Crude Oil Quality Management in a Volatile Crude Pricing Market

Presented at Crude Oil Quality Conference
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Agenda

- Crude Oil Pricing vs Cost of Production
- Crude Pricing Volatility and Impact on Crude Oil Quality Management
- Pricing volatility impact on refining
- Understanding the production operations
- Examples of challenges and possible solutions
- Conclusion
# Crude Pricing History – High and Low

<table>
<thead>
<tr>
<th>Crude Slate</th>
<th>Date</th>
<th>$/bbl</th>
<th>Date</th>
<th>$/bbl</th>
<th>Date</th>
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<th>Date</th>
<th>$/bbl</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTI</td>
<td>Dec 1998</td>
<td>$11.35</td>
<td>June 2008</td>
<td>$133.88</td>
<td>May 2014</td>
<td>$102.03</td>
<td>Feb 2015</td>
<td>$46.39</td>
</tr>
</tbody>
</table>
Drivers for Crude Oil Pricing

- The basic laws of supply and demand impact the crude pricing models.
- Socio-political status in the world (Venezuela, Russia, Iran)
- Drive for energy independence (United States)
- Total cost of production
Cost of Production


- Report does not cover shale or tight oils, where the cost of production are actually higher

<table>
<thead>
<tr>
<th></th>
<th>Lifting Costs</th>
<th>Finding Costs</th>
<th>Total Upstream Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>United States – Average</strong></td>
<td>$12.18</td>
<td>$21.58</td>
<td>$33.76</td>
</tr>
<tr>
<td>On-shore</td>
<td>$12.73</td>
<td>$18.65</td>
<td>$31.38</td>
</tr>
<tr>
<td>Off-shore</td>
<td>$10.09</td>
<td>$41.51</td>
<td>$51.60</td>
</tr>
<tr>
<td><strong>All Other Countries – Average</strong></td>
<td>$9.95</td>
<td>$15.13</td>
<td>$25.08</td>
</tr>
<tr>
<td>Canada</td>
<td>$12.69</td>
<td>$12.07</td>
<td>$24.76</td>
</tr>
<tr>
<td>Africa</td>
<td>$10.31</td>
<td>$35.01</td>
<td>$45.32</td>
</tr>
<tr>
<td>Middle East</td>
<td>$9.89</td>
<td>$6.99</td>
<td>$16.88</td>
</tr>
<tr>
<td>Central &amp; South America</td>
<td>$6.21</td>
<td>$20.43</td>
<td>$26.64</td>
</tr>
</tbody>
</table>
Observations in Crude Pricing and Cost Analysis History

- Crude Oil price increased significantly but the cost of production also increased in most areas

- Saudi Arabia Factors - Cost of production; Change of regime

- Although crude oil prices have come down, many producers will continue to produce in order to meet contract and financial obligations, even if total cost of production is higher than crude price

- CAPEX budgets cut significantly or non-existent
How does all of this relate to crude oil quality management?

- Producers are expected to focus on additional means to reduce the total cost of production

- Crude blending of lower cost crude oils with the higher cost crude oils to produce a crude blend with pricing that is acceptable

- Producers focus will shift to an operational excellence mode as opposed to a production maximization mode
Buy low – Sell High

- Buying large quantities of crude oil at the current reduced price, betting on a price increase to sell at a higher price

- Buying difficult to treat crude or off spec and treating to increase value
Refinery Process

- Process unit charge rate swings
- Processing issues
- Crude blending challenges
Residence time challenges, tank bottoms build up, solids push to crude

Free water knockout
Challenges and potential solutions
Crude Oil Quality Management
Hydrogen sulfide management

Challenges
- No CAPEX budgets for Amine Treating Units
- Lowest cost Hydrogen Sulfide Chemical programs
- Spent Amine disposal or regeneration cost
- Monitoring

Solutions
- Lease equipment for amine treating
- Hydrogen Sulfide Program Management requirements from service oriented suppliers
Contaminants Management Detecting & Monitoring

- Understanding the monitoring techniques available for both Hydrogen Sulfide contamination as well as associated treatment chemistries (MEA, MDEA, etc.)

- Implement written contractual specifications incorporating the H$_2$S limits, means of measurement, and associated contaminants.

Topguard FAMS®
Crude Oil Blending

Challenges

- Incompatibilities – Resulting in asphaltene or paraffin precipitation
- Vapor Pressure limitations – Resulting in a requirement for more crude oil stabilization prior to shipping
- BS&W increases – Moving the crude oil quicker and pushing the limits on BS&W limitations

Solutions

- Monitor for crude oil blending incompatibilities –
  - Baker Hughes patented ASIT® Test methods
  - Heptane insolubles
  - PSRT (Paraffin settling rate test)
Crude Oil Blending - Solutions

- Light ends capture, compression or GTL technologies to meet vapor pressure specs without flaring.
Crude Oil BS&W Management - Challenges

- Break tanks residence time management
- Pushing the specs on water and allowing a higher content of solids
Crude Oil BS&W - Solutions

- Movement of crude to storage facilities and allowing for additional emulsion breaking at the crude oil terminal through tank de-emulsifier pretreatment. Discharge of water at terminal location.
Summary

- There are numerous elements that impact the price of crude.

- The cost of production is comprised of two elements, finding and lifting.

- The only lever the production firms can pull to control cost in a volatile market is the lifting cost.

- The volatility of the crude pricing will have major impacts on refinery operations.
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Expansion or maintaining of specifications and monitoring of those specifications is critical to reduce downstream impacts.

Even with a major reduction in crude oil pricing, there are still opportunities to recognize sizable profits.