Saudi Aramco

Wastewater Conservation & Reuse
Agenda

- **Saudi Aramco Environmental Policy**
- **Conservation Efforts**
- **Practical Examples of Work**
  - Low Tech
  - High Tech
- **Reuse Performance / Direction**
- **Conclusion / Summary**
Saudi Aramco Env. Policy

“The Company will …. Promote environmentally sound waste disposal practices and cost effective waste minimization through source reduction, reuse and recycling.”
Conservation Mandate

- **First Conserve**
  - Waste Minimization Audits
  - Water Conservation Audits
- **Treat & Reuse**
  - Sanitary Wastewater
  - Industrial / Oily Wastewater
- **Dispose Appropriately**
Economic Evaluation - Basis

- **Groundwater is a Limited Resource**
  - Value = Cost of Desalinated Sea Water
  - \$10 / 1000 gallons
Water Conservation Audits

- **Gas Plant Industrial Reuse Audit**
  - Quantified all Water Uses
    - Evaluated Water Quality Requirements
    - Mapped Water Use Location
  - Quantified all Water Disposed
    - Evaluated Disposed Water Quality
    - Mapped Water Disposal Location
  - Identified Acceptable **Low Tech** Reuse
  - Economic Evaluations
Low Technology Reuse / Disposal Options
Typical Plant Arrangement
# Acceptable Low Tech Reuse Matches

<table>
<thead>
<tr>
<th>Wastewater Source</th>
<th>Potential Reuse (Minimal Treatment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler Blow down</td>
<td>Raw Water Makeup / Irrigation</td>
</tr>
<tr>
<td>RO Reject</td>
<td>Raw Water Makeup / Irrigation</td>
</tr>
<tr>
<td>Sanitary Wastewater</td>
<td>Irrigation</td>
</tr>
<tr>
<td>Cooling Tower Blowdown</td>
<td>Fire Water Makeup</td>
</tr>
</tbody>
</table>
**WW Reuse – New High Tech Options**

- **JGP Industrial WW Reuse**
  - Combine Sanitary & Oily Wastewater
  - API & Walnut Shell Filters
  - MBR Treatment (carbon assisted)
  - RO to Provide Boiler Feed Water
- **Annual Cost Savings** > $1 MM
Sour Water
Stripper
Boiler
Blowdown
Fire Training
Wastewater
Oily
Wastewater

Sanitary WW

Walnut Shell Filters
MBR & RO

Irrigation
Boiler
Feed Water
Disposal

JGP – Carbon Assisted MBR & RO
**WW Reuse Performance / Direction**

- **Sanitary Wastewater**
  - 72% Reused
  - *Projects to raise to over 94%*
    - *All WW Treatment Systems > 100 m3/day*

- **Oily Wastewater**
  - *Most Discharged to Evaporation Ponds*
  - *Moving to Beneficially Reuse*
    - *Oil Field Pressure Maintenance*
    - *High Tech Oil Removal & MBR*
Conclusion

- Water Conservation Goals
  - Appropriately Value Water
  - Minimize Consumption & Maximize Reuse
- Water Audits
  - Low & High Tech Reuse Options
- Provide Acceptable Treatment for Discharges
  - Moving to Beneficial Reuse Options
Thank You For Your Time