IPRO 346
Expansion of the BP Whiting Refinery
IPRO 346 Overview

**Problem:**
- BP Whiting Refinery

**Objectives:**
- Initial Investigation
- Technical Options
- Final Design
The BP Whiting Expansion

- Increase in heavy Canadian crude oil
- Higher pollutants
- Increase in ammonia and total suspended solids (TSS)
The New Permit

- **Ammonia effluent limitations**
  
<table>
<thead>
<tr>
<th></th>
<th>Monthly Average</th>
<th>Daily Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>1,030 lbs/day</td>
<td>2,060 lbs/day</td>
</tr>
<tr>
<td>Proposed</td>
<td>1,584 lbs/day</td>
<td>3,572 lbs/day</td>
</tr>
</tbody>
</table>

- **TSS effluent limitations**
  
<table>
<thead>
<tr>
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<th>Monthly Average</th>
<th>Daily Maximum</th>
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</thead>
<tbody>
<tr>
<td>Existing</td>
<td>3,646 lbs/day</td>
<td>5,694 lbs/day</td>
</tr>
<tr>
<td>Proposed</td>
<td>4,925 lbs/day</td>
<td>7,723 lbs/day</td>
</tr>
</tbody>
</table>
Social Issues

- Public Outcry
- Fact vs. Fiction
- “I don’t want a refinery in my backyard.”
Team Management

- Keeping Pace
  - Dates
  - Progress

- Challenges
  - Unique Solutions for Unique Problems
Management Continued

- Single Point of Accountability

- Resource Management System
  - Budget
  - “The proof is in the pudding”
Team Principles

- Code of Ethics
- Who’s Your Sponsor?
Project Overview

- Initial Ideas
- Viable Technologies
- Practical Solutions
Practical Solutions
Practical Solutions

Brine Treatment Unit
Sour water Stripper
Membrane Unit
Membrane Processes
Membrane Processes

Positives

- Reduces Units
- Smaller Footprint
- High Quality Water
- Water Reuse
Membrane Processes

Negatives

- Membrane Fouling
- Short Life Time
- High Capital and Operating Costs
Brine Treatment

• Most Total Suspended Solids (TSS) are Oil

• Efficiently removes oil from water

• Help with upsets
Sour Water Stripper
## Results

### Wastewater With added Units

<table>
<thead>
<tr>
<th></th>
<th>TSS, mg/L</th>
<th>Flow, MGD</th>
<th>NH$_3$-N, mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inlet Concentrations</strong></td>
<td>15,000</td>
<td>22</td>
<td>300</td>
</tr>
<tr>
<td><strong>Outlet Concentrations</strong></td>
<td>20</td>
<td>22</td>
<td>1.0</td>
</tr>
</tbody>
</table>

- **TSS (lb/day)** = 3700 ± 20%
- **NH$_3$ (lb/day)** = 190 ± 20%
## Results

### Wastewater With Out added Units

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<tr>
<td><strong>Outlet Concentrations</strong></td>
<td>196</td>
<td>22</td>
<td>10.3</td>
</tr>
</tbody>
</table>

\[
\text{TSS (lb/day)} = 36000 \pm 20\%
\]

\[
\text{NH}_3\text{ (lb/day)} = 1900 \pm 20\%
\]
# Costing

<table>
<thead>
<tr>
<th>Project</th>
<th>Cost (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded Brine Treatment Unit</td>
<td>$50 M</td>
</tr>
<tr>
<td>Sour Water Stripping</td>
<td>$70 M</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$130 ± 25%</strong></td>
</tr>
</tbody>
</table>
Thank You!