CONFERENCE ON WATER OPTIMIZATION IN THERMAL POWER PLANTS

on

Water Management Skills

by

Ion Exchange India Ltd
A LEADING COMPANY IN THE FIELD OF WATER & WASTE WATER TREATMENT AND ENVIRONMENT MANAGEMENT WITH GLOBAL PRESENCE AND CATERING TO THE NEEDS OF INDUSTRY, HOMES AND COMMUNITIES FOR OVER FOUR DECADES.
HIGH PURITY SYSTEM FOR NEW GENERATION POWER PLANTS
COOLING WATER SYSTEM

River water intake

Corrosion inhibitor

Antiscalant

Ozone / chlorine

Pressure Sand Filters

CT Basin

HEAT EXCHANGERS

 Blow down
Products/Plants/Systems

- Pretreatment
- Softnening
- Demineralisation
- ETP/RECYCLE
- RO
- SWRO
- CPU
- Plant transportation system
- SSF/AIE
STRENGTH OF IEI IN POWER SECTOR

• UHRC / HRSCC / Lamella
• AVGF / GSF / MGF / PSF
• Softeners / DM Plant / Ultra Filtration / Reverse Osmosis / EDI
• Deaerator / Liqui-cel / Degasser
• Proprietary chemicals for WT, CWT & BWT
• Instruments for water analysis
• Cationic conductivity columns
• Lime soda softening process
• Oil – water separators
• Sewage treatment plants
• O&M Services
CLARIFICATION
Pretreatment

Widest Range...

84 MLD cascade Aeration
Jindal power Ltd., Chhattisgarh

24 MLD Ultra high rate clarifier
PT Indo Bharat Rayon, Indonesia

432 MLD High Rate Solids Contact Clarifiers
PT RAPP, Indonesia

9.6 MLD Lamella clarifier and UF
Sterlite, Salem, Tamilnadu

Lamella clarifiers, 72 MLD,
CESC Ltd., Calcutta
INDION CLARIFIERS

1. High Rate Solid Contact Clarifiers
2. Lamella Clarifiers
3. Ultra High Rate Clarifiers
Combining the Benefits Of Both HRSCC & Lamella
UHRC
Process

The water passes successively through:

- A flash mixer - where coagulant & INDION polyelectrolyte are added introduced into the water
- A flocculator - where flocs generated in the flash mixer grow and mature
- A lamella settler - where weighted flocs are separated from treated water
ULTRA HIGH RATE CLARIFIER

INDONESIA
## Ultra High Rate Clarifier

<table>
<thead>
<tr>
<th>Features</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficient design</td>
<td>Low power consumption</td>
</tr>
<tr>
<td>Intimate and prolonged contact with large quantities of previously</td>
<td>Rapid chemical reactions</td>
</tr>
<tr>
<td>formed flocks</td>
<td>More complete reactions</td>
</tr>
<tr>
<td></td>
<td>15-20 % reduction of chemicals Required</td>
</tr>
<tr>
<td></td>
<td>Thorough contact with solids regardless of</td>
</tr>
<tr>
<td></td>
<td>throughput</td>
</tr>
<tr>
<td></td>
<td>Minimum possibility of carryover</td>
</tr>
<tr>
<td></td>
<td>Minimum amount of water lost by blow-off</td>
</tr>
<tr>
<td></td>
<td>Reduced dewatering requirements</td>
</tr>
<tr>
<td>Features</td>
<td>Advantages</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>In-built flash mixer, flocculator and thickener</td>
<td>Low capital cost - space saving, compact, easy operation</td>
</tr>
<tr>
<td>Inbuilt thickening pickets concentrate the settled sludge</td>
<td>Increases sludge concentration</td>
</tr>
<tr>
<td>Tangential water inlet</td>
<td>Greatly increases recirculator efficiency</td>
</tr>
</tbody>
</table>
| Mechanisms are suspended from fixed bridge    | Minimum operator attention required.  
|                                              | Simplifies maintenance                           |
Pretreatment

Widest Range...

Dual Media Filtration
JSW Steel, Toranagallu, Karnataka

120 MLD Pressure Sand Filter
Jindal Steel & Power, Patratu.

Auto Valveless Gravity Filters
O.P Jindal Thermal Power Plant, Chhattisgarh

DynaSand continuous sand filter at steel industry - Mukand Steel, India
INDION Auto Valveless Gravity Filter (AVGF)
What is an AVGF?

- An AVGF is a highly efficient gravity filter that operates automatically without a single valve, backwash pump, flow controller or any instruments.

- The filter operates on the loss of head principle.

- As the filter bed collects dirt during the filter run, head loss increases and the water level rises in both the inlet and backwash pipes. The backwashing thus begins when the siphon is established.
Continuous Sand Filter

Brought to you by

ION EXCHANGE (INDIA) LTD
Continuous Sand Filter
Principle of Operation

- The dirty sand is carried from the lower part of the filter through the air lift pump up to the sand washer in the upper part of the filter.

- The cleaned sand is then returned to the upper layer of the bed.

- The entire filter bed is thus constantly moving downwards. This continuous action enables it to filter influent containing up to ten times more dirt than a conventional filter.
Continuous Sand Filter
# Desalination Technologies and processes

<table>
<thead>
<tr>
<th>Thermal Technology</th>
<th>Membrane Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Stage Flash Distillation (MSF)</td>
<td>Electrodialysis (ED)</td>
</tr>
<tr>
<td>Multi-Effect Distillation (MED)</td>
<td>Electrodialysis reversal (EDR)</td>
</tr>
<tr>
<td>Vapor Compression Distillation (VCD)</td>
<td>Reverse Osmosis (RO)</td>
</tr>
</tbody>
</table>
DESALINATION PROCESS

Process that removes dissolved minerals including salts from sea water.

FOR INDUSTRY AND DOMESTIC USE.

➢ THERMAL TECHNOLOGY
DESALINATION PROCESS

- MEMBRANE TECHNOLOGY (REVERSE OSMOSIS)
RO Desalination

- Product recovery from 30% to 90% of the feed flow

- Required pressure:
  - 7 to 13 bar for normal water (TDS upto 5000 mg/l)
  - 17 to 27 bar for brackish water (TDS upto 12000 mg/l)
  - 54 to 80 bar for seawater (TDS upto 50,000 mg/l)
SEA WATER DESALINATION

NTPC PROJECT - SCHEME

A) PRETREATMENT

Flash mixer → Flocculation tank → Lamella Clarifier → Dual Media Filter

chemical dosing system → Cartridge Filter → Pressure Sand Filter

B) RO PLANT

High Pressure Feed Pumps → Membrane Assembly Units → Energy Recovery Device (Px)

C) CHLORINATION SYSTEM
## COMPARISON THERMAL VS SWRO

<table>
<thead>
<tr>
<th></th>
<th>MSF</th>
<th>RO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Consumption</strong></td>
<td>~13 kWhel/m³ (70 kWhth + 3 to 4 kWhel)</td>
<td>4 - 5 kWhel/m³</td>
</tr>
<tr>
<td><strong>Recovery</strong></td>
<td>10% - 20%</td>
<td>30% - 50%</td>
</tr>
<tr>
<td><strong>Investment [$/m³/day]</strong></td>
<td>~ 1,000 – 1,500</td>
<td>~ 7,00 – 1,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10% for membranes)</td>
</tr>
<tr>
<td><strong>Chemicals [$/m³]</strong></td>
<td>~ 0.03 to 0.05</td>
<td>~ 0.06 to 0.1</td>
</tr>
<tr>
<td><strong>Brine Quantity</strong></td>
<td>Distillate x 4 to 9</td>
<td>Permeate x 1 to 4</td>
</tr>
<tr>
<td><strong>Brine Quality</strong></td>
<td>Chemicals, Heat</td>
<td>Chemicals</td>
</tr>
<tr>
<td><strong>Robustness</strong></td>
<td>High</td>
<td>Fouling Sensitivity, Feed water Monitoring</td>
</tr>
<tr>
<td><strong>Improvement Potential</strong></td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
Total Water Management

26.4 MLD Desalination Plant for Chennai Petroleum Corporation, Tamil Nadu

Control Room
Degasser Towers
Sea Water Intake 3.5kms
Reverse Osmosis
Lamella Clarifier
Zero Discharge System at Chennai Petroleum Corporation, Tamil Nadu
Sea Water RO

- **Largest installed capacity in India**
- **Largest industrial SWRO plant in India**
  26.4 MLD commissioned at Chennai Petroleum Corporation, Tamil Nadu
- **Largest SWRO plant for power project in India**
  19.8 MLD SWRO plant for NTPC-TNEB JV 3 x 500 MW thermal power plant, Vallur, Tamil Nadu
- **SWRO plants for industrial sector in India**
  - 7 MLD SWRO plant for Mundra Thermal Power Project at Adani Power, Kutch, Gujarat
  - 6 MLD SWRO plant for Gujarat Anion Cement, Kutch, Gujarat
  - 6 MLD SWRO plant for Indian Rayon & Industries, Veraval, Gujarat
  - 4.3 MLD SWRO plant for Gujarat Electricity Board, Sikka, Gujarat
  - 3.6 MLD SWRO plant for Madhucon Power for 2 x 135 MW thermal power project of Simhapuri Power, Nellore, Andhra Pradesh
  - 3.5 MLD SWRO plant for Gujarat Heavy Chemicals, Veraval, Gujarat
  - 1.3 MLD SWRO plant for Chemplast Sanmar, Karaikal, Pondicherry
- **O&M contract for GMDC’s Thermal Desalination**
Recycle - Towards Zero Discharge

World getting conscious of importance of environment - more resources are being recycled

- Sullage, sewage and industrial effluent becoming sources of water
- Technologies available to enable recycle and recovery of as much as 99% water - moving to zero discharge
- Ultrafiltration successfully used worldwide to obtain high quality water in one step, even from sewage
<table>
<thead>
<tr>
<th>Client:</th>
<th>INDIA BULLS REALTECH LTD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gurgaon, India</td>
</tr>
<tr>
<td>Project:</td>
<td>Tertiary Treatment Plant (TTP) for Supplying Water to 5X270 MW Sinnar Thermal Power Project Nashik, Maharashtra</td>
</tr>
<tr>
<td>Sector:</td>
<td>Power</td>
</tr>
<tr>
<td>Capacity:</td>
<td>117,000 m³/day (117 MLD)</td>
</tr>
<tr>
<td>Technology:</td>
<td>1) Tertiary Treatment Plant:</td>
</tr>
<tr>
<td></td>
<td>\textit{INDION} Dyna Disc $\rightarrow$ \textit{INDION} Dyna Sand Oxy Filter $\rightarrow$ \textit{INDION} Contact Chlorination System</td>
</tr>
<tr>
<td></td>
<td>2) Sludge Management:</td>
</tr>
<tr>
<td></td>
<td>Centrifuge</td>
</tr>
<tr>
<td>Scope:</td>
<td>Design, Engineering, Supply, Construction, Erection &amp; Commissioning &amp; 5 years Comprehensive Operation &amp; Maintenance of TTP</td>
</tr>
<tr>
<td>Delivery time:</td>
<td>- 7 months for 17,000 m³/day (17 MLD)</td>
</tr>
<tr>
<td></td>
<td>- 9 months for 30,000 m³/day (30 MLD)</td>
</tr>
<tr>
<td></td>
<td>- 13 months for 117,000 m³/day (117 MLD)</td>
</tr>
</tbody>
</table>
Case Study - Zero Discharge at Gujarat Ambuja Cement

- Ion Exchange India Ltd.
- SODA ASH
- INDION PSF
- CLARIFIED WATER TANK
- UF WATER STORAGE TANK
- HRSCC
- EQUILISATION TANK IN RCC (BY CLIENT)
- LIME DOSING
- SODA ASH
- CHLORINE DOSING
- INDION REVERSE OSMOSIS UNIT
- INDION REVERSE OSMOSIS UNIT II
- ANTI Scalant DOSING
- HCL
- UF WATER STORAGE TANK
- EVAPORATOR

- RO PERMEATE S.T
- 415.40 m³/D
- 60.49 m³/D to sludge
- 652 m³/D
- 651.58 m³/D
- 107 m³/D
- 28 m³/D
- 506.58 m³/D
- 10 m³/D FOR CEB

Ion Exchange India Ltd.
Zero Discharge Plant at Gujarat Ambuja Cements (Holicim)
1) UF SYSTEM AS PRETREATMENT
2) UF SYSTEM FOR FINAL TREATMENT
CASE 1 – COLLOIDAL SILICA REMOVAL

<table>
<thead>
<tr>
<th>Customer</th>
<th>MALCO, Tamilnadu (Sterlite Group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Water Source</td>
<td>Surface water (Kaveri River)</td>
</tr>
</tbody>
</table>
| Problem                   | • Colloidal silica in raw water created problems on turbine in power plant  
                            • High turbidity                   |
| Flow m3/hr                | 63                               |
| Inlet Colloidal Silica ppm| 4                                |
| % Reduction               | 99.99                            |
SCHEME

LAMELLA CLARIFIER  MGF  ULTRAFLTRATION

WATER FOR POWER GENERATION  DM PLANT
### CASE 2 – COLLOIDAL SILICA REMOVAL

<table>
<thead>
<tr>
<th>Customer</th>
<th>Navelli Lignite Corporation Chennai</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Water Source</td>
<td>Surface water</td>
</tr>
<tr>
<td>Problem</td>
<td>Colloidal silica in raw water created problems on turbine in power plant</td>
</tr>
<tr>
<td>Flow m3/hr</td>
<td>15 x 3 Streams</td>
</tr>
<tr>
<td>Inlet Colloidal Silica ppm</td>
<td>4</td>
</tr>
<tr>
<td>% Reduction</td>
<td>99.99</td>
</tr>
</tbody>
</table>
SCHEME

DM PLANT → MB

ULTRAFLTRATION

WATER FOR POWER GENERATION
### CASE 3 – COLLOIDAL SILICA REMOVAL

<table>
<thead>
<tr>
<th>Customer</th>
<th>Jindal Power Ltd, Raigarh, Chattisgarh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Water Source</td>
<td>Surface water</td>
</tr>
<tr>
<td>Problem</td>
<td>• Colloidal silica in raw water created problems on turbine in power plant</td>
</tr>
<tr>
<td>Flow m3/hr</td>
<td>100 x 3 Streams</td>
</tr>
<tr>
<td>Inlet Colloidal Silica ppm</td>
<td>1</td>
</tr>
<tr>
<td>% Reduction</td>
<td>99.99</td>
</tr>
</tbody>
</table>
SCHEME

CLARIFIER → MGF → DM PLANT

MB → ULTRAFILTRATION

WATER FOR POWER GENERATION
Recycling in 3x660 MW Power Plant

Water Balance

- Dolomite
- FeCl₃
- Poly
- Acid
- OHBWST (From RO Reject)
- TO CMB I
- UFPT
- UF
- HCl
- SMBS
- AS
- UF CEB Waste
- RO permeate tank
- NaOH
- RO
- RO CEB Waste
- UF CEB Waste
- MCF for RO
- UF Recovery 90%
Case Study 1

Customer: Chennai Petroleum Corporation Limited (CPCL)

Problem: Acute water scarcity in the region which led to shutdown of refinery few years back.

Quantitative Analysis:
- Zero discharge 200 m³/hr capacity Effluent treatment & recycling plant
- Inlet TDS: 1860 ppm, BOD: 20 ppm, COD: 250 ppm,

Solution:
- Zero effluent discharge effluent treatment plant was designed with 200 m³/hr capacity UF plant followed by 220 m³/hr RO plant.
- Outlet Quality: TDS < 40 ppm, BOD: Below detectable limit, COD: Below detectable limit
ZERO EFFLUENT DISCHARGE IN REFINERY INDUSTRY

INLET ANALYSIS (Typical)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.0 - 8.5</td>
</tr>
<tr>
<td>O&amp;G (ppm)</td>
<td>10</td>
</tr>
<tr>
<td>TSS (ppm)</td>
<td>50</td>
</tr>
<tr>
<td>Turb (NTU)</td>
<td>20</td>
</tr>
<tr>
<td>BOD</td>
<td>20</td>
</tr>
<tr>
<td>COD</td>
<td>250</td>
</tr>
<tr>
<td>TDS</td>
<td>1860</td>
</tr>
<tr>
<td>Cl (ppm)</td>
<td>850</td>
</tr>
<tr>
<td>Ca (ppm)</td>
<td>130</td>
</tr>
<tr>
<td>Mg (ppm)</td>
<td>70</td>
</tr>
<tr>
<td>M Alk (ppm)</td>
<td>62</td>
</tr>
<tr>
<td>Nitrates (ppm)</td>
<td>20</td>
</tr>
<tr>
<td>Phosphates (ppm)</td>
<td>5</td>
</tr>
<tr>
<td>Si (ppm)</td>
<td>15</td>
</tr>
<tr>
<td>Coll Si</td>
<td>7.2</td>
</tr>
<tr>
<td>Fe (ppm)</td>
<td>3</td>
</tr>
<tr>
<td>SO4 (ppm)</td>
<td>300</td>
</tr>
<tr>
<td>Phenols (ppm)</td>
<td>1</td>
</tr>
<tr>
<td>SDI</td>
<td>&gt; 6</td>
</tr>
</tbody>
</table>

INDION MULTIGRADE SAND FILTER

Recovery - 87%

INDION ULTRAFILTRATION SYSTEM

Recovery - 85%

RO FEED TANK

(110 x 2 = 220 M3/HR)
Chennai Petroleum

Industrial waste water recovery for reuse
INDION SWIFT SYSTEMS

SHORT CYCLE ION EXCHANGER

&

HYDROGEN ION POLISHING

ION EXCHANGE INDIA LTD.
KEY FEATURES

- Fully Automatic PLC Control.
- Rapid regeneration...... ONLY 35 MINUTES
- Short Cycle 3-4 hours...... SIZE OF PLANT REDUCED TO 1/3rd.
- Outlet Quality of conductivity as per USP norms.
- Minimum Bacteria Build Up because of short Cycle.
- High grade MONOSPHERE RESIN USED. Ensures High Exchange Capacity and minimum leachables.
- Message display facility for all alarms and stages......Easy monitoring
- NON CORROSIVE FRP CONSTRUCTION.
- Near neutral effluent....... NO NEED TO ADD EXTRA CHEMICAL FOR NEUTRALIZATION.
<table>
<thead>
<tr>
<th>RAPIDE PLUS</th>
<th>CCR MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVITY at 25 deg C</td>
<td>&lt;1.0 Max us/cm.</td>
</tr>
<tr>
<td></td>
<td>&lt;0.1 Min us/cm.</td>
</tr>
<tr>
<td>pH</td>
<td>5.0 – 7.0</td>
</tr>
</tbody>
</table>
CLEANER THE TECHNOLOGY......
GREENER THE ENVIRONMENT