP

Aquatech is a global leader in water purification technology for the world's industrial and infrastructure markets, with a focus on Desalination, Water Reuse and Zero Liquid Discharge.

Aquatech's product groups include:

- Raw Water Treatment
- Ion Exchange
- Membrane Processes (UF/RO/MBR)
- Thermal Desalination (MED/MVC/MSF)
- Wastewater/Effluent Treatment
- Zero Liquid Discharge

The company also offers a large portfolio of water management services designed to help plant personnel and end user organizations get the most out of their water treatment system, whether originally supplied by Aquatech or not. These services include:

- Spare parts supply
- Operation and maintenance contracts
- Technical audits
- Leased water treatment systems
- Technical training
- Annual, quarterly, and monthly maintenance contracts
- Remote monitoring
- Build-own-operate contracts (BOO)

CORPORATE HEADQUARTERS

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Certified System
ISO 9001

Industrial Process Water • Membrane Desalination • Thermal Desalination • Wastewater Recycle and Reuse • Zero Liquid Discharge • Total Water Management