

Accomplishing Zero Liquid Discharge in Petrochemical Facilities



Contents

- **Brief Introduction – Aquatech**
- **Drivers for accomplishing ZLD**
- **Source of generation of wastewater**
- **Analytical quality - Effluent & Treated**
- **Challenges**
- **Approach**
- **Case Study – Petrochemical plant in Egypt**
- **Conclusion**

Introduction

Aquatech exists to meet the world's need for Pure Water. We will provide *Technology Leadership*, and *Performance Excellence* to the markets we serve.



**Global Headquarters,
Canonsburg, PA, USA**



Manufacturing Facility

- Leading player in the global water industry
- 34 years of successful growth and performance
- Worldwide offices in Canada, China, India, Italy, UAE, KSA and USA
- Over 1000 Major Projects in > 60 Countries
- Focus - Industrial and Infrastructure Markets
 - Process / Pure Water
 - Wastewater Treatment and Recycle and Reuse
 - Desalination
 - Zero Liquid Discharge
- 4 Key Business Models
 - Capital Equipment / Systems
 - Design –Build Solutions
 - Technology Products and Components
 - Services : O&M / DB(O) / BOOT

Aquatech Business Units

Industrial Solutions

- Industrial Process Water
- Industrial Wastewater treatment & Recycle
- Zero Liquid Discharge (ZLD)
- Spent Caustic Treatment

- HIGH TECH PROCESS ENGINEERING
- Advanced Oxidation Process
- EQUIPMENT SUPPLY FOCUS



- Thermal Desalination
- Industrial Concentration (Evaporators, Crystallizers, etc.)

- ZLD Treatment
- IGCC WW
- Shale Gas
- Oil Recovery



Infrastructure

- Desalination
- Water Reuse Projects
- Major Industrial EPC projects

- EPC / BOP CAPABILITY
- MAJOR PROJECT FOCUS



Products and Services

- WATERTRAK™ Standard Products
- Water Management Services
- Spare Parts
- AMC

- SHORT TERM RECURRING REVENUE



Operating Services

- Industrial DBOOM
- Contract Operations
- Infrastructure DBOOM

- LONG TERM RECURRING REVENUE
- WRAP OF OTHER BUSINESS UNITS



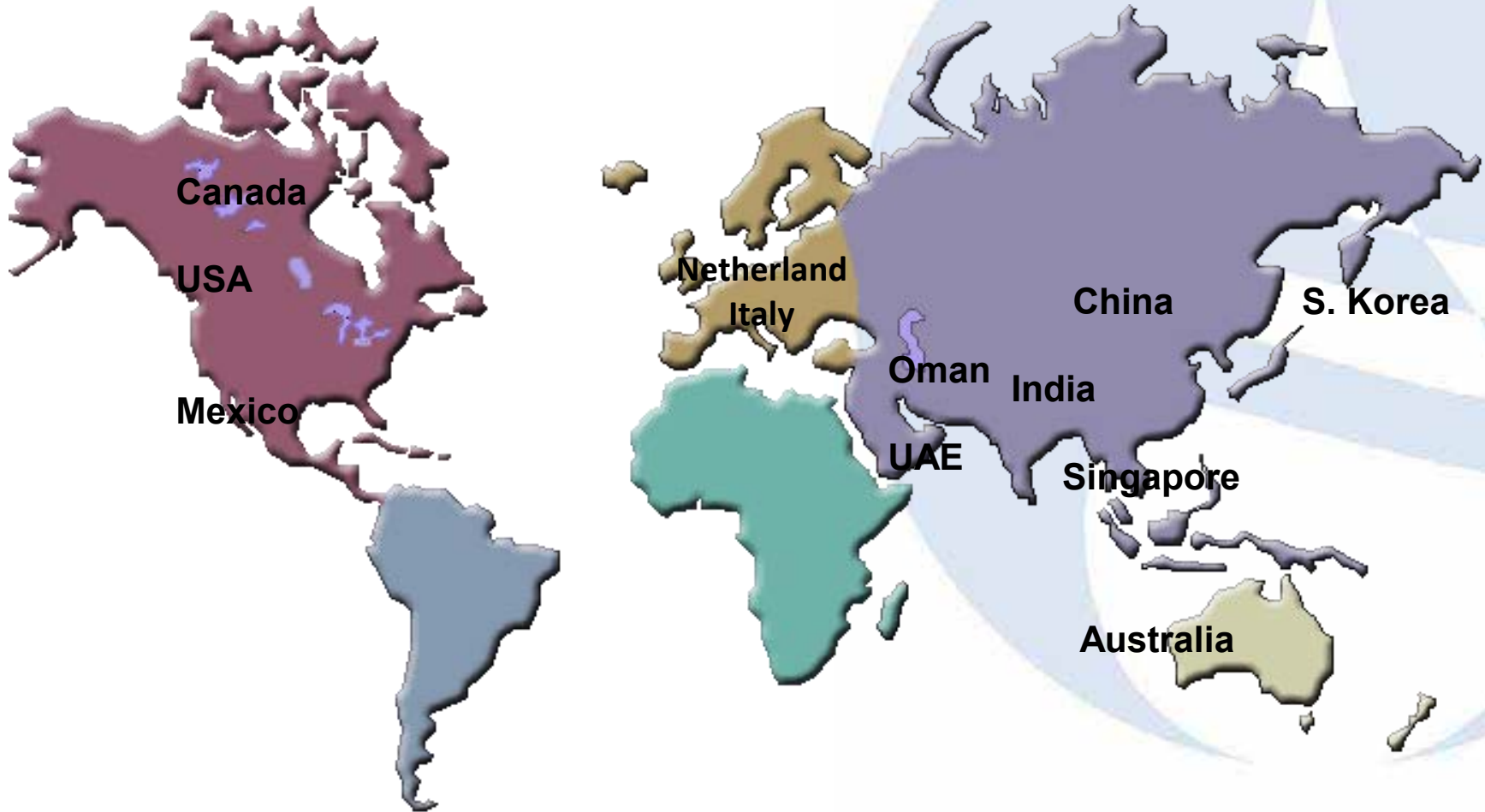
QUA™ Advanced Membrane Technology

- FEDI™
- UF
- MBR
- EDR
- Other Development

- HIGH TECHNOLOGY RECURRING REVENUE



International Presence



Worldwide Job Sites

Over 1000 Major Projects in > 60 Countries



Aquatech International Timeline

In 1981 Aquatech was established specializing in pure water systems for the Steel Industry located in the metropolitan Pittsburgh area.

In the early 1990's Aquatech developed a global presence.

The mid 1990's saw Aquatech's entry into the Zero Liquid Discharge and Wastewater recycle/reuse Markets.

In 2006, Aquatech Becomes the EPC with ENEL Italy & Occidental Mukhaizna Oman.

In 2012, Aquatech 1st ZLD in Egypt, completes 1st RR in GCC, awarded WWTP for Rabigh Ph II, Ethydc, Desal – FEWA, ZLD - Marcellus Shale

In the late 1980's Aquatech began offering a more diversified product range including membrane systems and pre-treatment.

In 2000, Aquatech acquired the Industrial Concn and Desalination business units of Aqua-Chem, Inc. to strengthen their *Desalination* and *Zero Liquid Discharge* capabilities.

2009 & beyond, the management and shareholders of Aquatech commit to an accelerated growth strategy to become a Tier 1 Global Water Platform with >35% Recurring Revenue based Businesses including DBOOM, O&M and Products

In 2014, was Aquatech awarded one of the largest Thermal Desal MED based job for Petroleum Refinery in Oman, awarded to treat complex produced water for steam generation in Oman

Drivers for accomplishing ZLD

- Environment protection
- Meeting regulation requirement
- Economics

Source of Generation

Various Generic Chemical Processes in a Petrochemical Plant

- **Distillation**
- **Catalytic Cracking**
- **Catalytic Reforming**
- **Alkylation**
- **Hydrotreating**
- **Amination**
- **Condensation**
- **Esterification**
- **Halogenation**
- **Nitration**
- **Sulfonation**
- **Ammonolysis**
- **Isomerisation**
- **Pyrolysis**

And Host of other Process

Sources of Generation

Direct Contact, Indirect Contact, Utilities -

- **Water used for wash impurities from Organic Compound products or reactants**
 - **Water used to cool quench**
 - **Condensed Steam**
 - **Water from Raw and product material storage tanks**
 - **Water Used as carrier for catalysts and neutralizing agents**
 - **Water as By Product**
 - **Water used for Equipment Wash (Discharged from process equipment like Scrubbers, Decanters, Evaporators, Distillation Columns, mixing vessels, reactors**
 - **Leakages from Pumps, Heat Exchangers, Condensers etc.**
 - **As Blow Down from Boilers or Cooling Towers**
-
- **Accordingly the waste water streams generated contain contaminants, Organic Compounds etc.**
 - **Some of them have Volatile Organic Compounds**

Analytical Quality of Effluent

Parameter	Feed Wastewater Quality Range	Treated Effluent Quality Range
pH	5.0 – 9.0	7.0 – 8.0
Oil & Grease, mg/l	100 – 300	ND
TSS, mg/l	100 – 1000	ND
Conductivity, $\mu\text{s}/\text{cm}$	10000 – 25000	< 15
Total Hardness, mg/l CaCO ₃	50 – 100	-
NH ₃ , mg/l	5 – 50	ND
Sulfide, mg/l	5 – 50	ND
Phenols, mg/l	5	ND (< 1 ppb)
Silica, mg/l	5 – 50	-
BOD ₅ , mg/l	30 – 200	ND
COD, mg/l	50 – 300	< 10
BTEX compounds, mg/l	0.5 – 25	ND

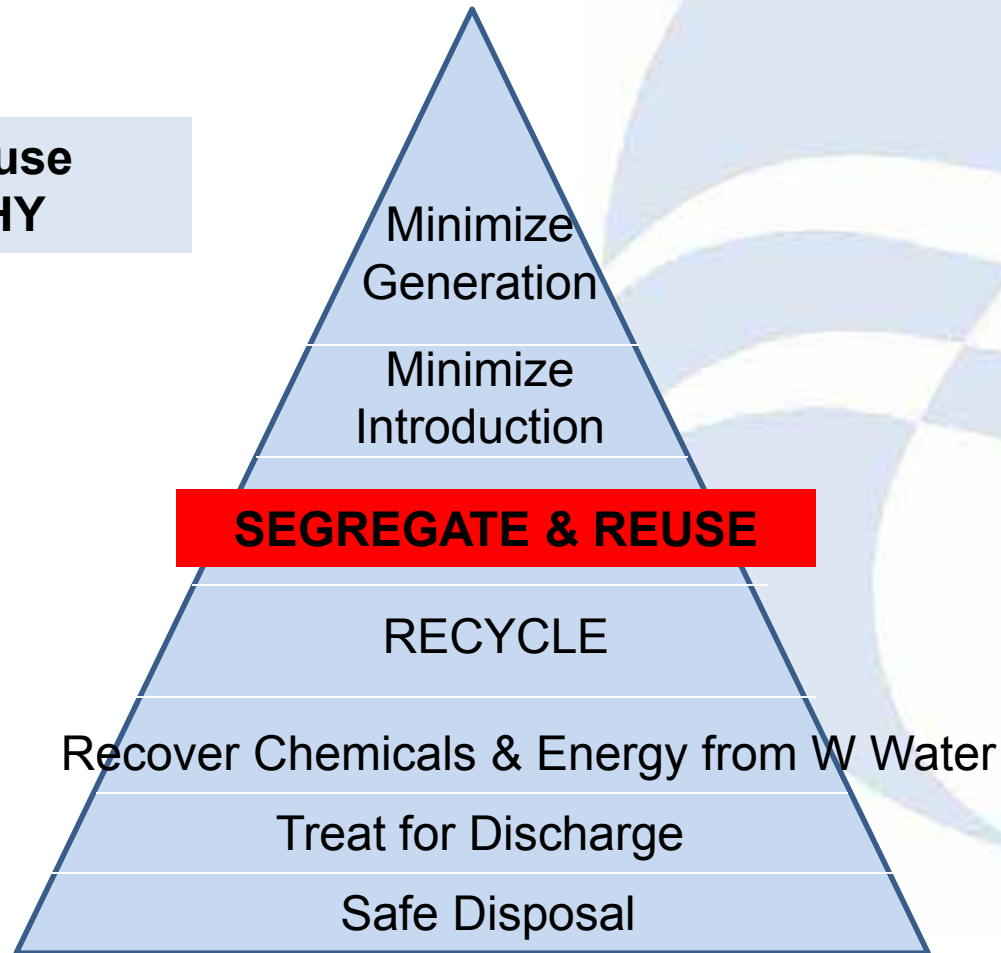
Challenges

CHALLENGES IN WASTEWATER TREATMENT OF PETROCHEMICAL EFFLUENT

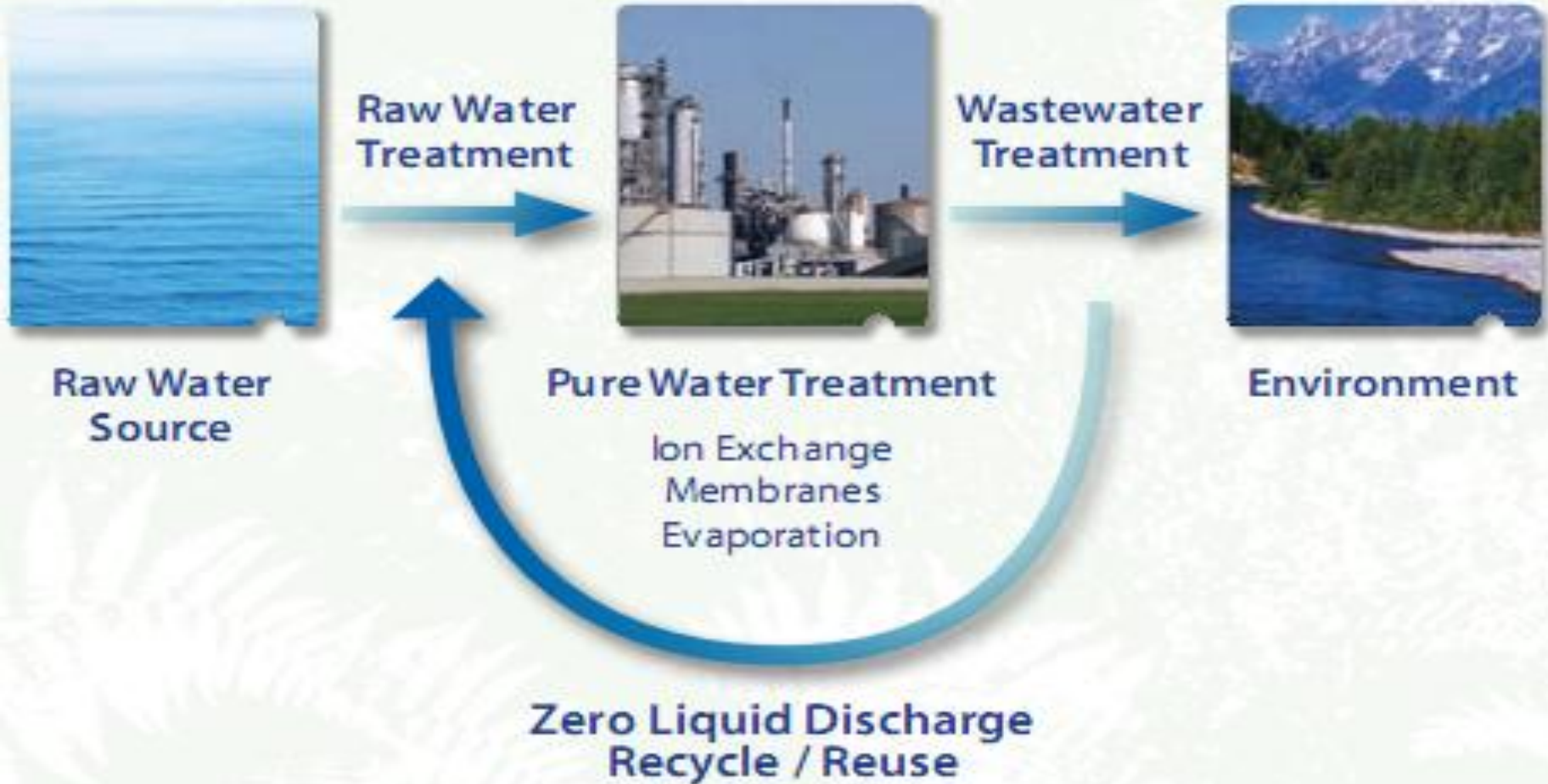
- **Removal of Oil & Grease**
- **Organics / Hydrocarbons present – Phenols, Glycols, VOC**
- **Hazardous air pollutants**
- **Removal of Heavy Metals**
- **Chemical Oxygen Demand (COD)**
- **Disposal of Spent caustic**
- **Solids Waste Management**

Approach to Recycle & Reuse

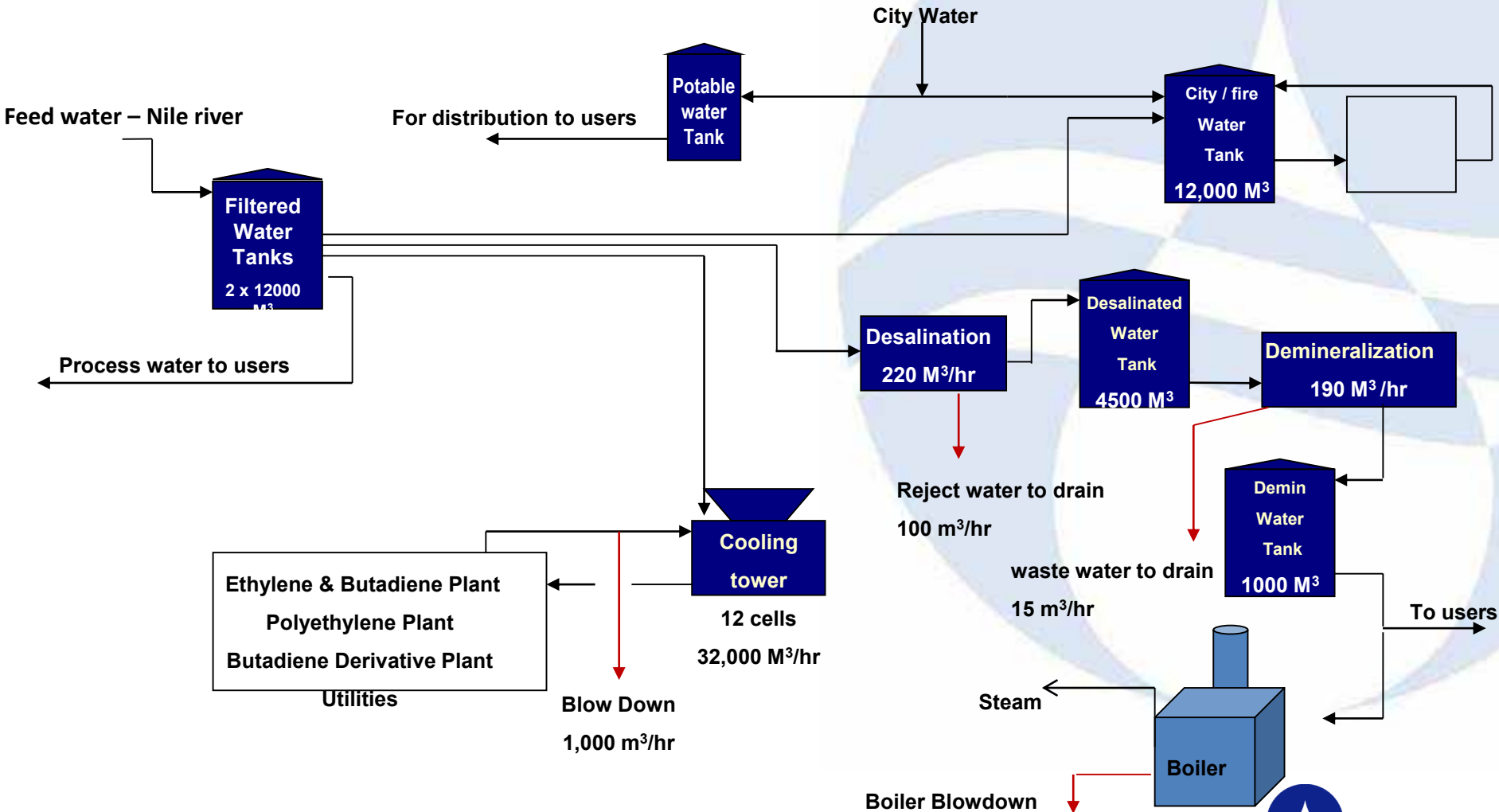
Recycle Reuse HEIRARCHY



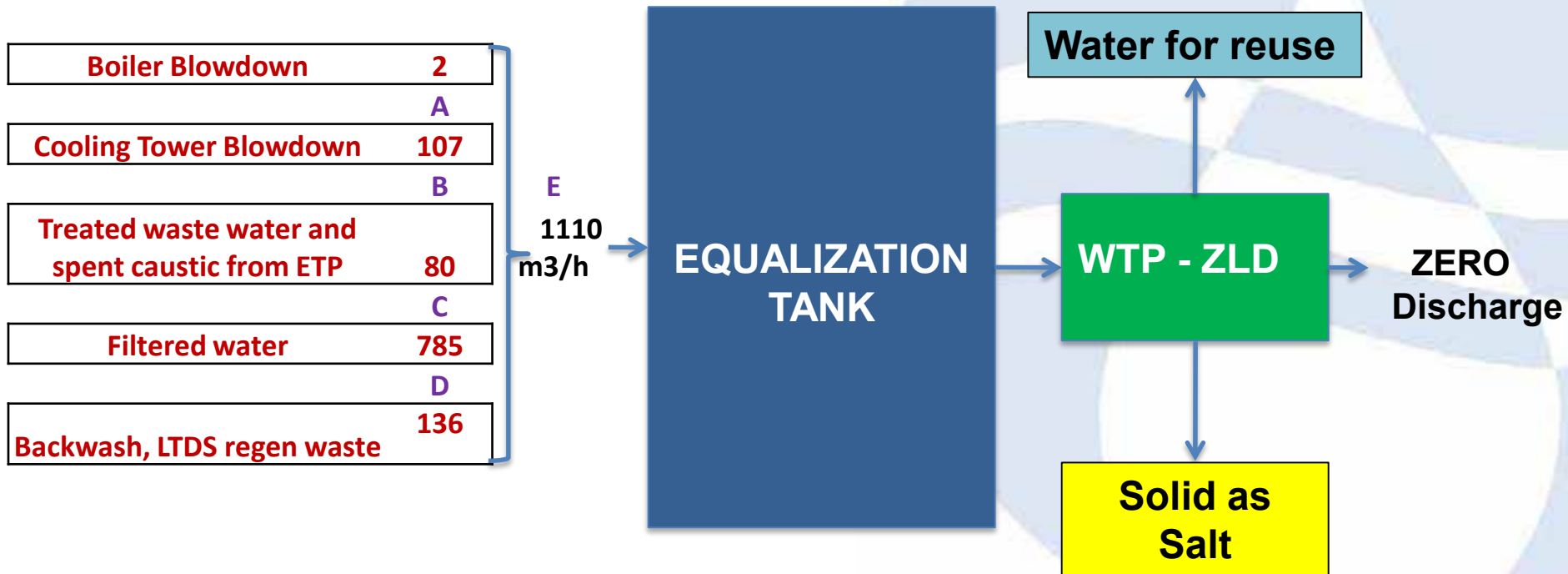
Integrated Systems Capabilities



Basic Design – Water Treatment System - PFD



Case Study - Water Balance Diagram



Process Wastewater WWTP

WWTP – Salient Features

MBBR – Disk Screen – Advanced Oxidation System

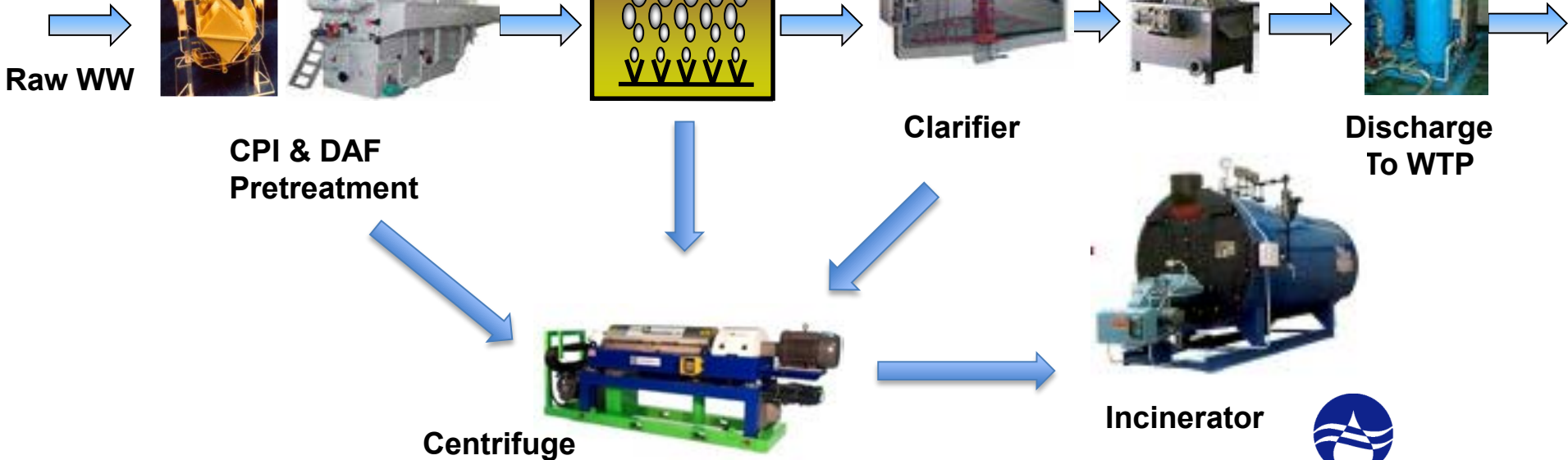
**Sludge Dewatering – Centrifuge
Incinerator**

WWTP using Bio Core

Bio Core - Moving Bed Bioreactor

Disk Screen

AOP



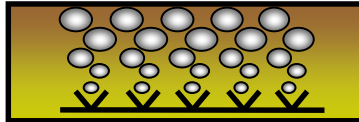
Strictly Confidential

Process Wastewater WWTP – Salient Features

WWTP utilizes the most Advanced Technologies



- FLOW RATE – 25 m³/h
- DAF – Dissolved Air Flotation – As pre-treatment
- BIOLOGICAL SYSTEM – BIOCORE™ – Moving Bio Bed Reactor – Fixed Film



Utilizes the most advanced technology – Aqua Chip
Aqua Chip has the highest s/a 3000 m²/m³
Compact size of Bio reactor
Most suitable for treating of difficult effluent

- DISK SCREENING – Advanced Filtration – Non stop operation
- Consistent quality of treated waste water



- ADVANCED OXIDATION SYSTEM – Specifically designed to meet the stringent requirement of phenol levels as < 1 ppb



- INCINERATOR – Specifically designed to meet client's requirement. It shall incinerate Oily and biological sludge



Process – Spent Caustic Treatment

Evaporation - Package

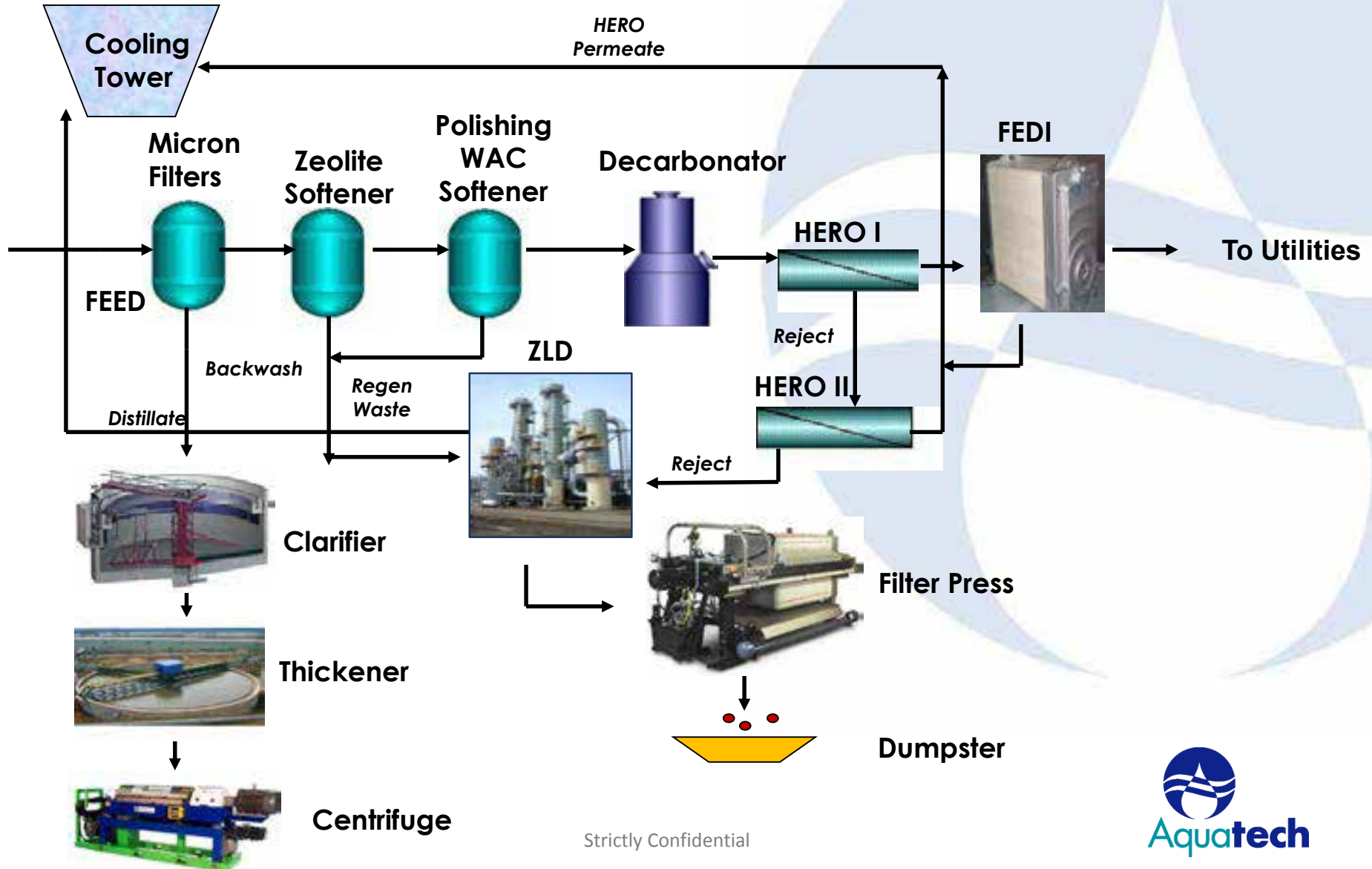
Salient Features –

- Designed to treat Spent Caustic generated from during the process. It consisting of recalcitrant organics, volatile organics and inorganic salts.
- Flow Rate – 7.5 m³/h
- The evaporator utilizes Aquatech's proven technology – FCC



Strictly Confidential

Process Flow Diagram – WTP & ZLD



Strictly Confidential

WTP & ZLD Package – Salient Features

WTP & ZLD utilizes the most advanced technologies

- HERO™ – High Efficiency Reverse Osmosis
 - Upto 95% recovery of permeate
 - Can withstand O&G up to 10 ppm & silica up to 2000 ppm
 - Cleaning frequency – once a year
- FEDI™ – Fractional Electro De Ionizer - Utilizes Advanced Technology
 - Advanced two stage process
 - Optimized power consumption
 - Environmental friendly
 - Free of scaling problems
- ZLD – Zero Liquid Discharge – Brine Concentrator & Crystallizer



1. Flow Rate – 1110 m³/h – Optimally designed for OPEX
2. There is zero waste water discharged from the complete system
3. Treated water produced in different stages of production meets all the requirement of utilities and process

ZLD – Process Schematic



Wastewater storage



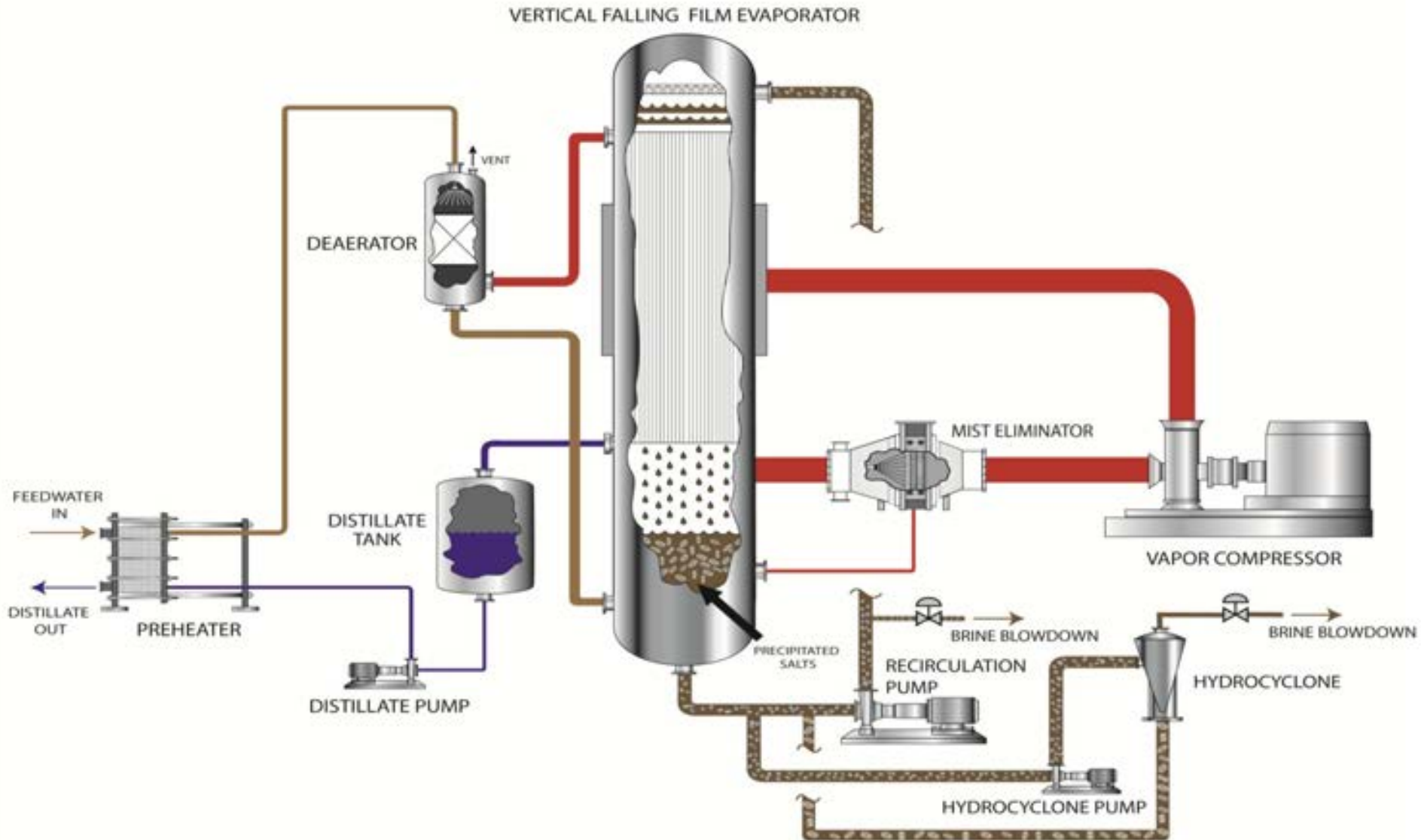
Brine Concentrator



Crystallizer

Strictly Confidential

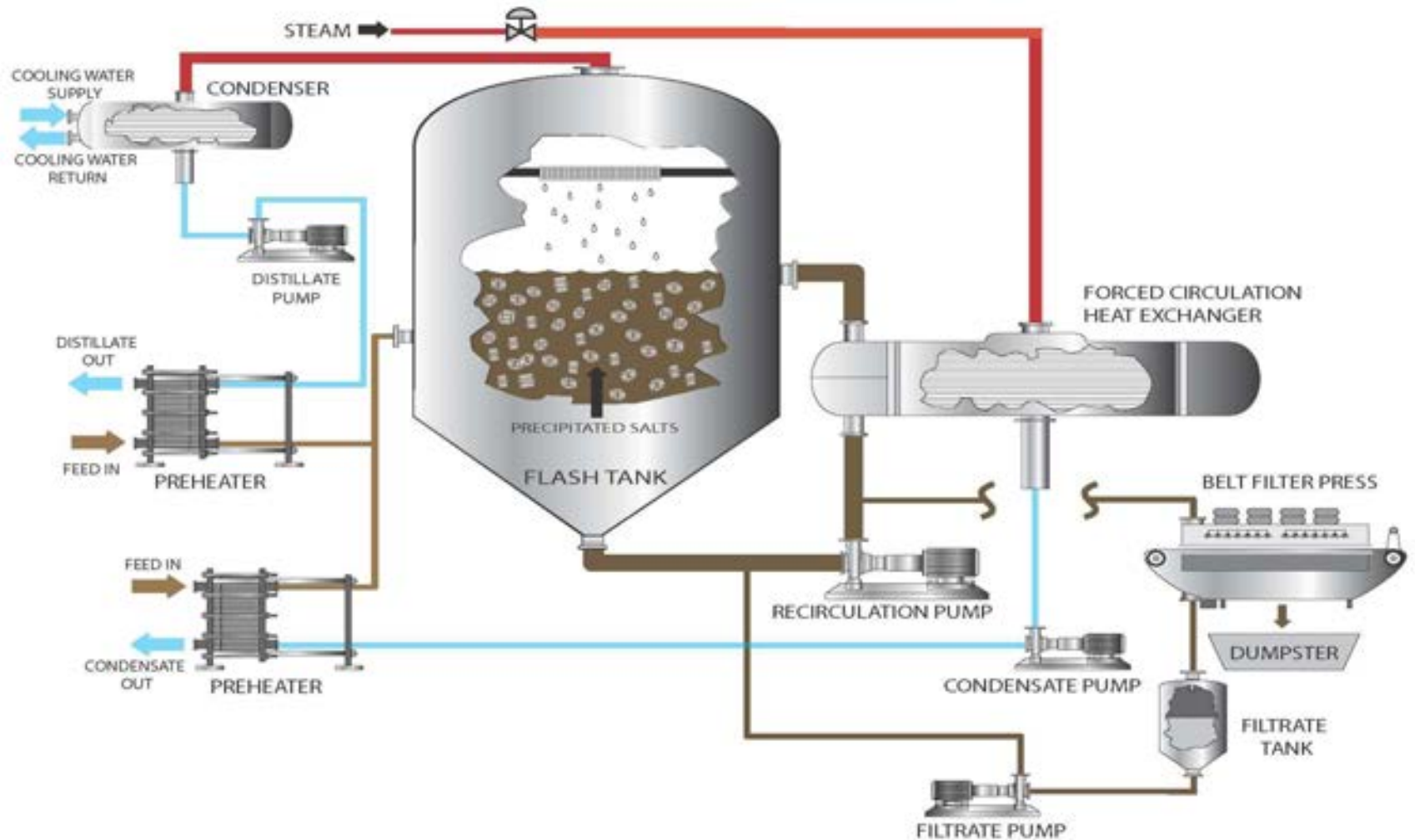
ZLD – Falling Film Evaporator



ZLD – Falling Film Evaporator



ZLD – Crystallizer



ZLD – Crystallizer



Evaporation - Package

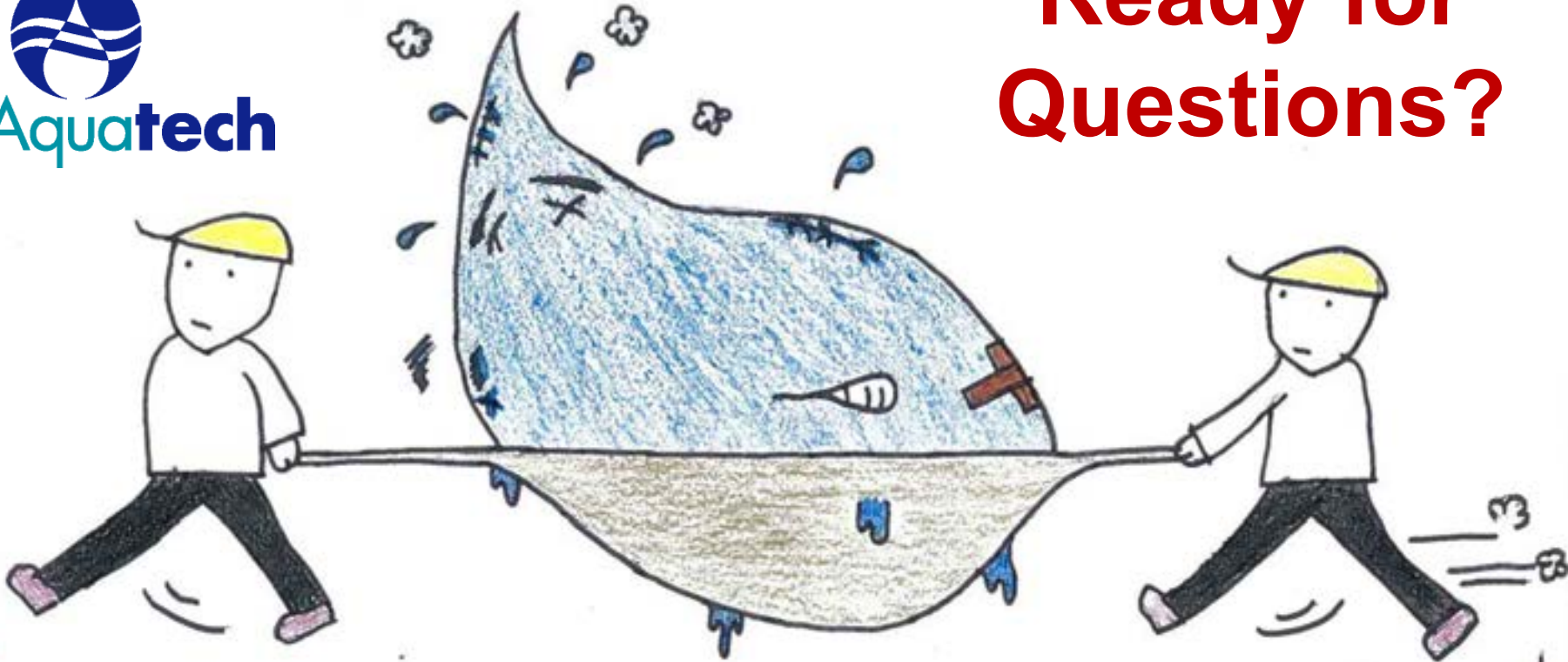


Conclusion

By applying the maximum water management and the ZLD concept water consumption was reduced from **2,660 m³ / hr to 800 m³/hr**, i.e. **saving almost 70 %** of the similar plant water consumption.



**Ready for
Questions?**



Save

Each Drop Of Water.