COQA Domestic Sweet Project

1Q2017 Update

Aaron Dillard, Phillips 66
Bill Lywood, Crude Quality Inc.

March 9th, 2017
COQA Domestic Sweet Project

- Program definition
  - Sampling/testing program, back data fill, web based quality information system
  
- Defined Scope
  
- To transparently monitor a defined set of properties in Domestic Sweet deliveries at Cushing, OK for the purpose of beneficially expanding the specifications listed in Section 200 of the CME contract
Agenda

• Review of current web site status
  – a screenshot tour
• Data management system
  – what you don’t see
• Current task list
• Decisions needed & Next Steps planned
• Oversight Committee contact list
First thing people see

This site was established, and is maintained, in the interest of communicating data and information pertaining to the quality of Domestic Sweet crude at Cushing, OK as well as quality issues faced by the industry at large. We are committed to providing information that is current and dependable, and relevant to existing and anticipated industry needs.

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Wish to continue to crudemonitor.us
Home page

List of streams in system

Extracted from waiver page

User instructions and introductions

WELCOME TO CRUDEMONITOR.US

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The data and information presented in this website are provided through the COQA Domestic Sweet Committee, which has sponsored the collection and development of these data on behalf of its member companies.

Data Reports

The data report pages provide a summarized view of the current and historical data for a single crude stream. Also included on these pages are distillation results (both simulated and physical), trend charts for key characteristics, and a customizable export to excel function. To access the data reports, click on the crudemonitor.us home button and select crude using scroll-down links on the left-hand column.

Monthly Reports

The monthly report pages detail the summary comments for a single sample of a crude stream. Comments are arranged by sampling month, and are labeled according to sample date. Links for the individual sample data have been provided for each comment. To access the monthly reports, click on the monthly reports link at the top of the home page and select crude using scroll-down links on the left-hand column. The monthly reports page can also be accessed through a link on each crude data page.

Tools

Various tools related to crude blending and crude comparisons have been provided for public use.

Industry Resources

The industry resources page includes links to various related...
COQA

Crude page

Stream Description

Spec links

Comments section

Basic analysis results

Pop up chart with dropdown list

Data Export section
Spec links

COQA Recommended Specifications

- In order to better define the quality of WTI, in a letter dated 10 August 2010, the COQA recommended the following specs be added:
  - MCRT: 2.4% wt. or less
  - TAN: 0.28 or less
  - Nickel: 8 ppm or less
  - Vanadium: 15 ppm or less
  - Light Ends <220°F by HTSD: Not more than 19% by mass
  - 50% Point by HTSD: 470°F- 570°F
  - Vacuum Resid > 1020°F by HTSD: Not more than 16%
Comments (monthly reports)

- **Date: Feb 23, 2017**
  - Batch: DSW-006 - Cushing
  - MCRT and metals above historical norms. 220oF recovery = 18 mass%, 50 mass% point = 512oF, 1020oF - vac resid = 13.9 mass%
  - [View sample data](#)

- **Date: Jan 29, 2017**
  - Batch: DSW-001 - Cushing
  - MCRT higher than historical norms. Vanadium slightly over COQA recommended maximum of 15%.
  - [View sample data](#)

- **Date: Oct 15, 2016**
  - Batch: averaged - Cushing
  - These results are monthly historical and aggregated information contributed from mid and downstream parties. Individual batch testing of the stream for this project commenced in January 2017.
  - [View sample data](#)

- **Date: Sep 15, 2016**
  - Batch: averaged - Cushing
  - These results are monthly historical and aggregated information contributed from mid and downstream parties. Individual batch testing of the stream for this project commenced in January 2017.
  - [View sample data](#)

- **Date: Aug 15, 2016**
  - Batch: averaged - Cushing
  - These results are monthly historical and aggregated information contributed from mid and downstream parties. Individual batch testing of the stream for this project commenced in January 2017.
  - [View sample data](#)
Crude comparisons

Crude Comparison - From Jan. 01, 2014 to Dec. 31, 2014
Format is: Average ± std. dev.

<table>
<thead>
<tr>
<th>Basic Analysis</th>
<th>WTI-Patoka (WTI-P)</th>
<th>Domestic Sweet Blend (DSW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity</td>
<td>40.4 ± 0.4</td>
<td>41.0 ± 0.4</td>
</tr>
<tr>
<td>Density (kg/m³)</td>
<td>822.4 ± 1.8</td>
<td>818.8 ± 1.9</td>
</tr>
<tr>
<td>Sulfur (wt%)</td>
<td>0.42 ± 0.03</td>
<td>0.39 ± 0.01</td>
</tr>
<tr>
<td>Metals (wt%)</td>
<td>2.25 ± 0.54</td>
<td>1.65 ± 0.24</td>
</tr>
<tr>
<td>Sediment (ppm)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TAN (mgKOH/g)</td>
<td>0.12 ± 0.01</td>
<td>0.10 ± 0.00</td>
</tr>
<tr>
<td>Salt (ppt)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nickel (mg/kg)</td>
<td>50 ± 0.6</td>
<td>4.9 ± 0.6</td>
</tr>
<tr>
<td>Vanadium (mg/kg)</td>
<td>12.1 ± 1.4</td>
<td>12.8 ± 1.7</td>
</tr>
<tr>
<td>Olefins (wt%)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Light Ends (vol%)</th>
<th>WTI-Patoka (WTI-P)</th>
<th>Domestic Sweet Blend (DSW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butanes</td>
<td>1.53 ± 0.10</td>
<td>-</td>
</tr>
<tr>
<td>Pentanes</td>
<td>3.86 ± 0.23</td>
<td>-</td>
</tr>
<tr>
<td>Hexanes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Heptanes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Octanes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nonanes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Decanes</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BTEX (vol%)</th>
<th>WTI-Patoka (WTI-P)</th>
<th>Domestic Sweet Blend (DSW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>9.22 ± 0.03</td>
<td>-</td>
</tr>
<tr>
<td>Toluene</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Xylenes</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distillation (°C)</th>
<th>WTI-Patoka (WTI-P)</th>
<th>Domestic Sweet Blend (DSW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5% Mass Recovered</td>
<td>65.3 ± 3.56</td>
<td>51.9 ± 6.73</td>
</tr>
<tr>
<td>10% Mass Recovered</td>
<td>84.4 ± 2.68</td>
<td>79.0 ± 3.10</td>
</tr>
<tr>
<td>20% Mass Recovered</td>
<td>120.5 ± 4.76</td>
<td>117.2 ± 2.49</td>
</tr>
<tr>
<td>30% Mass Recovered</td>
<td>168.5 ± 6.11</td>
<td>163.4 ± 3.06</td>
</tr>
<tr>
<td>40% Mass Recovered</td>
<td>214.8 ± 7.21</td>
<td>217.6 ± 3.69</td>
</tr>
<tr>
<td>50% Mass Recovered</td>
<td>270.5 ± 6.84</td>
<td>274.1 ± 4.07</td>
</tr>
</tbody>
</table>
Blending calculator

Blending hydrocarbons with varying densities or molecular structures can result in a phenomenon known as shrinkage. In the same way that mixing 1 litre of golf balls and 1 litre of sand results in a mixture of less than 2 litres, mixing crude often results in a decrease in expected volume.

This calculator works on an iterative method to calculate, in each step, the amount of diluent that would be required to reach a target density and then determine any discrepancies caused by shrinkage. Further iterations can then be used to get closer to the target density. Iterations continue until the density of the blend is within 0.0001% error with the target density (however, only a maximum of six iterations will be shown in the table).

Liability Statement
This calculator has been provided as a tool, and should be used solely for informational purposes. It is not intended to replace your own calculations as each situation requires specialized considerations. Crude Quality Inc. accepts no responsibility for any inconsistencies with the actual chemistry that may arise from the use of this calculator.
Compatibility calculator

According to research done by Dr. Irv Wiehe of Soluble Solutions, mixing incompatible crudes can result in asphaltene precipitation which can damage equipment used in the processing of crudes. In order to determine the compatibility of blending a crude and a diluent, testing can be done to determine the solubility blending number ($S_{BN}$) and insolubility number ($I_N$). From testing an oil sample (typically with toluene and n-heptane), $S_{BN}$ and $I_N$ can be determined.

To determine blending compatibility, Dr. Wiehe requires the resulting $P$ value (which is equal to the ratio of $S_{BN}$ to $I_N$) of the blend to be equal or greater than 1.3. This calculator requires a more conservative $P$ value of greater than 2.0. As such, the optimal percentage of diluent in the blend is calculated as that which gives a $P$ value of exactly 2.0.

Liability Statement
This calculator has been provided as a tool, and should be used solely for informational purposes. It is not intended to replace your own calculations as each situation requires specialized considerations. Crude Quality Inc. accepts no responsibility for any inaccuracy or lack of accuracy in the data used in this calculator.
Links to others

- **US Technical Organizations**
  >> [Crude Oil Quality Association (COQA)]()
  >> [National Academy of Sciences]
  >> [Hydrocarbon Online]
  >> [Petroleum Environmental Research Forum]
  >> [Refining On-line]
  >> [Society of Petroleum Engineers]

- **US Government Departments**
  >> [American Petroleum Institute]
  >> [US Energy Information Administration]

- **Pipelines**
  >> [Enbridge]
  >> [TransCanada]
  >> [Kinder Morgan]
  >> [Plains All American]
  >> [Magellan Midstream Partners]

- **Petroleum Industry Pricing Links**
- **Canadian Producer Associations**
- **Canadian Technical Organizations**
- **Canadian Government Departments**

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**COQA**

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**Crudemonitor.us**

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Accreditations (Contact us)

Crude Oil Quality Association (COQA)

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Dan Brussar
Vijay Nair
Cara Madee
John Harkins
Brent Sisest
Derek Taylor
Ashok Anand

Phillips 66
Nalco Champion
Exxon Mobil
AFPM
CME (NYMEX)
Shell (retired)
Marathon Petroleum
Sunoco Logistics
Enterprise Products
Plains All America
Enbridge Pipelines Inc

Chair
Secretary

please contact the Chair regarding membership on the committee.

The crudemonitor.us program operates under a support model representing key stakeholders across the industry. This crudemonitor.us Oversight Committee consists of members experienced in the broad use of this crude quality data. This committee is established to provide budget and scope approval for this industry supported function (currently refinery/midstream funded). It is premised on open access, crude quality data for Refiners, Producers, Marketers, Pipelines and Government throughout the US. Industry has wide support to sustain this historic data program.
Data management

- What you don’t see
- Data import formatting
- Data import
- Data review
- Comments
- Committee review
- Posting
Data management system

Input Data
- Condensate
- Crudes
- Assays
- DHA

New Crude Stream
- Add new crude stream
- Add new condensate stream

Edit Data
- Find a sample
- Edit an assay

Edit Existing Crude Streams
- Edit crude stream
- Edit condensate stream

Summary Reports
- Find a sample
- PDF reports by date added

Comments
- Recent samples
- Find a sample
Data review

Color coding
- **Red** – 3σ
- **Pink** – 2σ to 3σ
- **Yellow** – σ to 2σ
- **Green** – < σ

Pick out anomalies
Follow recent trends
Adding comments

<table>
<thead>
<tr>
<th>Domestic Sweet</th>
<th>WTI</th>
<th>Condensates</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;&gt; on 2017-02-22</td>
<td>All samples since Jan. 1, 2013 have comments.</td>
<td>All samples since Jan. 1, 2013 have comments.</td>
</tr>
<tr>
<td>&gt;&gt; on 2017-02-16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;&gt; on 2017-01-30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Add, group & activate streams

Edit WTI-C Information

Name: WTI-Cushing
Acronym: WTI-C
Grade: WTI - Other
Active: Yes
Location: Cushing, OK

Description:
The West Texas Intermediate (WTI) designation is often used interchangeably with Domestic Sweet Crude Oil. The latter is a fully blended aggregate of many streams, not all of which originate from west Texas. WTI-Cushing test results are included for comparison purposes only.

Update Database Information
Oversight Committee contacts

COQA Domestic Sweet Monitoring Project
Updated 3-6-17

Oversight Panel Members

<table>
<thead>
<tr>
<th>Company</th>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFPM</td>
<td>David Freidman</td>
<td><a href="mailto:DFRIENDMAN@AFPM.ORG">DFRIENDMAN@AFPM.ORG</a></td>
<td>202-552-8461</td>
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<td>CME NYMEX - Primary</td>
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<td>212-299-2604</td>
</tr>
<tr>
<td>CME NYMEX - Secondary</td>
<td>Owain Johnson</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enbridge - Primary</td>
<td>Ashok Anand</td>
<td><a href="mailto:ashok.anand@enbridge.com">ashok.anand@enbridge.com</a></td>
<td>780-420-8694</td>
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<tr>
<td>Enbridge - Secondary</td>
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<td><a href="mailto:Nanette.Yearley@enbridge.com">Nanette.Yearley@enbridge.com</a></td>
<td>780-420-8519</td>
</tr>
<tr>
<td>Enterprise - Primary</td>
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<td>713-381-2545</td>
</tr>
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<td>Enterprise - Secondary</td>
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<td><a href="mailto:JMGAYHART@eprod.com">JMGAYHART@eprod.com</a></td>
<td>713-381-6944</td>
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<tr>
<td>Exxon Mobil - Data Analysis</td>
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<td><a href="mailto:frank.hagardorn@exxonmobil.com">frank.hagardorn@exxonmobil.com</a></td>
<td>832-625-7106</td>
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<tr>
<td>Marathon Petroleum</td>
<td>Cara Madee</td>
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<td>618-553-0946</td>
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<tr>
<td>Marathon Petroleum - Primary</td>
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<td><a href="mailto:cmleidy@marathonpetroleum.com">cmleidy@marathonpetroleum.com</a></td>
<td>419-422-2121</td>
</tr>
<tr>
<td>Nalco - Secretary</td>
<td>Dennis Haynes</td>
<td><a href="mailto:dthaynes@nalco.com">dthaynes@nalco.com</a></td>
<td></td>
</tr>
<tr>
<td>Phillips 66 - Chairman</td>
<td>Aaron Dillard</td>
<td><a href="mailto:aaron.l.dillard@p66.com">aaron.l.dillard@p66.com</a></td>
<td>832-765-3001</td>
</tr>
<tr>
<td>Plains AA</td>
<td>Derek Taylor</td>
<td><a href="mailto:DDTaylor@paalp.com">DDTaylor@paalp.com</a></td>
<td>713-412-2961</td>
</tr>
<tr>
<td>Consultant - Data Analysis</td>
<td>Vijay Nair</td>
<td><a href="mailto:VJNAIR7@gmail.com">VJNAIR7@gmail.com</a></td>
<td>832-279-5649</td>
</tr>
<tr>
<td>Sunoco Logistics</td>
<td>John Harkins</td>
<td><a href="mailto:jjharkins@sunocologistics.com">jjharkins@sunocologistics.com</a></td>
<td>215-287-6514</td>
</tr>
</tbody>
</table>

Oversight - Administrative Members

<table>
<thead>
<tr>
<th>Company</th>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Quality Inc.</td>
<td>Bill Lywood</td>
<td><a href="mailto:lywood@crudequality.com">lywood@crudequality.com</a></td>
<td>780-991-9900</td>
</tr>
<tr>
<td>Crude Quality Inc.</td>
<td>George Lywood</td>
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<td>780-757-9909</td>
</tr>
<tr>
<td>COQA - Executive Director</td>
<td>Dennis Sutton</td>
<td><a href="mailto:coqasutton@gmail.com">coqasutton@gmail.com</a></td>
<td>419-306-0375</td>
</tr>
</tbody>
</table>
Progress

• Historical data added
  – Plains, Enbridge, Marathon (Enterprise pending)

• Historical data reviewed

• Sampling program
  – Enterprise underway, Enbridge being approved
  – Plains, Magellen & Blue Knight in development

• Testing program
  – Intertek has been a strong, helpful “partner”
Decisions & Next Steps

• O/sight committee review items
  – Suggestions related to database structure, presentation format, extraneous data

• Make system public – 3rd week of March 2017
  – Leave WTI-C and DSW data separate
  – WTI-P will eventually be removed from the web site as a reference

• Permission for samples
  – Enbridge internal underway
  – AFPM in construct