Introducing
Baker Petrolite BPR 45165
Coker Antifoam

Larry Kremer
Agenda

- First a word from our sponsor
- Other Baker Petrolite coker products
- Antifoam technology
- Introducing BPR 45165, a new type of coker antifoam
Baker Petrolite

- #1 Worldwide Supplier of Oilfield Products and Chemical Services
- Leading Global Supplier of Refinery and Petrochemical Process Additives
- Based in Sugar Land, Texas
- 2,500 Employees
- Serving Markets in over 70 Countries
Baker Petrolite Industrial Division

Core Applications Technologies

- Refinery Process Chemicals
- Finished Fuels Additives
- Petrochemical Process Additives
- Water Treatment Chemicals

Committed Partner of Refining and Petrochemical Industries
Coker Unit Chemical Applications

- Fractionator and Gas Plant Corrosion Control
- Main Fractionator Ammonium Chloride Control
- Distillate Stability Additives
- Blowdown System Water Clarification
- Cutting Water Recycle Clarification
- Furnace Antifoulants
- Coker Odor Control
- Coke Drum Antifoam
Coker Corrosion Mechanisms

- Hydrogen blistering and cracking
- Sulfide stress corrosion cracking
- Ammonium bisulfide corrosion
- Under-deposit corrosion
Problems with Corrosion

- Equipment Damage
- Unplanned outages
- Reduced/lost throughput
- Column tray corrosion and fouling
  - Pressure drop
  - Poor separation
  - Plugged strainers
How do you know if you have corrosion?

- Equipment performance
- Corrosion history
- Corrosion monitoring
  - HYDRAFLUX℠ CMS real time hydrogen flux monitoring
  - Corrosion coupons, probes
  - UT Measurements
- Analytical testing
  - Process water iron, CN spot test readings
- Ionic Equilibrium Modeling
  - Ammonium chloride salt deposition calculations
Corrosion Mitigation Strategies

- Wash water system modifications
- Corrosion inhibitor applications
- Ammonium Polysulfide injections for CN control
- Ammonium chloride dispersants for controlling fractionator salt fouling and under deposit corrosion
Blowdown System Water Clarification

• Problems with emulsion:
  – Level control difficult
  – Water in skim oil
  – Excessive oil in recovered water

• Solution:
  Proper polymer resolves emulsion
All polymers dosed at 400 ppm, mixed for 15 seconds, settled for 2 minutes;
Polymer 1 yielded lower TOG values;
Polymer 2 broke faster and separated within 20 seconds;
Lower pH aided to breaking the emulsion.
Blowdown System Water Clarification

- **Benefits**
  - No hydrocarbon recovery necessary in recycle water tank
  - Fewer hydrocarbon emissions from water recycle system
  - Less hydrocarbon gunking in quench/cutting water equipment
  - Level control easier
Cutting Water Recycle Clarification

- Problem with coke fines in cutting water
  - Erosion of pumps and cutting equipment
  - Solids build up restricts flow
- Solution: Coagulant settles fines rapidly
NOTE:
Inject SPC-700 at 0.2 to 0.3 percent solution
Cutting Water Recycle Clarification

• **Application Benefits**
  – Provides cleaner, less abrasive recycle water
  – Reduces water pump and jet nozzle erosion
  – Lower pump, seal, valve and jet nozzle repair and replacement costs
  – Less equipment downtime for repairs
Baker Petrolite introduces

BPR 45165 Antifoam
A new type of coker antifoam
Baker Petrolite BPR 45165 Antifoam

• Past improvements in antifoam technology have primarily benefited other units

• BPR 45165 Antifoam
  – Not only reduces silicon contamination of coker products
  – It also provides better foam control
  – Retards build up of foam
Questions for rest of talk

- What is silicone antifoam?
- How does it end up in coker liquids?
- How can you reduce contamination?
- What are the benefits of the new antifoam?
- What are the test results of the new antifoam?
Problems With Silicone Antifoam

- Best for controlling foam
- Contaminates coker products
  - Carry over
  - Decomposition
- Silicon (Si) in products poisons catalysts
How does silicon end up in liquid products?

- **Entrainment** - controlled by:
  - Injection away from OH
  - Use carrier to blow antifoam to foam front
  - High boiling carrier to prevent flashing
- **Decomposition** - controlled by product selection
Poly dimethylsiloxane (Silicone)
Thermal Degradation of Silicone

- Begins to decompose at 350°C
- Higher Temperature = faster decomposition
- Forms cyclic trimers and larger
- Defoaming ability reduced
- Breakdown products go overhead and contaminate product
Decomposition Products of Silicone
## Decomposition Products of Silicone Distill into Coker Products

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclic D3</td>
<td>134</td>
<td>273</td>
</tr>
<tr>
<td>Cyclic D4</td>
<td>175.8</td>
<td>348</td>
</tr>
<tr>
<td>Cyclic D5</td>
<td>210</td>
<td>410</td>
</tr>
<tr>
<td>Cyclic D6</td>
<td>245</td>
<td>473</td>
</tr>
</tbody>
</table>
## Silicon Reduction in Products

<table>
<thead>
<tr>
<th></th>
<th>60,000cSt ppm Si</th>
<th>600,000cSt ppm Si</th>
<th>ppm Si reduction</th>
<th>%Si reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphtha</td>
<td>34</td>
<td>12.3</td>
<td>21.7</td>
<td>63%</td>
</tr>
<tr>
<td>LCGO</td>
<td>7.9</td>
<td>3.2</td>
<td>4.7</td>
<td>59%</td>
</tr>
<tr>
<td>HCGO</td>
<td>7.3</td>
<td>2.7</td>
<td>4.6</td>
<td>63%</td>
</tr>
</tbody>
</table>
Higher MW results in Less Si to Coke Drum

Coker Antifoam Case Example
Moving to High Viscosity Antifoam (600 Mcst)

Plant switched from 60Mcst to 600Mcst Antifoam resulting in less usage and lower silicon addition
Use Higher Viscosity Silicone

- Higher Viscosity = Larger Molecule
- Larger Molecule takes longer to degrade
  - Defoams longer
  - Lower dosage required
  - Less Si in products
  - Less catalyst contamination
Introducing

Baker Petrolite
BPR 45165
coker antifoam
Why Did Baker Petrolite Develop a New Coker Antifoam?

- Limit to higher Molecular Weight
  - High viscosity difficult to handle
  - Higher Molecular weight cost more
- New type of antifoam developed
  - Effective at lower dosages
  - Less thermal breakdown
  - Prevents foam build up
  - Patents pending
First refinery trial

- Coker makes fuel grade coke
- Base case BPR 45160 (600,000 cSt) silicone defoamer
- Measured foam knock down
- Refoam after drum switch
- Si contamination of coker products
First refinery trial

- Results of BPR 45165 defoamer
  - Knocked down foam better
  - Prevented refoam after switch better
  - Could allow reduced outages
  - Reduced silicon contamination of products by over 50%
# First refinery trial

<table>
<thead>
<tr>
<th>Sample</th>
<th>Base Si (ppm)</th>
<th>New Si (ppm)</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coker Naphtha</td>
<td>3.29</td>
<td>1.29</td>
<td>62.5%</td>
</tr>
<tr>
<td>Coker Kerosene</td>
<td>4.41</td>
<td>1.92</td>
<td>56.5%</td>
</tr>
</tbody>
</table>
Second refinery trial

- Anode grade coke production
- Si in product poisons catalyst
- Excessive defoamer usage
- Used BPR 45160 (600,000 cSt silicone) defoamer for 4 years
### Second refinery trial

**Samples 1 hour before drum switch**

<table>
<thead>
<tr>
<th>Drum 1</th>
<th>BPR 45160</th>
<th>BPR 45165</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Defoamer</td>
<td>Defoamer</td>
<td></td>
</tr>
<tr>
<td>Naphtha</td>
<td>58</td>
<td>35.9</td>
<td>38%</td>
</tr>
<tr>
<td>LCGO</td>
<td>38.8</td>
<td>10.3</td>
<td>73%</td>
</tr>
<tr>
<td>HCGO</td>
<td>5.5</td>
<td>2.2</td>
<td>60%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drum 2</th>
<th>BPR 45160</th>
<th>BPR 45165</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphtha</td>
<td>33.8</td>
<td>8.2</td>
<td>75%</td>
</tr>
<tr>
<td>LCGO</td>
<td>28.7</td>
<td>3.2</td>
<td>88%</td>
</tr>
<tr>
<td>HCGO</td>
<td>1.8</td>
<td>0.9</td>
<td>50%</td>
</tr>
</tbody>
</table>
Second refinery trial

- New defoamer reduced Si in product
- More efficient to add antifoam early
  - Foam easier to prevent than knock down
  - Use less antifoam
- Kept foam down after drum switch
- New material easy to handle
Summary

- First trials short (few weeks)
  - Proved silicon reduced in liquid products
  - Showed improved foam control
- Baker Petrolite seeks to work with refineries on longer evaluation to:
  - Prove improved foam control
  - Demonstrate lower outages
  - Increase coker profitability