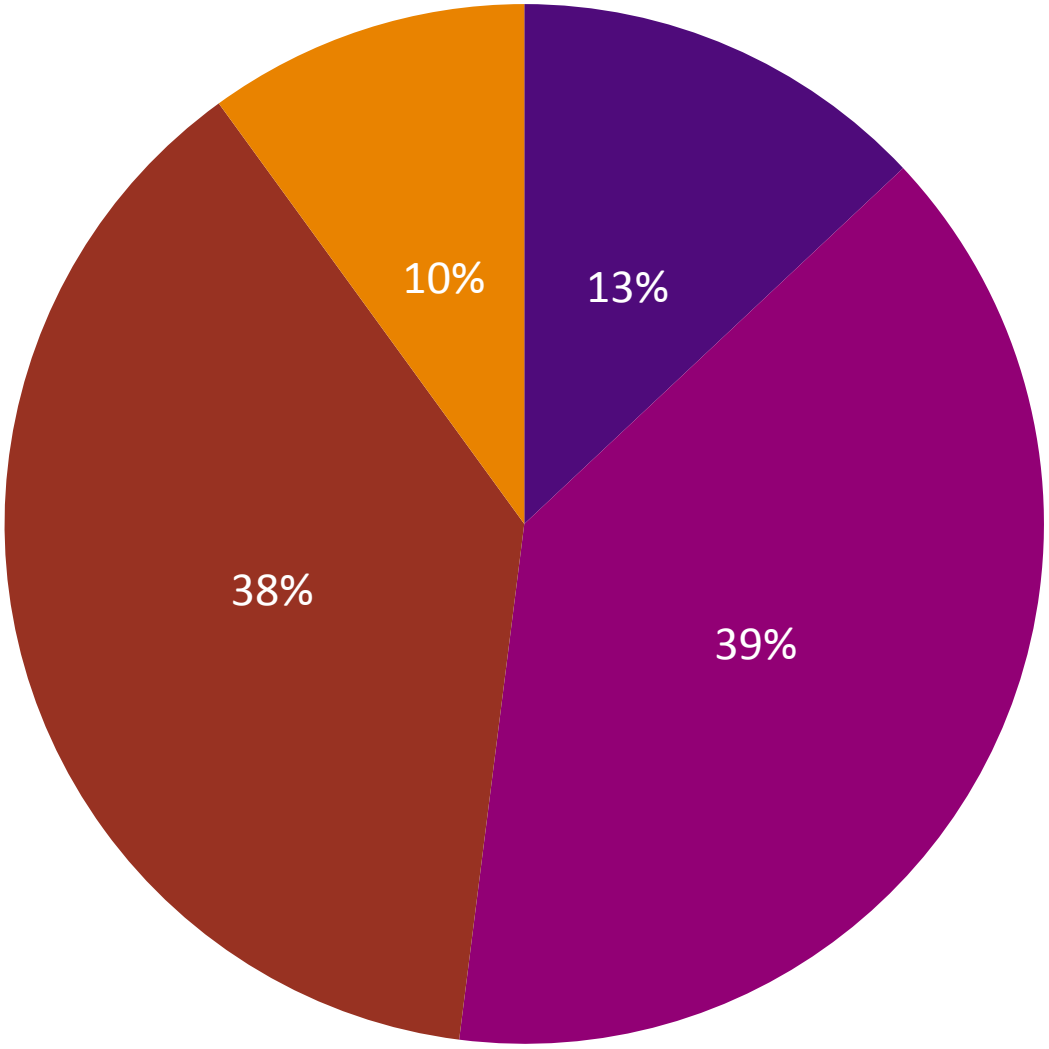
Reclaimed Waste Water for Power Plant Cooling Tower Water & Boiler Feed Make-up

Richard Coniglio, Business Product Manager

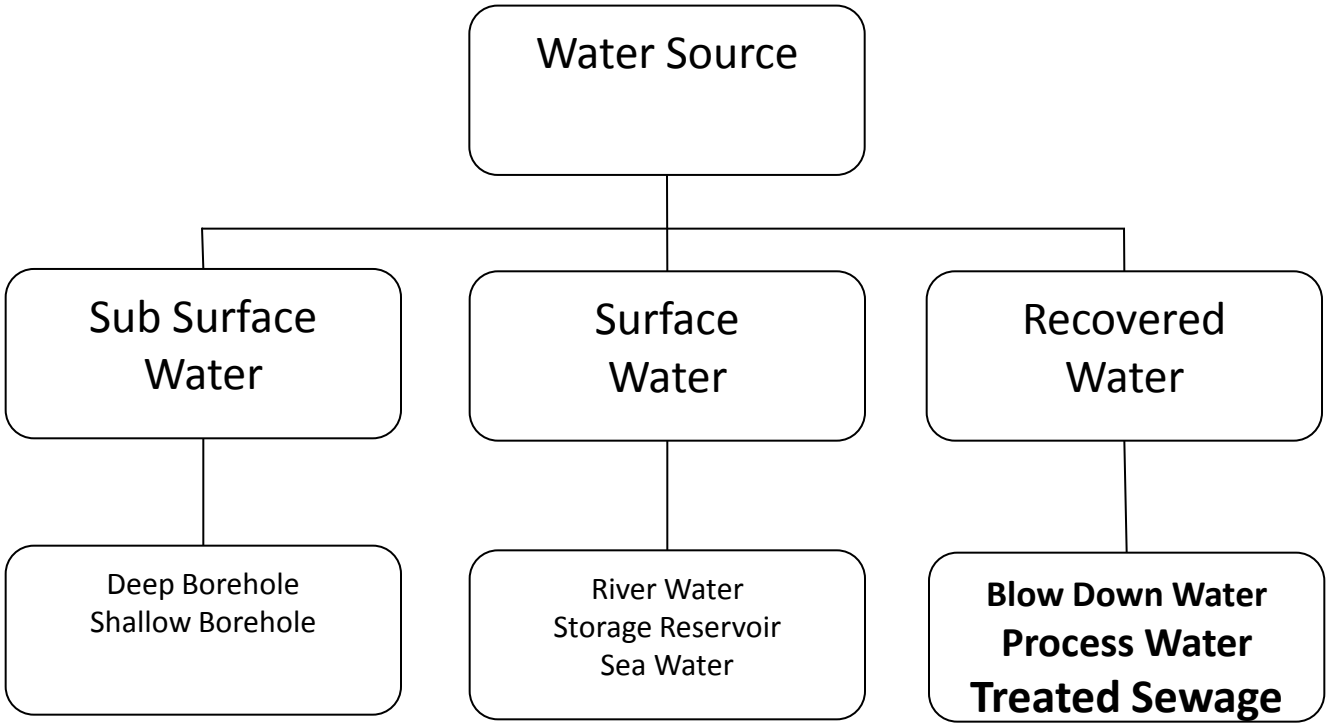
- 70% Covered with Water
- 3% is Fresh Water
- 1% of the Fresh Water is only accessible.

Source: U.S. Dept. Of Energy

Daily Freshwater Withdrawal Has increased from 341 BGPD in 1995 to 400 BGPD in 2010



Source: USGS


Water Source
Sub Surface Water
Surface Water
Recovered Water
Deep Borehole
Shallow Borehole
River Water
Storage Reservoir
Sea Water
Blow Down Water
Process Water
Treated Sewage

Available Secondary Treated Municipal Waste Water

From

Publically Owned Treatment Works (POTW)

1- ***Within 10 Miles Radius from the Power Plants:***

50% of ALL Existing Power Plants

80% of ALL Proposed New Power Plants

2- ***Within 25 Miles Radius from the Power Plants:***

75% of ALL Existing Power Plants

97% of ALL Proposed New Power Plants

Source: University of Pittsburgh Study for U.S. Dept. of Energy

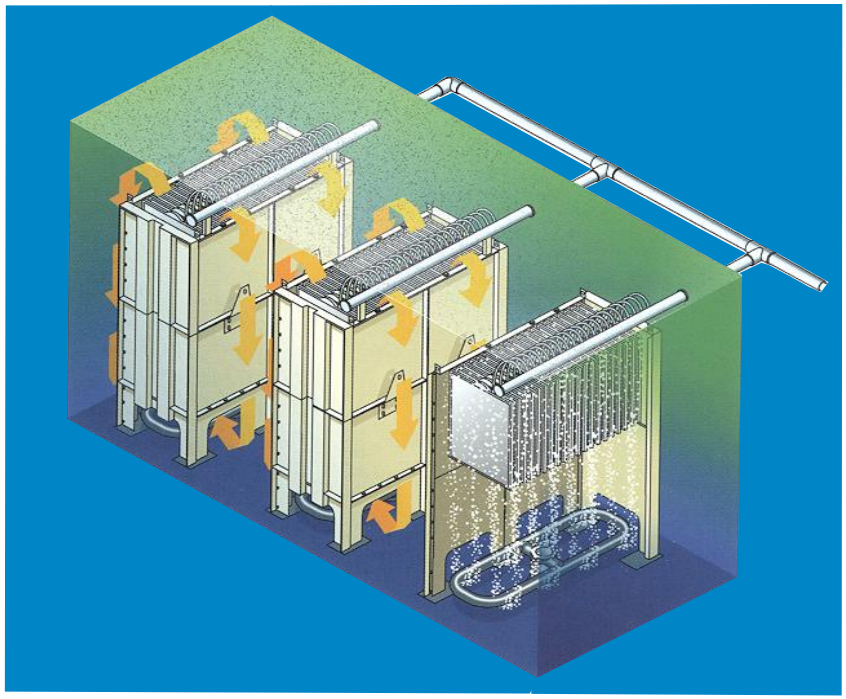
Wastewater Treatment Core Technologies

- Sedimentation
- Filtration
- Aeration
- Flotation
- Biological Treatment Systems
- Chemical Treatment Systems
- Disinfection System

MBR Process

What is a membrane bioreactor?

- A membrane bioreactor is a state of the art wastewater treatment process utilising biological treatment alongside filtration all in one common tank.



MBR Process

How does it work ?

Filtration Process

- Barrier filtration
- Membranes
- Separates solids and liquids

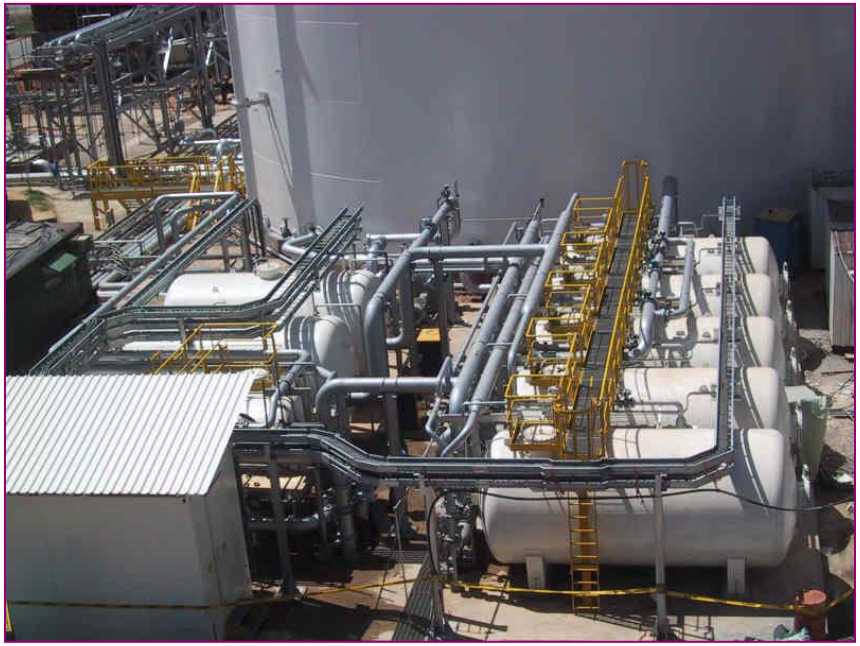
Biological Process

- Activated sludge (MLSS)
- Bacteria
- Oxidises organic constituents, BOD, and Nitrification of Ammonia to Nitrate

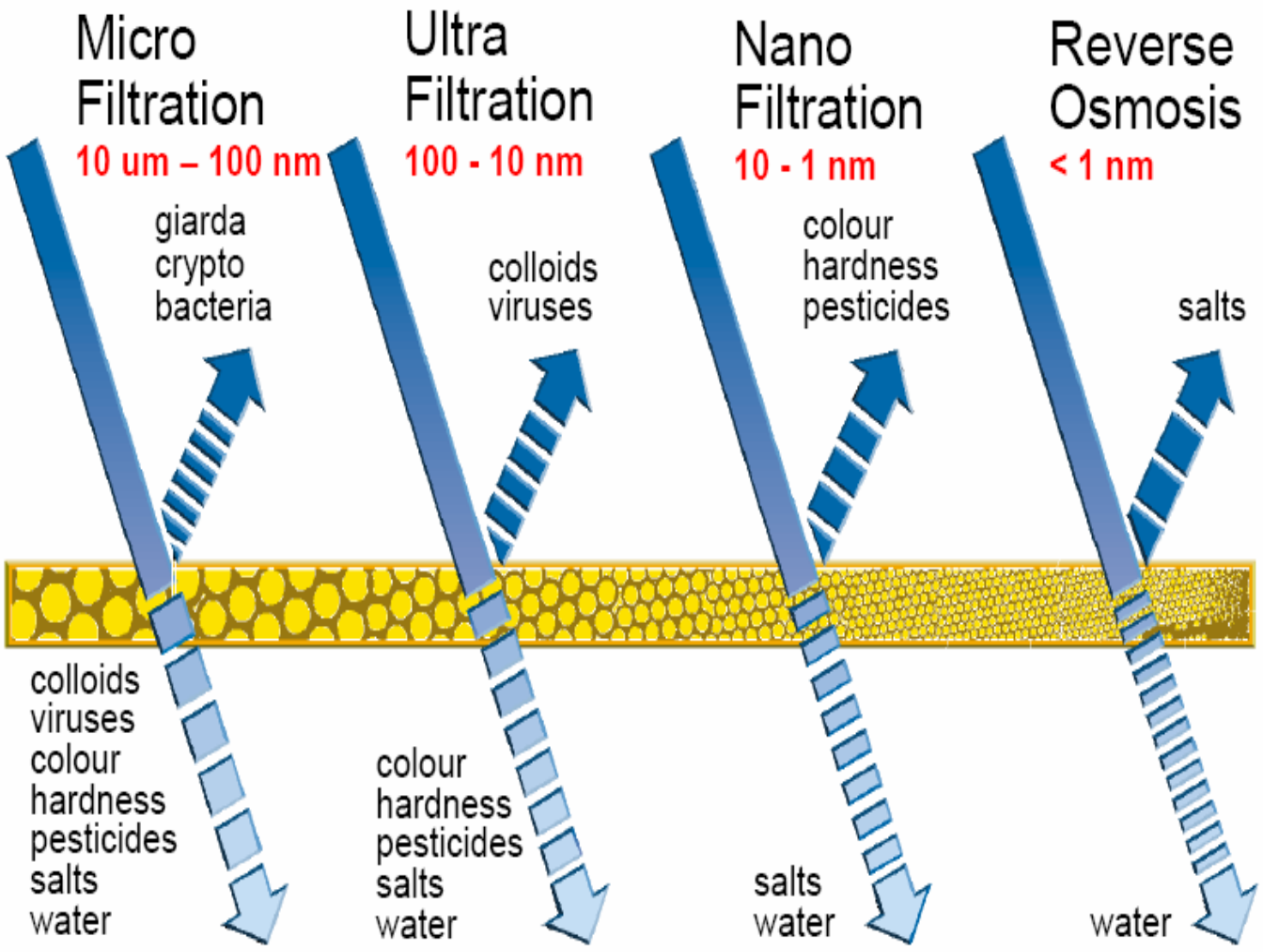
Membrane + Bioreactor

Process Design Filtration

- Multimedia Filtration
- Micro Filtration
- Ultra Filtration
- Activated Carbon Filtration
- Precoat Filtration



MembraneTechnologies



What UF removes

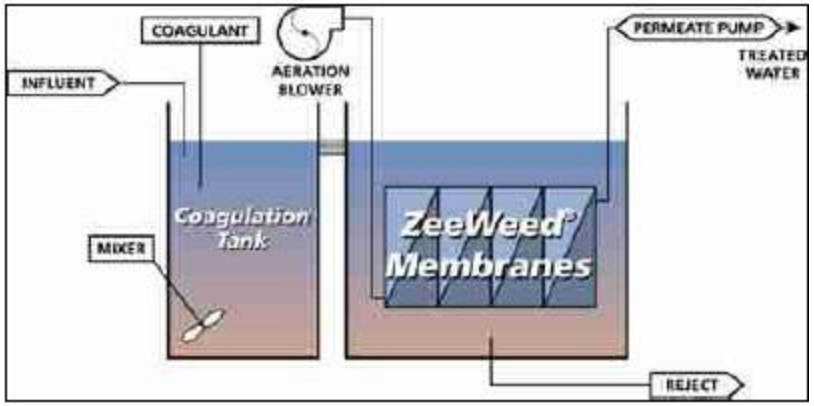
Ultrafiltration removes

- Particles
- including a portion of colloids like non reactive silica
- High Molecular Weight species
- including large organics
- Pathogens

Ultra-filtration does NOT remove

- Dissolved salts
- Most dissolved organics
- Other species like true color, taste & odor etc...

Submerged Ultrafiltration

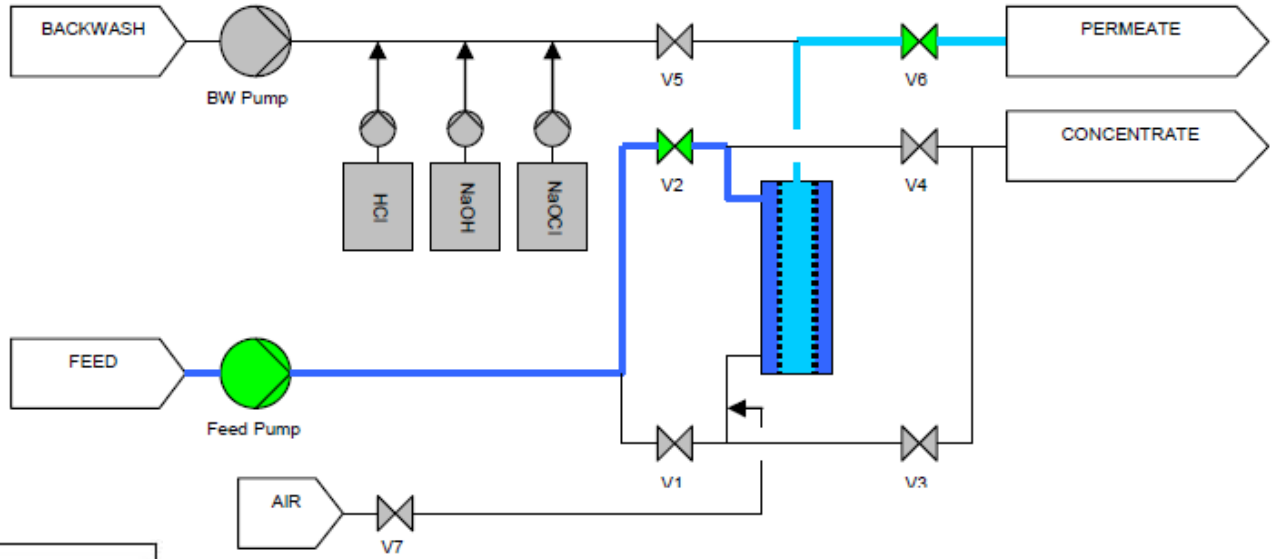


Where Used :-

RO Pre-treatment

Removes fine solids > 0.02 µm

Pressurised Ultrafiltration



Process Design
Demineralization

Membrane based

- **Reverse Osmosis**
- **Electrodeionization**

Ion Exchange based

- **Softening**
- **WAC/SAC – WBA/SBA**
- **Mixed Bed IX**

Case Study No. 1
800 MW- CCPP
Ankara, Turkey

- Fresh water is not readily available
- Municipal waste water treatment plant
  - 6,000 gallon/minute (gpm)
  - SS: 400-800 mg/L
  - COD: 100-140 mg/L as O2
  - NH4-N: 40 mg/L
- Water is screened and treated before being piped to the plant 1.5 miles away
  - 2 x 3000 gpm Lime softeners,
  - 6 x 1000 gpm open multimedia filtration unit.
- 5,000 gpm for the cooling tower water make-up.

Lime Softening system

Open Multi Media Filter

Case Study No. 1
800 MW- CCPP
Ankara, Turkey

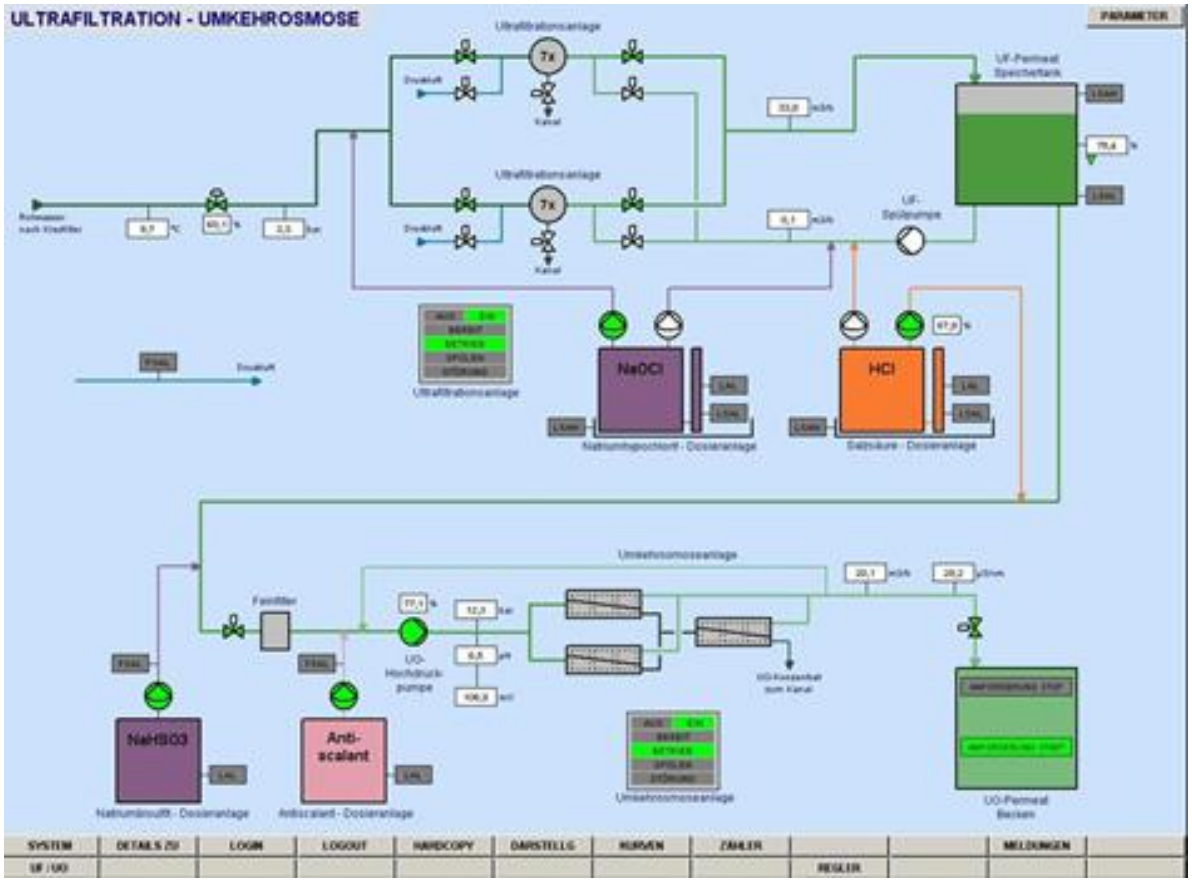
- 200 gpm is further treated to produce the Boiler Feed water make-up necessary
  - Ultrafiltration,
  - activated Carbon filter,
  - reverse osmosis,
  - mixed bed ion exchange.
- The produced water quality for the boiler has conductivity <0.08 µs/cm and silica <10 ppb SiO2.

Ultra Filtration For Boiler Feed Water

Reverse Osmosis for Dissolved Solid Removal

Mixed Bed Ion Exchange for Boiler Feedwater

Case Study No. 2
Compact Water Treatment Package To Treat Municipal Waste Water For Low Pressure Boiler Make-up Water in Austria

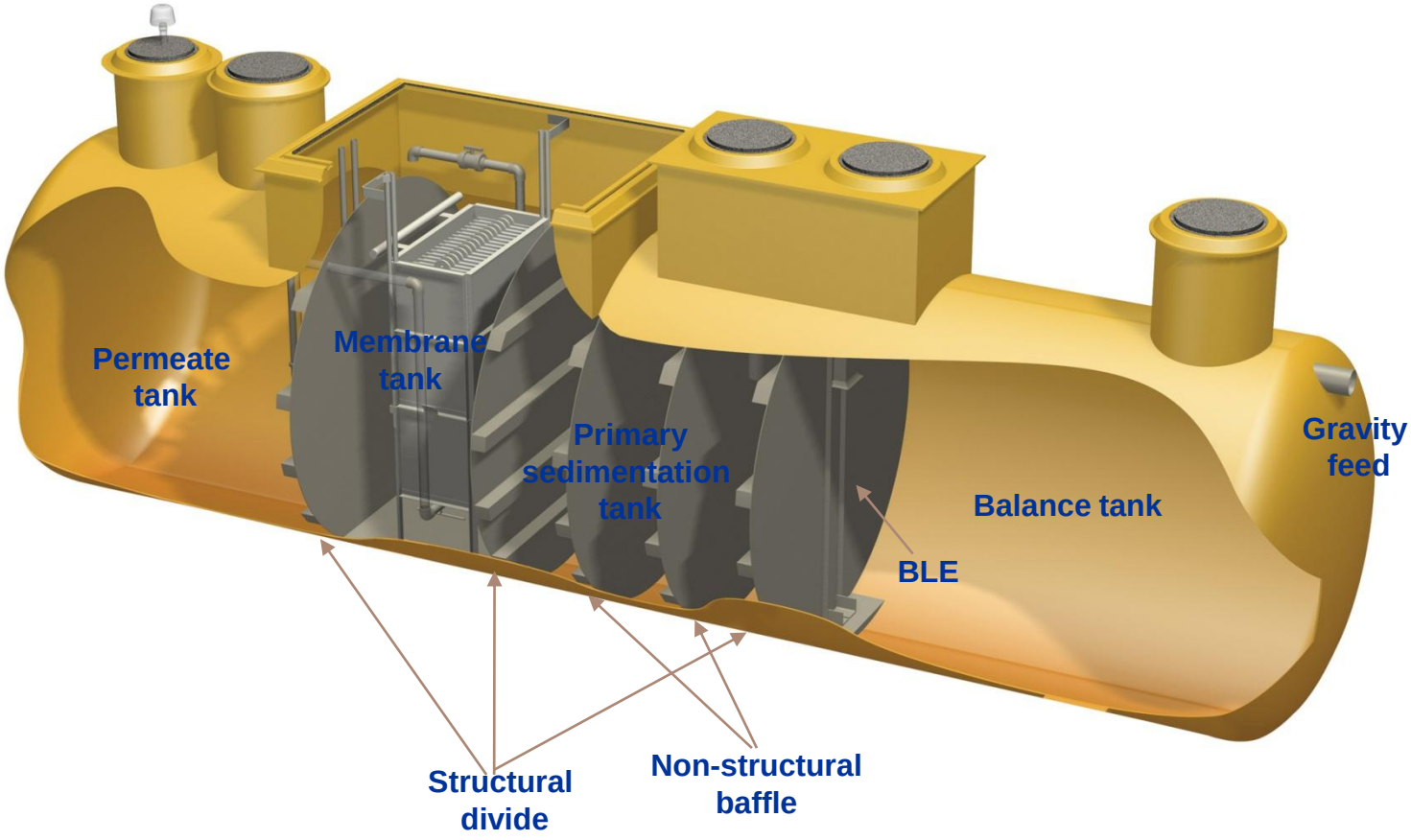


Case Study No. 2
Compact Water Treatment Package To Treat Municipal Waste Water For Low Pressure Boiler Make-up Water in Austria

- 180 gpm of raw water from the neighboring waste water treatment facility was pumped into the plant
- Ultrafiltration is used to remove particles and colloidal matters down to 0.03 µm
- R.O. membranes used to remove 99% of the salts and organic maters
- The quality of water produced includes, conductivity of approximately 50 µs/cm and total hardness of <0.2 mequ/L suitable for the low pressure boiler.

Case Study No. 3
Using Treated Waste Water As 85,000 GPD for Cooling Water Make-up
Texas Power Plant

MBR Process - Package Plants



Case Study No. 3
Using Treated Waste Water As 85,000 GPD for Cooling Water Make-up Texas Power Plant

- 100,000 Gallon Per Day (gpd) wastewater is supplied into the treatment facility.

- Headwork : Fine Screening and equalization basin
- Anoxic Basin: mixed activated sludge
- Pre-Aeration Basin: To prevent premature fouling of the membranes in the MBR Basin, fine bubble diffusers are used
- MBR Basin: produce an extremely clean effluent commonly referred to as permeate
- Chlorine tablet feeder disinfection system for disinfection prior to discharge

Final treated 85,000 gallon per day of water suitable for cooling water make up is discharged to the cooling pond

Conclusions

- Sufficient Treated Municipal Waste Water is available in close proximity to Power Stations.
- Treated Municipal Waste Water is a Good Supply Source for Power Plant Cooling Water and Pure Water for Boiler.
- Challenges in Using Available Municipal Wastewater are Avoiding Corrosion, Scaling, Bio fouling, Environmental Compliance.
- Challenges are overcome, using proven technologies and proven processes to reduce Bacteria, Ammonia, Phosphate, Organics, Chloride, TSS, TDS, Pathogens .
- Maintain proper chemistry to keep phosphorus, Ammonia, Chloride, Sulphate, Chloride, Bacteria low and use On-Line Automatic Tube Cleaning Systems (circulating Balls or Brush & Basket type) to maintain condenser performance.