Enbridge System: Crude Types, Transportation and Handling Systems

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Enbridge Liquids Pipeline Overview
Alberta Oilsands Regional Pipeline Development

- **Waupisoo Pipeline**
  - 30” diameter, 390 km.’s, 350 KBPD initial capacity
  - In service now

- **Opti-Nexen (Long Lake)**
- **ConocoPhillips/Total (Surmont)**
- **EnCana (Christina Lake)**
- **PetroCanada (MacKay River)**
- **Suncor**
- **Cheecham Terminal**
- **Athabasca Pipeline**
Mainline Expansions - Alberta Clipper

- New 36” diameter line, Hardisty to Superior, 1,000 miles
- 450 kbpd additional capacity into Chicago
- In-service mid 2010
- Fully supported by industry
- Under Construction
Mainline Expansion
Southern Lights Diluent Supply

- 180 kbpd diluent capacity
- Contract pipeline
- In service Q4 2010
- Fully supported by industry
- Under Construction
<table>
<thead>
<tr>
<th>Commodity Type</th>
<th>API</th>
<th>%S</th>
<th>MCR</th>
<th>TAN</th>
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<tbody>
<tr>
<td>Heavy</td>
<td>19-21</td>
<td>2.6-4.5</td>
<td>8.5-11.3</td>
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<td>Heavy Hi Tan</td>
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<td>7.5-10</td>
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<td>2.5</td>
<td>6.0</td>
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<tr>
<td>Sour</td>
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<tr>
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<tr>
<td>Lt Sweet Synthetic</td>
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</table>
Quality Management of Commodities in Enbridge Batched Pipeline

• Enbridge controls quality of delivered crude in the following ways.
  – In the Pipe: Manage Interface - number, type, size, cut
    • Line Splits: Like Commodities in segregated lines
    • Line Rates: Turbulent flow to minimize interface sizes
    • Batch Sizes: Minimum 60KB, Multiples batch trains
    • Batch Sequence; Based on least contamination risk
    • Batch Cuts (Interfaces): Mid point
  – In the Tank
    • Tank Bottoms Crossing
    • Tank Selection/Terminal Piping/Service Change
The Quality Matrix – Number & Type

<table>
<thead>
<tr>
<th>CRUDE TYPE MATRIX - THE QUALITY PROCESS</th>
<th>Heavy -TAN</th>
<th>Heavy</th>
<th>Medium</th>
<th>Sour</th>
<th>Sweet</th>
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<td>3</td>
<td>4</td>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Sour</td>
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<td>2</td>
<td>1</td>
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<td>Condensate</td>
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<td>5</td>
<td>4</td>
<td>3</td>
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The above numbers rank the order (as a guideline) that should be followed when changing from crude types. One being first choice. Seven being the last choice.

When making sequence decisions between crudes of the same type (Heavy-Heavy). Reference the crude prices for best choice.
Line Rates at Turbulent flow - size

Turbulent Flow

Laminar Flow

Notice the increased size of the mixing area from the Turbulent to Laminar flow
In The Tank

- **Tank Selection** - This is important to determine the amount of contamination created from station piping. This may increase or decrease depending on the location of the tank and the amount of common piping. Most sensitive crude types closest to manifold.

- **Tank Bottoms Crossing** - The procedure for this is outlined in the Service Levels (Table 5). Outlines how each commodity is treated through tankage at every location from receipt to delivery.

- **Tank Service Change** - Follows a rigid procedure to minimize contamination.

- **Tank Cleaning** - Can cause a product to be delivered with a high S&W which can cause refinery problems. Procedure in place to monitor and restrict high S&W
Special Procedures

- High Tan (Total Acid Number > 1.0) commodities have dedicated tanks or flush batch (destined to the same facility) is required if routed through a regular heavy tank.

- Cracked products contain olefins desired by very few refineries. Cracked products require both front and back buffers that are sized to contain the cracked crude interfaces. The whole train (buffers and crude) moves into the same refinery.
Quality Metrics

- Reward/penalty based on meeting or exceeding targets set over 5 years (2005-2009). Targets negotiated based on baseline data on main lines only – to Sarnia & Chicago
- Targets set on formula which includes
  - Absolute change + constant x std dev at delivery
- Quality metrics parameters – receipt to delivery
  - Heavy: sulphur, MCR, TAN
  - Light Synthetic: sulphur, density
  - Refined products: diesel flash, uLSD sulphur pick-up
- Light Targets tightened by 50% and Heavy targets tightened by 30%
- Performance has been excellent – 24 out of 30 targets in 2009 were in bonus situation indicating the gains in quality of crude being delivered
- Connecting pipelines benefiting
Southern Lights Diluent Quality

Objectives

• Provide additional diluent source
• Maintain quality of aggregate stream within industry specifications
• Ensure all sources meet acceptable quality through routine specification control
• Shipper awareness of expected quality and quality control
Diluent Approval/Acceptance

- Specifications “mirrored” from Western Canadian condensate pool
- Assay Submission to SL
- Internal assay review for SL acceptance
- Approval of commodities within specifications
Diluent Specification Monitoring

- Online monitoring includes density and RVP
- Monitoring of all other specs through composite sample lab analysis
- Analysis frequency adopted from Western Canadian condensate pool
- Monitoring frequency will increase upon spec violation
- No options for stream reclassification @ Manhattan Terminal
SL Equalization

Equalization Measurements

- Light ends analysis (butane content)
- Sulphur
- Density

Equalization will differ from Western Canadian condensate as it will cover BOTH receipt and delivery quality
SL Shipper Quality Awareness

- No options for rerouting off spec material @ Manhattan
- Environmental permit on tankage will require tight control on RVP
- Numerous potential sources/absent product history
- Inlet quality diligence (connecting carrier) will be required to meet spec
Summary

• Growth expected in new and existing crude types – some challenging
• Enbridge infrastructure being expanded to connect increased supply sources to existing & new markets
• Quality metrics benefiting connecting pipelines
• Quality metrics principles/practices extended to all expanded infrastructure
• Southern Lights spec and quality monitoring and equalization practice being finalized