Contaminant Impact on Desalting

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Baker Petrolite
February 8, 2007
Outline

- What I am not going to talk about
- Types of problems
- Naturally occurring constituents of crude oil
- Some additives
- Remedial action
• **Constituents with problems downstream of the desalter**
  - Ni, V, etc.
  - Se
  - Phosphorous compounds
  - Silicone oil
  - Organic chlorides
Problems

- **Stable emulsions**
  - High BS&W out
  - Rag layer build up
- **Oil under carry**
- **Fouling and mud build up**
- **High current draw**
Naturally Occurring Constituents

- Water
- Salt (brine and crystals)
- Paraffin
- Asphaltene
- Filterable solids
- Calcium naphthenate
- Organic Acids (TAN)
Marlim Crude Tank Treatment Trial - Total Drain Water (Bbl)

- **Untreated T-41**
- **Baker Petrolite Treated T43**

- BPR23040 additive crude tank treatment for Marlim crude
  - Drier easier to desalt crude, Less oil in water draw off

Drained Water (Barrels)

Settling Time (Hrs)
Mitigation Strategies for Asphaltene

- Discontinue purchase
- Limit blends to compatible mixtures
- Treat crude oil with asphaltene stabilizers
Case History 1

- Introduction of crude 2 caused formation of rag layer shorting out bottom grids
- Oils were found to be incompatible
- Blend had ASI in unstable region

<table>
<thead>
<tr>
<th>#</th>
<th>Oil / Blend</th>
<th>ASI</th>
<th>% Asphaltenes</th>
<th>% Resins</th>
<th>Asph/Res</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crude 1</td>
<td>1.75</td>
<td>3.4</td>
<td>7</td>
<td>0.49</td>
</tr>
<tr>
<td>2</td>
<td>Crude 2</td>
<td>0.96</td>
<td>5.4</td>
<td>10.8</td>
<td>0.50</td>
</tr>
<tr>
<td>3</td>
<td>Crude 3</td>
<td>1.5</td>
<td>6.53</td>
<td>27</td>
<td>0.24</td>
</tr>
<tr>
<td>4</td>
<td>55% (1) 20% (2) 25% (3)</td>
<td>1.24</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Case 1

ASIT$^{SM}$ Asphaltene Stability Index Test

Asphaltene stabilizer increases stability of blend

<table>
<thead>
<tr>
<th>EDDA Demulsification Test</th>
<th>% Water Drop</th>
<th>% Water Drop</th>
<th>% Water Drop</th>
<th>BS&amp;W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 min</td>
<td>10 min</td>
<td>15 min</td>
<td></td>
</tr>
<tr>
<td># 4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.6</td>
</tr>
<tr>
<td># 4, Stabilizer &amp; Demulsifier</td>
<td>3.3</td>
<td>3.8</td>
<td>4.5</td>
<td>0.14</td>
</tr>
</tbody>
</table>
Solids Stabilized Emulsion
5% Wash Water Added
Filterable Solids

• Can be measured by ASTM D 4807-88
  ➢ Washed with toluene to eliminate asphaltenes
  ➢ Filtered through 0.45μm filter

• Solids are known to stabilize emulsions
  ➢ Logan C Waterman -1965
  ➢ Wasan
  ➢ Masliyah
Sources of Solids

- Oil field
  - Formation solids
  - Corrosion
  - Slop oil
  - Other
  - Well to well variation
Filterable Solids
Individual Lease Samples
Blended and sold as single crude oil
Sources of Solids

- **Pipeline**
  - Corrosion
  - Pigging

- **Terminals**
  - Incompatible blends
  - Tank cleaning
Desalter Upsets Related to Solids

Graph -1

Combined Crude Filterable Solids

Solid shading indicates desalter upset

Wetting Agent
pH Effect on Emulsion Stability

$$R^\text{-}C^\text{=O} \text{OH} + \text{NaOH} \rightleftharpoons R^\text{-}C^\text{=O} \text{O}^\text{-} \text{Na}^\text{+} + \text{H}_2\text{O}$$
pH Effect vs. Time

Naphthenic Acids  Time = 24 hours
Additives

- Methanol
- Amines
- Surfactants
- Slop oil
Methanol

- Studied by COQG
- Emulsion stabilization
- Overwhelm WWTP
Amines

• **Sources**
  - Hydrogen sulfide treatment
  - Corrosion inhibitors and neutralizers
  - Naturally occurring amines

• **Problems**
  - Stabilize emulsion in desalter
  - Over load WWTP
  - Tower corrosion
Surfactants

• **Source**
  - Emulsion breakers
  - Paraffin and asphaltene antifoulants
  - Cleaning
  - EOR

• **Problems**
  - Stabilize emulsion – over treat
    - Change to compatible emulsion breaker
    - Lower chemical dosage
  - Over load WWTP

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Problems with Slop Oil

• **Solids**
  - Coke fines stabilize emulsions
  - Cat fines stabilize emulsions
• **Water can over load desalter**
• **Cleaning waste can stabilize emulsions**
• **Incompatible solvents can destabilize asphaltenes**
Desalter Emulsion Band
SEM Analysis

- Silicon: 32.3%
- Iron: 22.0%
- Sulfur: 18.2%
- Aluminum: 13.4%
- Calcium: 11.6%
- Potassium: 2.5%

50X
Summary

- Several components can lead to desalter problems
- Critical to monitor desalter feed for problem constituents
- Intermittent problems often disappear before cause can be found
- Sometimes you have to ride the problem out