Introducing the Baker Hughes Field ASIT Services Technology

by Corina Sandu

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Outline

• Why this technology?
• Where are the problems?
• What are asphaltenes?
• Field ASIT Services™ Technology
  • Field trial results
    – Crude oil
    – Blends of crudes
    – Desalter optimization
    – Fuel oil
• What are the targeted applications?

Field ASIT Services is a trademark of Baker Hughes Incorporated
Motivation

• Opportunity crudes (e.g., heavy and “high acidic”) are appealing feedstocks on the market

• Processing these particular crudes is challenging due to
  – High solids
  – Increased amount of water
  – S content
  – Asphaltenes
  – Viscosity

• Blending opportunity crudes can offer challenges with respect to stability and compatibility
Colloidal Structure of Asphaltenes

- Colloidal systems that contain condensed polyaromatic compounds (H/C ≈ 1.15)
- Measured by solubility (Aromatic soluble, N-alkane insoluble)
- Not all black solids are asphaltenes (e.g., heavy wax and iron sulfide)
- High affinity towards aggregation (starting from nanoaggregation)

- T, P, and chemical changes can significantly alter and result in asphaltene aggregation, and thus precipitation
## Current Methods on the Market

<table>
<thead>
<tr>
<th>Method</th>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settling Optical Technique</td>
<td>ASTM D7061</td>
<td>Not powerful for crude stability detection</td>
</tr>
<tr>
<td>Spot Test</td>
<td>ASTM D4740</td>
<td>Too qualitatively and inaccurate</td>
</tr>
<tr>
<td>Hot Filtration Test</td>
<td>ASTM D4870</td>
<td>Too limited, not reliable (can miss detecting very unstable fuels)</td>
</tr>
</tbody>
</table>
Baker Hughes Stability Methods of Evaluation

- Heptane Dispersant Test (HDT)
- Spot Test (ASTM D4740)
- Field ASIT services Technology
- Hot Filtration Test (ASTM D4870M)
Field ASIT Services—Instrument

• Measures the onset of the flocculation of the asphaltenes with high accuracy by inducing the asphaltene precipitation via titration with a paraffinic solvent.
Field ASIT Services—Features

- Requires small volume of sample (1 to 2 mL)
- Fast acquisition (20 minutes per sample)
- Data-processing capabilities
- Ease of use
- Resolves different types of samples: crude, heavy crudes, reduced crudes
- Portable
Field ASIT Services—Automatic Report

Test Operator: Ajmal Ansari
Date: 7/15/2009
Time: 1:52 PM
Fuel Type: Crude
Location: Blend #4 40/60, Untreated

Additive Options
- Additized: None
- Additive Package: N/A
- Additive Dosage: N/A ppm

Data Analysis
- ASI Value: 126.49
- Fuel Grade: Borderline
- Crashing Rate: N/A
- Recommendation: N/A
Examples of Improved Stability by Blending

100% heavy oil – very unstable
Synthetic blend – no chemical treatment
Desalter Upset Case Study

• Central US refinery reported
  – Destabilization of asphaltenes due to out-of-spec naphtha
  – Issues in desalter operation
    • Large stable rag layer
    • Poor effluent brine quality

• Baker Hughes tasks
  – To optimize desalter performance
  – To explore the possibility to increase the use of naphtha
Samples Investigated for Central US Refinery

<table>
<thead>
<tr>
<th>Tested Crude Samples</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthetic Canadian Crude (SCC)</td>
<td>100</td>
</tr>
<tr>
<td>SCC/CN</td>
<td>95/5</td>
</tr>
<tr>
<td>SCC/CN</td>
<td>90/10</td>
</tr>
<tr>
<td>SCC/CN + Blending Aid # 1</td>
<td>90/10</td>
</tr>
<tr>
<td>SCC/CN + Blending Aid # 2</td>
<td>90/10</td>
</tr>
</tbody>
</table>
ASIT Results for Central US Refinery: SCC & SCC/CN

Decrease Asphaltene Stability

<table>
<thead>
<tr>
<th></th>
<th>SCC</th>
<th>SCC/CN 95/5</th>
<th>SCC/CN 90/10</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASI</td>
<td>183.1</td>
<td>175.8</td>
<td>169.7</td>
</tr>
</tbody>
</table>

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ASIT Data on SCC/CN Upon Chemical Treatment

Increase Asphaltene Stability

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>ASI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCC/CN 90/10 Untreated Blend</td>
<td>169.7</td>
</tr>
<tr>
<td>SCC/CN 90/10 Blending Aid 1</td>
<td>176.4</td>
</tr>
<tr>
<td>SCC/CN 90/10 Blending Aid 2</td>
<td>187.3</td>
</tr>
</tbody>
</table>
Baker Hughes Solution: Desalter Upset Case Study

• Blending Aid # 2 was selected and applied in the SCC tank continuously at 24 ppm

• Resolution of rag layer achieved after one week; decreased from 5 ft to 10 in

• Demulsifier dose reduction from 12 to 9 ppm was applied

• Improvement in water quality
Crude Oil Blend Study

- Texas Gulf Coast refinery
  - Diversify the selection & blending of crude feedstocks
  - Avoid desalter upsets due to changes in the crude slates

- Baker Hughes approach
  - Perform a study on the asphaltene stability of the new crude selections
  - Test a series of crude blends to determine the most optimum blending ratio
ASIT Trend on Crude Oil Stability

Crude Stability Trend: Higher Stability, Higher ASI

Field Results: One Day
ASIT Response Upon Chemical Treatment

Field Results

64% Improvement

ASI

Untreated Crude 1
Blending Aid #1
Blending Aid #2
Blending Aid #3
Blending Aid #4
Blending Aid #5
Blending Aid #6

57.92
94.84
83.46
87.23
62.17
85.76
85.02

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ASIT Results on Crude Oil Blending Study

Field Results: Customer Crude Blends

- Blend 1: 110.9
- Blend 2: 112.47
- Blend 3: 82.42
- Blend 4: 126.5
- Blend 5: 144.66
Baker Hughes Solution: Blending Crude Oil Case Study

- Identification of the most unstable crude was done
- Chemical treatment solution was identified and recommended
- Blending optimization study identifies the most unstable/stable blends
Field ASIT Services Technology Offers

• Flexibility in selecting feedstocks
• Ability to optimize the blend feedstock ratios
• Capability of selecting appropriate chemical solutions and optimum additive amount
• Fast response & implementation
• Customized solutions
• Energy savings
• Increased throughput (most important)
Targeted Applications

• Compatibility/stability of crude oil
  – Oil may be asphaltene unstable
  – Blending may cause destabilization of asphaltenes
• Desalter upsets due to asphaltene destabilization
• Heat exchangers fouling
• Continuous application monitoring
Thank You

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