BIOGRAPHY

Randy Segato
Suncor Energy Inc.

Randy Segato has a diversified background with 22 years of experience covering Refining and Upgrader operations, as well as Products and Crude Oil Trading. He is a champion of crude quality within Suncor and is active within CAPP, CCQTA and the COQG, chairing several industry panels. Randy maintains a position as crude quality specialist at Suncor Energy Marketing Inc.

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Crude Oil Value Management Through North American Pipeline Delivered Systems

Randy Segato
Suncor Energy Marketing Inc.

Suncor produces synthetic crude from its operations in Fort McMurray for destinations across North America. Injected and delivered crude quality varies due to pipeline and terminal system logistics which implies changes in valuation. Refinery Planners/Engineers and Crude Traders are tasked to maximize profitability while minimizing risk within this varying world of crude classifications, new commodity developments, batch interfaces, shared tank bottoms and sampling limitations. In order to manage this continuously changing landscape, Suncor’s integrated oil flow operations will be reviewed with focus on best practices in Crude Oil Quality management from source to refineries.
Crude Value Management
Through Pipeline Systems

5th NCUT Upgrading and Refining Conference
September 15, 2009
Edmonton, Alberta, Canada

Randy Segato
Crude Value Management … is the process to acknowledge, measure, and act on system variances that affect crude quality.

A crude’s Refining Value is derived from the delivered crude quality vs alternatives.

Fundamental changes to crude quality dynamically alter crude value and thus shift crude price differentials.
Agenda

- Considerations of Pipeline Delivered Networks

- Benefits of a Disciplined Crude Value Management Program
  - Principles of Crude Quality
    - For Producers
    - For Refiners

Objectives

to obtain appreciation of crude quality variances on Refining Value. 
we will touch on some best practices in obtaining and managing crude quality data.
Crude Value Management

It seems so simple!

We’ve been doing this for years so what’s the problem?
Crude Value Management

The system is changing

New Crudes are entering the market faster. New Pipelines and logistics continue to come on stream.

US and Canadian growth imply expanded crude quality valuation because of more options available.
Pipeline Considerations impacting crude value

Commodity Classes ie. “rules and regs”
- Batch system (Enbridge, KM)
  - Nominal 10 km³ batches maintain unique quality from injection to delivery
- Basket approach (line 9, Capline, Keystone (ACS))
  - Like crude grades managed by pipeline as a like commodity, delivery of crude grade not specifically guaranteed to be single crude quality
- Pooled feeder streams (MSW, CRW, SLE, SHE)
  - Feeder streams equalized across month into delivered tank but injected batches vary and are rarely “just the average”

Fluid Flow Realities alter quality as batch moves down pipelines
- Flow Regime
  - Expect turbulent flow to minimize interface but sometimes operate in laminar flow, or even start/stop; can changes over time; sometimes line service switches
- Interfaces
  - similar gravity, similar viscosity makes interface difficult to detect; large pipelines can have 25%+ contamination based on one interface; best practice would have interfaces governed based on a known predictable “batch cut matrix” outlining accepted cuts between grades
- Tank Logistics
  - breakout tankage change in service; can have like grade in one tank; can have dissimilar crudes share tank bottoms; rarely have full grade mixing in a tank but is possible

Just some quick P/L considerations
### Table 5

**Commodity Segregation through Tankage**

<table>
<thead>
<tr>
<th>Transport Commodity</th>
<th>Crude Quality Category</th>
<th>Edmonton</th>
<th>Hardisty</th>
<th>Kerrobert</th>
<th>Regina</th>
<th>Clearbrooke</th>
<th>Superior</th>
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<td>R/S</td>
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<td>B/C</td>
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<td>U.S. &amp; Foreign Sour - Mokena (UOM, FHM)</td>
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</table>

As a first option, a commodity will cross bottoms with the same commodity. Second, third, and fourth choices (commodity group) are noted in superscript in preferential order.

**Commodity Group Codes** – A-Heavy, B-Heavy High Tan, C-Cracked, D-Medium, E-High Sour, F-Sweet, G-Light Synthetic, H-Condensate, I-Light Sour, J-Heavy Synthetic

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**Draft June 22 2007**

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**Table 5 (partial)**

**Crude Value Management**
**Tank Service Legend**

<table>
<thead>
<tr>
<th>Service</th>
<th>Receipt</th>
<th>Breakout</th>
<th>Tank Service Definitions</th>
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</thead>
<tbody>
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<td>Segregated</td>
<td>R/S</td>
<td>B/S</td>
<td>Crude streams that does not share tankage with other crude streams.</td>
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<tr>
<td>Share Common Bottoms</td>
<td>R/B</td>
<td>B/B</td>
<td>Crude streams that can share tank bottoms with other crude types.</td>
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<tr>
<td>Commingled</td>
<td>R/C</td>
<td>B/C</td>
<td>Crude components that share tankage with other like-crude components to form single commingled streams e.g. SW, SLE, SHE, SO, CRW, LSB, M. Crude streams that can be commingled with a given commodity are noted in superscript in preferential order.</td>
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<td>No Tankage Requirement</td>
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</table>

**General Notes**

1. Above tankage references Enbridge facilities only.
2. The CRW, SW, SLE, SHE, LSB and M commodities are blended from their individual components and are combined on receipt and segregated receipt service is provided for these streams.
3. OCC, PBS and CCA require buffering.
4. SHE and SO will be commingled as required at breakout locations. Once commingled, they are treated as a single commodity and may cross bottoms with compatible sours.
5. US and Foreign crude is received at Clearbrook, Mokena, Griffith, and Lewiston on the Enbridge system. US sweet crude will cross bottoms with commodity group “F”. US Sour crude will cross bottoms with commodity groups, in the order of E, D, and I. US medium crude will move through the system the same as Midale. US heavy crude streams are segregated through the system the same as heavy streams.
6. Natural Gas Liquids, Gasoline, and Distillate do not utilize Enbridge tankage and are therefore not included in this table.
Let’s not forget that there is also exposure to quality changes due to Intra-Terminal manifold lineups and configuration.
Overall,

Crude Value Management requires a detailed understanding on the complete crude logistic system

...from creation of the Crude Commodity

...through to delivery into refinery tanks.

Pipelines function given the assets they have and the mix of commodities they carry. However, these will change over time and shippers must always be knowledgeable of current practice.

*Refiners expect the pipeline systems to be predictable and steady.*
✓ Overview of Pipeline Delivered Network (USA/CAN)

➢ Benefits of a Disciplined Crude Quality Management Program
  ➢ Principles of Crude Quality
    ➢ For Producers
    ➢ For Refiners
Crude Value Management

For Refiners, crude selection is based on relative price differentials (diffs) between grades, which are based on relative crude quality differences.

Without appropriate crude quality assessment for planning models (Linear Programs/LP), higher basis risk ensues...

you could guess right? 😊

you could guess wrong? 😞

but why guess?

Managing Crude Value proactively should be a core refinery business process.

As **absolute** crude diffs widen, proper crude selection becomes even more vital.
Quality within a commodity class is still quite variability in quality and thus value (typically perceived as small relative quality changes but in fact can be significant).

Quality across commodity class is often considered as “contamination” and results from pipeline interfaces and/or tank mixing. (typically perceived as large relative quality changes).
**Benefits from improved (=accurate) Crude Quality Management**

- **Improved realization of producer value**
  - If Refinery buyers consider “worst case” yields, value is lost by Producers and Refiner
    - Poor choice by Refiner in determining (incorrect) sub optimal case for relative crude marginal value understanding with hurdle rate to enter Refinery higher than it should be
    - Crude parity point moves to next available Tier/location typically at lower netbacks to producer

*It is recommended to model actual landed quality for most LP’s seeking profit maximization in monthly planning processes.*

*Alternatively, and during new crude introductions, It is acceptable to model blends of crudes to represent delivered qualities but must be based on real crude contaminations expected and expected landed qualities.*

*Use of injected crude quality representation adds large errors (positive or negative) to crude valuation for most customers.*
Benefits from improved (=accurate) Crude Quality Management

- Understand your customer
  - Refineries inevitably establish prices based on crude quality fundamentals
  - Refiners continue evolving Linear Programming (LP) models requiring more sophisticated/accurate crude Assay data
LSB injected at Cromer delivered to Suncor Sarnia Refinery.

- Source Monitoring
- Refinery Landed Monitoring
LSB injected at Cromer delivered to Suncor Sarnia Refinery.

- Source Monitoring options:
  - Arrange your own samples (difficult)
  - Utilize Canadian Association of Petroleum Producers (CAPP) support for industry crude quality at source

Next slides via CrudeMonitor Inc (thanks Bill)
Welcome to CrudeMonitor.ca!

**Statistical Reports**

The 2001-2005 results for the Heavy Crude Quality Monitoring program have been summarized and statistically tested and reported. The results of the statistical review are available through the following selections.

Summary properties sheets are available for **light streams** and **heavy streams**.
Some simply use the typical data.

This however is only numerically average data over time and does not lead to acceptable level of detail for refining.
### Heavy Crude Quality Project Analyses Summary (May 2009)

<table>
<thead>
<tr>
<th>Crude</th>
<th>Sample Date</th>
<th>No. Samples or Batch #</th>
<th>Sulphur (wt%)</th>
<th>API Density (degree)</th>
<th>Absolute Density (kg/m³)</th>
<th>Sediment (ppmw)</th>
<th>MCR (wt%)</th>
<th>Salt (ptb)</th>
<th>TAN (mgKOH/g)</th>
<th>Nickel (mg/L)</th>
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<td>2008 Q4 3</td>
<td>0.83</td>
<td>38.4</td>
<td>832.2</td>
<td>356</td>
<td>3.5</td>
<td>10.1</td>
<td>0.19</td>
<td>18.8</td>
<td>8.9</td>
<td>18.8</td>
</tr>
<tr>
<td></td>
<td>2009 Q1 6</td>
<td>0.87</td>
<td>38.4</td>
<td>832.3</td>
<td>555</td>
<td>2.2</td>
<td>237.5</td>
<td>0.14</td>
<td>4.2</td>
<td>8.3</td>
<td>22.0</td>
</tr>
</tbody>
</table>

**Average**
- 1.15
- 36.2
- 843.1
- 522
- 3.0
- 130.2
- 0.16
- 5.7
- 9.8

**Std Dev**
- 0.17
- 1.2
- 6.1
- 107
- 0.6
- 85.9
- 0.07
- 2.2
- 4.6

**Avg + StdDev**
- 1.33
- 37.4
- 849.2
- 629
- 3.6
- 216.0
- 0.23
- 7.9
- 14.4

**Avg - StdDev**
- 0.98
- 35.0
- 837.0
- 415
- 2.4
- 44.3
- 0.09
- 3.5
- 5.3

More data is available on trends which is valuable insight into longer term trends and key for producers, strategists etc.

Though an upgrade vs simply averages, interpretation of trend is difficult.
Available trends for key properties help establish source changes
This historical data is best suited for trends over months.
Crude Value Management

Example of WCS Seasonal data

Sidebar: Let's leave LSB for a moment …

Seasonal changes can be seen clearly with this source data.

Q? how many assay representations would you consider for this crude?
Crude Value Management

Example of LSB @ Cromer data
This data is very good at providing trends in SOURCE data. It has sufficient frequency for longer term trends. It does not necessarily translate to changes in delivered quality.
Best Practices at Refineries

Monitor all crudes for landed quality

1. Custody Transfer Based Qualities with Pipelines
   Density/Sulfur….per batch (from composite sample)
   (part of existing Refinery and P/L accounting data)

2. Key Bulk Qualities to identify need for detailed assay change
   MCR/HTSD….frequency of 8-12 batches/month (from composite sample)
   (2 – 5 k$/month)

3. Full assay of landed quality for use in LP
   Full Assay of Landed Crude….frequency of 5-12 grades/year (from composite sample)
   (12 – 20 k$/assay)
With this increased frequency of data, we can see and eliminate outliers caused by poor sampling, poor lab analysis, or outright exceptions.

Changes in landed crude quality starting in 2008 also show change in variance.

This Variance now is wider than historical. The “system” surrounding LSB movements is changed.

NOTE SHOWN IN SOURCE DATA.
MCR is simple cheap accurate test used to track resid content.

Very beneficial for indications of type of contamination

(especially in systems with resid free synthetics which have MCR<0.2)
HTSD (ie D2887) is vital for yield understanding and thus the key value parameter to be monitored.

HTSD provides improved Crude Value understanding.

Best Practice would be to do 3-6 HTSD per crude run per year.

Software Tools (such as H/CAMS) are available to take HTSD, Density, Sulfur and do a “flash assay update” to a base assay. This provides 90% of the accuracy update vs a full assay update at a fraction of the cost.
Crude Value Management

LSB @ Delivery

LSB Landed HTSD Yield

a 15% change in naphtha content for the same crude!!!
A full assay should be done “when the quality has fundamentally changed”. This is self guided by each Refinery but should be based on multiple quality variances.

Assay complexity dictated by LP model need (or Unit monitoring needs).

Use changes in these qualities to trigger new assay needs for LP

Density
Sulfur
MCR
HTSD

This topic is a complex subject for another day!
Crude Value Management

In Summary

To maximize value retention to Producers and also value maximization for Refiners…..

- Understand the Logistics affecting Crude Quality
- Track Source Crude Quality for long term trends
- Have a disciplined system to track landed refinery crude quality at a higher frequency
- Monitor continuously to keep pace with changing quality.

Thank you!