How to update an old Assay

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Agenda

- Haverly Systems Inc
- SimDist vrs TBP – some observations
- Updating an old Assay with H/CAMS
  - Flash Assay Tool
  - Blending crudes
Haverly Systems Inc (HSI)

- Haverly Systems has now been in business for over 40 years. Have been profitable every year.
- Refining & Petrochemical represents 90% of HSI revenues with over a 1000 systems installed worldwide
- Currently offer three main application groups;
  - Crude Assay Management (H/CAMS)
  - Refinery/Petrochemical LP Planning (GRTMPS)
  - Scheduling Optimization (H/SCHED)
SimDist vrs TBP

• TBP Distillation
  – ASTM D2892 uses 15 plate column, 5:1 reflux ratio
  – method only applies to crude oil
  – distillation starts at atmospheric pressure and then switches to vacuum conditions at approx 350 F and continues to 650 deg F
  – remaining charge transferred to vacuum potsstill method – ASTM D5236
  – distillation continues at 0.5 mm Hg to obtain an AEBP limit of 1000-1050 deg F
  – Reproducibility of methods:
    - ASTM D2892 1.2 wt%
    - ASTM D2892 (vac) 1.4wt%
    - ASTM D5236 1.5wt%
SimDist vrs TBP

- **SimDist (HTSD)**
  - HTSD is an ASTM proposed method which is basically an extension of ASTM D2887
  - key difference between HTSD & D2887 is the ability to analyze residue containing samples
  - produces the boiling range distribution of hydrocarbons by gas chromatography up to final temp of approx. 1380°F (750°C)
  - Analysis calibrated by correlating the C5 to C120 n-paraffins elution time to their AEBP
  - Results obtained very quickly (few hours) compared to 2-3 days for physical distillation (D2892/5236)
SimDist vrs TBP

**Some observations**
- There is general assumption that SimDist is the equivalent to Wt% TBP.
  - This is not entirely correct.
- ASTM states that it is “% eluted” (i.e., “% OFF”)
- matches WT% TBP quite well in the middle, underestimates at the front and over estimates yields at the back end.
  - Not consistent however.
- ideal situation is to also do a whole crude DHA (GC) so that the front of the yield curve is well defined
- H/CAMS is very well suited to receive this data since the front of TBP curves are built with a full GC if available
SimDist vrs TBP example - Statfjord
SimDist vrs TBP example - Cusiana
SimDist vrs TBP example – Eugene Island
SimDist vrs TBP example – Arab Medium
Case Study – updating an old assay

• Cusiana Crude
  – Location : Colombia
  – Current Production: 340 kBD
  – Maximum Production: approx. 500 Kbd
  – Field operated by BP Amoco
  – Producers : BP 19%
    Ecopetrol 50%
    TotalFinaElf 15.4%
    Triton Energy 9.6%
  – many problems with local rebels kidnapping employees and damaging pipelines!
Case Study – updating an old assay

- Crude has got 6 API lighter in 5 years
  - due to mixing of Cupiagua crude (43 API) and gas injection

<table>
<thead>
<tr>
<th>Year</th>
<th>API</th>
<th>Sulfur</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>36.25</td>
<td>.25</td>
</tr>
<tr>
<td>1998</td>
<td>39.39</td>
<td>.17</td>
</tr>
<tr>
<td>1999</td>
<td>41.0</td>
<td>.17</td>
</tr>
<tr>
<td>2000</td>
<td>42.23</td>
<td>.17</td>
</tr>
</tbody>
</table>
Case Study – updating an old assay

- 1999 time frame chosen because data for HTSD and a full TBP analysis on the same sample obtained.
- A full TBP 1995 assay and 1999 assay were compared economically in refinery LP model.
- The TBP 1995 assay was updated using H/CAMS Flash Assay tool and compared.
- Assay created by blending of Cusiana and Cupiaga assays together and also compared.
Flash Assay Tool....what is it?

- used to update an existing assay library member
- new Yield and Whole Crude property data entered
- minimum information is a new WC gravity
- yield data can be simulated distillation
- WC balancing property curves adjusted to match new total value
- history of flash entries and changes to assay kept
- Cut data for a *mini* or *short* assay can also be entered
Case Study – updating an old assay

- A complex LP model used describing a “typical” west US coastal refinery
- base case allowed any amount of 1995 assay of Cusiana to be processed. LP model chose to run 823 Mbbl

<table>
<thead>
<tr>
<th>LP analysis using GRTMPS model</th>
<th>Mbbls</th>
<th>Obj Fn (M$)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>1995 assay (TBP)</td>
<td>823</td>
<td>3884</td>
</tr>
<tr>
<td>Case 1</td>
<td>1999 assay (TBP)</td>
<td>823</td>
<td>4357</td>
</tr>
<tr>
<td>Case 2</td>
<td>1995 assay - Flash update with ’99 HTSD data</td>
<td>823</td>
<td>4332</td>
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<tr>
<td>Case 3</td>
<td>H/CAMS blend</td>
<td>823</td>
<td>4280</td>
</tr>
</tbody>
</table>
Case Study – updating an old assay

- Conclusions
  - if the 1995 assay is used in a planning LP Cusiana is being under valued by $0.57/bbl c.f. the more current 1999 quality
  - Updating the 1995 assay with the Flash Assay tool to a 1999 “vintage” compares very closely the actual full TBP assay. Only $0.03/bbl difference
  - Always try to obtain the most representative quality information possible when using crude assay data in a planning tool.