"Significant Cost Savings Obtained Using Advanced Membrane Systems for Cooling Tower Water Treatment and in ZLD plants"
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Cooling Tower Water - Contents

- Case studies in CT water applications, considering
- Water quality improvement
- Water footprint improvement, waste minimisation
- Economic Improvement
- Sustainable, reliable operation
- Conclusions
### Case: Cooling Tower (Indiantown, USA)
Typical Analysis of Different Makeup Waters used

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Blend of Well Waters</th>
<th>Waste Water</th>
<th>Surface Water from Taylor Creek</th>
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<tbody>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>3-10</td>
<td>N.R</td>
<td>3-30</td>
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<tr>
<td>Conductivity</td>
<td>uS/cm</td>
<td>6200</td>
<td>960</td>
<td>590</td>
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<tr>
<td>Iron</td>
<td>mg/l</td>
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<tr>
<td>Total Organic Carbon</td>
<td>mg/l</td>
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<td>31</td>
</tr>
<tr>
<td>Ca Hardness</td>
<td>mg/l</td>
<td>440</td>
<td>260</td>
<td>98</td>
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<tr>
<td>Mg Hardness</td>
<td>mg/l</td>
<td>540</td>
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<td>Sodium</td>
<td>mg/l</td>
<td>850</td>
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<td>55</td>
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<tr>
<td>Aluminum</td>
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<tr>
<td>Silica</td>
<td>mg/l</td>
<td>15.0</td>
<td>21.0</td>
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<tr>
<td>Sulfates</td>
<td>mg/l</td>
<td>300</td>
<td>31</td>
<td>58</td>
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<tr>
<td>Chlorides</td>
<td>mg/l</td>
<td>2000</td>
<td>97</td>
<td>110</td>
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</table>
Original Flow Scheme for Zero Liquid Discharge

Feed Water

- Surface water (high in organics),
- Highly saline ground water from wells
- Treated municipal waste water

3 sources

COOLING TOWER (4-7 COC)

Distillate Stream

To H.P. Boiler (180 bar)

MIXED BED DEMINERALIZER

Indiantown, Florida

contact: Marvin Drake

NAES Corporation

Waste Stream

Spray Drier Absorber

2 EVAPORATORS / BRINE CONCENTRATORS (2x0.7 MW)
Pall Pilot System: Confirmed Performance Under Varying Conditions in CTBD

Pall - Indiantown, FL
Cycle 1 - no pretreatment
- Turbidity -
Indiantown Cooling Tower Water Samples

Filtered Makeup

Cooling TWR Blowdown

MF Filtrate

RO Reject

MF-Filtrate: SDI 0.3 – 1.9 achieved
SAVINGS to the Power Plant

- Power (evaporation) = €317,600/year
- Elimination of maintenance/refurbishing/re-tubing & chemical cost on evaporators = €625,600/year

Investment costs

- Cost of MF/RO System: €1,240,000
- Cost of Installation: €564,000 (estimated).
- Annual Power, Chemicals and Consumables, cost to operate the MF/RO Plant: €162,400

ROI

- Return on Investment = 2.4 years
Evaporator Replaced by Membrane System (MF-RO)

3 Feed Water sources

COOLING TOWER

Blowdown (140 m³/h)

Pall Aria™ IMS

MF Filtrate Tank

RO Pass 1

RO Pass 2

Reject to SDA

Reject to Lime Slaking

MIXED BED DEMINERALIZER

To H.P Boiler (BFW)

High quality Permeate

SPRAY DRIER ABSORBER
MF and RO Systems Installed at Indiantown ZLD Plant
Replacement of Brine Concentrators

Pall Aria™ MF System
Inlet Flow: 140 m³/hr
Number of Modules: 56

Pall Aria Spiral RO System
2 Trains RO

NTU/bacteria: Up to 100% removal
TDS: 97% removal
Case Study: Cooling Tower Blowdown Treatment
Replacing Media Filters

Power Plant at TID Walnut
Case Study: Cooling Tower Blowdown Treatment
Replacing Media Filters

Results/Achievements:

- Unit running smoothly for more than a year with MF
- Turbidity < 0.1 NTU
- SDI improved from SDI$_5$ of 20 to SDI$_{15}$ ~ 3
- RO run-length increased from 2 to 21 days
- Water footprint improved
- Coagulants eliminated
- Plant reliability and availability up

Pall Aria MF-System (136 m$^3$/h; 600 gpm)
Case Study: CTBD / Recycle/ makeup water treatment
Replacing MMF at EnCana Cavalier

1. Used for a portion of raw water treatment and recycled water

Result: Reduction of TSS on the CT, and increased efficiency of CW-chemistry

Diagram:
- Makeup water / raw water
- CTBD
- Recirculation
- Pall Aria™ MF system
- RO
- Reuse BFW

Scope:

1. %

Figure 1: Replace MMF at EnCana Cavalier
Case Study: Water Treatment in Cooling Tower Area, Recirculation Water in Steel Mill, Asia

Pall Aria MF system installed in **kidney loop of recirculating water:**

- **NTU reduced** heavily in the loop; TSS from 30 to <1 mg/l (colloids, precipitates, corrosion products)
- **Bacteria reduced** (from 10 cfu to 1-2)
- **Reduced maintenance**, waste, chemicals, down-time, labour, water balance improved

![Turbidity Reduction in Recirculating System](image)

**Turbidity Reduction in Recirculating System**

- **Pall system in slipstream** of recirculation (5%; 80 m³/h)
Minimization of Brine Streams from SWRO Plants

- Pall Disc Tube™ RO membrane alternative configuration
- Operating up to 160 bar (140,000 TDS)
- Technology for waste minimization upstream ZLD plants

Open Channel Design
Zero Spacers on Feed Side
Pall Aria Mobile Units for Rental or Examining Performance Improvement around Cooling Towers