Economic Treatment of “Whole Crude Oil” for Odor/Corrosion Control & Value-Added Marketing

COQA
March 1, 2012
• Customer Value Proposition
• Process Highlights
• Commercial Highlights
• Summary
### Mercaptan Treatment → Numerous Benefits!

<table>
<thead>
<tr>
<th>TREATING BENEFITS/ “CUSTOMER” VALUE</th>
<th>Odor Control (to be widely monetized?)</th>
<th>Corrosion Control (to be widely monetized?)</th>
<th>Toxicity Minimization (to be widely monetized?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase “Customer” Sales Volume</td>
<td>Yes</td>
<td>Yes</td>
<td>Current: Unaware</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Future: ???</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Future: ???</td>
</tr>
</tbody>
</table>

**Current Value Proposition:**
- Transportation costs reduced
- Odor complaints minimized
## Feed/Product Properties (typical)

<table>
<thead>
<tr>
<th>Description</th>
<th>Feed</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Capacity</td>
<td>65,000-190,000 BPSD</td>
<td>Same as feed</td>
</tr>
<tr>
<td>API Gravity</td>
<td>$\geq 35$</td>
<td>Same as feed</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>$\leq 40$ wppm</td>
<td>Nil</td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td>$\leq 60$ wppm</td>
<td>1 wppm (max)</td>
</tr>
<tr>
<td>Mercaptans as S</td>
<td>150-650 wppm (caustic-treatable)</td>
<td>30 wppm as S (max) (volatile)</td>
</tr>
<tr>
<td>Total Acid Number (TAN)</td>
<td>$\leq 0.05$ mg KOH/g</td>
<td>0.01 mg KOH/g (max)</td>
</tr>
</tbody>
</table>

Total S reduction is possible but is not typically requested for crude oil treating
**Treating Chemistry**

**NAPFINING™** technology extracts hydrogen sulfide, carbon dioxide, & naphthenic acids “directly” from the whole crude oil using caustic:

\[
\begin{align*}
H_2S + 2NaOH & \rightarrow Na_2S + 2H_2O \\
CO_2 + 2NaOH & \rightarrow Na_2CO_3 + H_2O \\
RCOOH + NaOH & \rightarrow NaOOCR + H_2O
\end{align*}
\]

**MERICAT™** technology extracts/oxidizes mercaptans by contacting the whole crude & caustic “directly” in the presence of air in a single stage (sweetening):

\[
\begin{align*}
2RSH + 2NaOH & \rightarrow 2NaSR + 2H_2O \text{ (extraction)} \\
2NaSR + \frac{1}{2}O_2 + H_2O & \rightarrow 2NaOH + RSSR \text{ (oxidation)} \\
2RSH + \frac{1}{2}O_2 & \rightarrow RSSR + H_2O \text{ (net reaction)}
\end{align*}
\]
Where Does Sweetening Fit?

- Reduced Odor
- Improved Corrosion Control
- Lower Toxicity

Crude Oil Stabilization → Mercaptans Treatment → Sweetened Oil → Storage

H₂S, lights → Sour Stabilized Oil

Shipping → Pipelining

Refining → Crude Oil Unit
Operational Summary

- Temperature
- Pressure (min $\Delta P$)
- Chemicals/utilities
- Effluent handling
- Plot space requirements
- Maintenance requirements
Total Cost of Ownership

Initial Investment:
- Under normal operation, no major equipment replacement costs expected in less than 10-15 years

Operating Costs:
- Fresh Caustic
- Spent Caustic
- Oxidation Air
- Oxidation Catalyst
- Electricity
- Labor (operating/maintenance)

Note: BPSD assumes 350 stream days per year.
Tailored to Customer Requirements

- Minimum Offering
- Modular Offering
- Technical Services
- Legal Agreements
  - Confidentiality Agreement
  - Process License Agreement
  - Process & Equipment Guaranty Agreement
  - Engineering & Equipment Supply Agreement
“Direct” treating of **whole crude oil** gives superior performance at a lower cost vs. “indirect” treating

- Only one “direct” method capable of treating whole crude oil – patented FIBER FILM® contactor technology

- “Indirect” methods involve fractionation or stripping of the crude oil and is very costly

- Scavenger additives are cost-prohibitive at increased rates
• **Merichem “direct” treating is superior to conventional “indirect” methods**
• Deodorizing and reducing the corrosivity of crude oils via mercaptan sweetening “adds value” through higher sales margins and a broader potential customer-base
• Merichem’s crude oil treating technologies are well-suited for remote locations
• Treating solutions are effective at the wellhead, midstream, and end-user locations
• Merichem’s **NAPFINING/MERICAT C** technology combination achieves near complete removal of acidic impurities
• **FIBER FILM®** designs provide better overall value/effectiveness compared to other capital-based projects and scavenger technologies