Non Standard Tests for Predict Impact of Crude Oil Quality on Desalting.

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Crude Oil Quality Group
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Outline

• Introduction
• Electrostatic Desalter Demulsification Apparatus (EDDA)
• Filterable solids
• Asphaltene Stability Index Test (ASIT)
Problem with Standard Tests

• Full crude assay
  – Gravity, %S, %N, SARA, etc.
  – Does not predict how crude will perform in a desalter.

• Daily variation
  – BS&W
  – Salt in crude

• Refineries normally run blends of crudes
Electrostatic Desalter
Demulsification Apparatus
Canadian Crude Refinery
(3, 5, 7, 9% wash water)

Water Drop Rate for Different % Wash Water in Crude#1

Electrostatic Demulsification Dehydration Time (min.)

% water drop

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Filterable Solids

• Can be measured by ASTM D 4807-88
  – Washed with toluene to solubilize asphaltenes
  – Filtered through 0.45mm filter
• Solids are known to stabilize emulsions
  – Logan C Waterman -1965
  – Wasan
  – Masliyah
Filterable Solids of Selected Crude Oils

<table>
<thead>
<tr>
<th>CRUDE OIL</th>
<th>TYPICAL RANGE</th>
<th>HIGH VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lloydminster</td>
<td>50-150PTB</td>
<td>280</td>
</tr>
<tr>
<td>SJV</td>
<td>50-200</td>
<td>800</td>
</tr>
<tr>
<td>ANS</td>
<td>25-50</td>
<td>115</td>
</tr>
</tbody>
</table>
Typical Solids Analysis

- Iron Oxide and Iron Sulfide
- Sand
- Clay
- Silt
- Scale
Solids Stabilized Emulsion
5% Wash Water Added

100 X
Solids and Surfactant Molecules Stabilizing The Oil - Water Interface

Emulsion - Stabilizing Solids

Emulsified Water Droplet

OIL Emulsion - Stabilizing Molecules
Asphaltene Stabilized Emulsions

- Asphaltenes exist as a cross linked network at the oil-water interface
  - Asphaltene networks form strong interfacial films stabilizing the emulsion
- Asphaltenes at their limit of solubility in the oil form the most stable emulsions
- Predicting asphaltene stability may help improve desalting operations
Stability Indicators

• Asphaltene to Resin ratio, Saturate to Aromatic ratio
  - A/R ratio > 0.35 indicates oil has propensity to asphaltene destabilization
  - Generally, do not mix high S/A oil with low S/A oil

• Spot tests
  - Single solvent spot tests, mixed solvent spot tests, microscope investigations

• ASIT SM asphaltene stability index test
Additives can greatly increase the stability of an oil.
ASIT<sup>SM</sup>
Asphaltene Stability Index Test

- Used to determine stability of crude oil with regard to asphaltene stability
- Uses NIR laser to detect asphaltene precipitation in petroleum fluids
- Titration technique with non-solvent
- Stability based on field correlated results
- Gives qualitative information on rate of fouling
Case History 3

- Introduction of Crude 9 at 50% of normal crude feed resulting in formation of an unusual rag layer & level control problems in preflash tower
  - Foaming was determined to be the cause of the level control problems of preflash tower
- Blending Crude 9 with other crude oils resulted in poor desalting and an increase in BS&W
Case 3

ASIT℠ Asphaltene Stability Index Test

<table>
<thead>
<tr>
<th>#</th>
<th>Oil / Blend</th>
<th>ASI</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Crude 9</td>
<td>1.36</td>
</tr>
<tr>
<td>10</td>
<td>Crude 10</td>
<td>1.89</td>
</tr>
<tr>
<td>13</td>
<td>80% (Crude 9) 20% (Crude 10)</td>
<td>1.38</td>
</tr>
<tr>
<td>14</td>
<td>60% (Crude 9) 40% (Crude 10)</td>
<td>1.48</td>
</tr>
<tr>
<td>15</td>
<td>40% (Crude 9) 60% (Crude 10)</td>
<td>1.62</td>
</tr>
<tr>
<td>16</td>
<td>20% (Crude 9) 80% (Crude 10)</td>
<td>1.72</td>
</tr>
</tbody>
</table>
Case 3

**ASIT\textsuperscript{SM} Asphaltene Stability Index Test**

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<tr>
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<tr>
<td>11</td>
<td>Crude 11</td>
<td>1.03</td>
</tr>
<tr>
<td>17</td>
<td>84%(Crude 9) 16% (Crude 11)</td>
<td>1.09</td>
</tr>
</tbody>
</table>
EDDA Demulsification Test

Total Wash Water Added = 5%

Water Drop 5 min
Water Drop 10 min
BS&W %

# 17
# 17 & Asphaltene Stabilizer
# 17, Stabilizer & Demulsifier

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Outcome of Case History 3

- Crude 9 was reduced to 40% or less of the normal feed
- Additives containing asphaltene stabilizers were added to Crude 9 as it was transferred to tank storage
- Addition of asphaltene stabilizer allows refinery to run 85% crude 9 without problems
- Demulsifier program was changed
- Asphaltene destabilization believed to be contributing cause of foaming in preflash tower
  - Defoamer injected into feed of preflash tower
Conclusions

• ASIT℠ asphaltene stability index test, Filterable Solids & Electrostatic desalter dehydration apparatus (EDDA) testing are predictive tools for desalting operations
  – Used to optimize blending strategies & indicate problematic blends
  – Sensitive to small changes in blend components
  – Filterable solids are useful in monitoring batch to batch variation in crude quality.