Novel Applications of HTSD beyond Crude Oil

Expanding HTSD techniques to diversified /complex matrices including Bitumens, Bio-crude products and Tar Sand/Shale Derived Syncrudes

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Crude Oil Quality Association ~ Houston Program
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Scope:

- **Heavy Crackable Crudes**
  - Boscan Crude

- **Heavy oils derived from Tar Sands/ Oil Shale**
  - Bitumens

- **Bio Fuels**
  - Bio Crudes
  - Bio Diesel
  - Algal Fuels
Heavy Crackable Crudes
Boscan Raw Crude demonstrating Cracking
Comparison of Boscan Crude Run with Standard HTSD Conditions and Modified Injector Profile to Delay Cracking

Standard Conditions
Cracking occurs here

Modified Injector Profile
Cracking occurs here
### Boscan Crude Recovery Compared

<table>
<thead>
<tr>
<th>Temp, °F</th>
<th>HTSD Recovery, % Standard Conditions</th>
<th>HTSD Recovery, % Modified Injector Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>360</td>
<td>3.1</td>
<td>3.2</td>
</tr>
<tr>
<td>480</td>
<td>6.9</td>
<td>6.8</td>
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<tr>
<td>650</td>
<td>16.1</td>
<td>15.5</td>
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<tr>
<td>750</td>
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<td>27.5</td>
<td>25.8</td>
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<td>33.4</td>
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<tr>
<td>1000</td>
<td>50.2</td>
<td>41.0</td>
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<tr>
<td>1100</td>
<td>60.7</td>
<td>48.6</td>
</tr>
<tr>
<td>1200</td>
<td>70.4</td>
<td>57.3</td>
</tr>
</tbody>
</table>
Tar Sand/Oil Shale Derived Heavy Oils

• Peace River Bitumen

• Peace River Bitumen Extracts
Blue = N-Puraffin Calibrant Run by custom temperature profile

Red = Bitumen run by custom temperature profile with Cooling on Injector. This prevented injector from fully reaching the specified temperature. Maximum injector temperature estimated to be 160°C.

Green = Bitumen run by custom temperature profile with no cooling on injector for first temperature event. Allowed higher C#'s to trap onto column.
Comparison of Standard HTSD vs. Delayed Cracking Method
Bitumen Sample

Bitumen run by standard HTSD method

Bitumen run by Method used to delay cracking of heavy oils and bitumen
## Bitumen Recovery Compared

<table>
<thead>
<tr>
<th>Temp, °F</th>
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<th>HTSD Recovery, % Modified Injector Profile</th>
</tr>
</thead>
<tbody>
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<td>2.3</td>
<td>2.4</td>
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<tr>
<td>650</td>
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<tr>
<td>1200</td>
<td>67.5</td>
<td>60.0</td>
</tr>
</tbody>
</table>
Sample ID: Clean Bitumen B

Blue = Regular HTSD Inlet Temperature Profile
Red = Special Delayed Cracking HTSD Inlet Temperature Profile
Green = Carbon Disulfide Blank
HTSD Applied to Bio Fuels

• BioCrude
• BioDiesel
• Algal Derived Fuels
Biodiesel containing Light Ends and Glycerides

- Methanol
- Carbon Disulfide Solvent

- Light Ends
- C18 FAME
- C20 FAME
- monoglyceride
- diglyceride
- triglyceride
Algal Vegetable Oil (Biodiesel “Feed”)
Summary:

Benefits of HTSD in Extended Applications:

• Versatility

• Reproducibility

• Compares well with traditional Crude Oil HTSD

• Ability to Characterize Cracking