Molecules and Money

The Flash Assay Using Gas Chromatography

Forum: Crude Oil Quality Association
Long Beach, California

Presenter: Peter Spitz, AmSpec
Date: October 5, 2017
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- Rapid Crude Yield Program (RCY)
  - How It Works
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  - Agreement with Physical Assay
  - Near Real Time knowledge in Asset Quality
  - Updating (Flash) Last Assay
- Advantage of RCY and Discussion
- New Technology
AmSpec

the fastest growing INDEPENDENT Oil, gas, and chemical testing, inspection and certification (TIC) Service provider

DEDICATED FOCUS ON THE NEEDS OF THE PETROLEUM AND CHEMICAL SECTORS

FLEXIBILITY TO CUSTOMIZE SERVICES TO MEET CUSTOMER REQUIREMENTS

UNMATCHED SERVICE QUALITY AND RESPONSIVENESS
ENTREPRENEURIAL LEADERSHIP FOCUSED ON GROWTH

Track record of successful branch openings, having added 70+ facilities worldwide since 2010

Transitioned from an Americas-centric TIC vendor to a globally recognized brand while retaining entrepreneurial growth culture

Continued investment in people, processes and technology to support future growth

Expanded technical service offering into additives, calibration and other specialty services

Two Decades of Tremendous Growth

Three Phases of Strategic Platform Development

**Phase I:**
Established reputation in two of the most active U.S. trading ports – New York and Houston

**Phase II:**
Introduced new services to address the needs of demanding customers

**Phase III:**
Expanded network to access worldwide trading volumes

Deep Bench of 2nd Level Management, Including Functional and Technical Experts
AN EMERGING GLOBAL NETWORK BUILT TO SERVE THE CUSTOMER

*AmSpec has invested heavily in the strategic build-out of its network in key geographies*

**NETWORK BUILD-OUT AND FUTURE GROWTH**

- Emerging global network of 60+ facilities across four continents, with access to dozens of regional markets
- Several sites in various stages of development worldwide are expected to accelerate growth in 2017 and onwards
- 6 new greenfield expansions executed in 2016 and an additional 8 domestic and international sites planned in 2017 to increase network density and respond to demand from customers
- Expanded into South America in 2013 via acquisition
  - Currently 2 acquisitions in progress and 2 greenfield expansion plans
- Currently expanding into Europe and Africa through both greenfield and acquisition
  - 4 single site European acquisitions in progress
  - 1 African acquisition in progress with 9 sites
Why Perform Crude Quality Monitoring

Why Perform Gas Chromatographic Flash Assays

- Evaluation of potential crude and crude blends for Valuation and LP Planning
- Evaluation of current crude value vs the benchmark assay valuation (check your position)
- Monitor natural or deliberate changes in crude quality
- Prediction of when to do another physical assay
- Reconciliation of refinery product yield with predicted refinery performance of (existing versus predicted quality)

Additional applications in E&P for reservoir continuity, reservoir communication and cement integrity in multiple zone production oil wells.
Benefits of Rapid Yield (Flash) vs. Physical Assay

- Cost
- Time (2 days vs 2-3 weeks)
- Quality seen near real time for CQM.
- Samples (up to 300 ml) may be shipped passenger aircraft under “excepted” quantity by IATA
- Base for “flash” assay for updating an older assay
How It’s Done

- Front End Detailed Hydrocarbon Analysis (DHA)
  - ASTM D7900 (IP 601)
  - All molecules up to n-C9 (151C) – precursors for isomerization, cracking and reforming
- High Temperature Simulated Distillation (HTSD)
  - ASTM D7169
  - Merged with D7900 data provides accurate yield information.

Allows precise, accurate molecular and yield monitoring of crude oil, condensate, and shale oils.

The global best practice for routine crude quality monitoring
D7900 and D7169
Detailed Hydrocarbon Analysis and Simulated Distillation

Individual molecular speciation of all molecules up to 151C
Gas Chromatography and Physical Distillation

**D7900** Standard Test Method for Determination of Light Hydrocarbons in Stabilized Crude Oils by Gas Chromatography

**D7169** Standard Test Method for Boiling Point Distribution of Samples with Residues Such as Crude Oils and Atmospheric and Vacuum Residues by High Temperature Gas Chromatography

Each molecule moves at differing speed based on partitioning in the mobile and stationary phases based on boiling point.
Gas Chromatographic and Physical Distillation

Often have near perfect agreement
Difference in Physical and Simulated Distillation

But Not Always

True Boiling Point against Merged SimDist
Successive Weekly Sampling Same Crude Shows Variability of Grade

Yield Curve by Rapid Yield Program

2 % dif in 400°F - yield

Sampling 1st Week
Sampling 2nd Week
Gasoline Content, Same Crude, Same Sample Point over Two Weeks

600k bbls

20% Gasoline

RBOB USD 1.83/gal

Change in value with 2% variation gasoline fraction

approx. USD 900,000
Check if a New Assay is Required
Maybe So

Updating Eagleford
Asset Quality

Eagleford
- Developed 2008
- 3.4 billion bbl recoverable
- Highly variable in quality
Use of HCOMET Validating the Rapid Yield

Haverly H/Comet
Netback Report:
Model: Advanced Jacobs LP Model    Ref Type: Avg Gulf Coast Complex Refinery

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Crude Slate (Vol)
- BONNY LIGHT: BONLT335 Vol 80,000
- MARS Blend: MARS292 Vol 60,000
- ARAB MED EXP BLD: ARAMD308 Vol 40,000
- Eagle Ford - 2014 - 44.5 API: EGLFD444 Vol 120,000
- Eagle Ford - 2017 - 46.5 API Flash (Amspec): EGLFRD465_FL Vol -- 120,000 -- --
- Eagle Ford - 2014 - 46.5 API Full TBP: EGLFRD465 Vol -- -- 120,000 --
- EagleFord Gen Grade (Amspec) 2017-49.5 API TBP: EaglefordGen495 Vol -- -- -- 120,000

Validation of the “Flash Assay” updating the 2014 Physical Assay
Same asset grade showing quality variation
Check if a New Assay is Required
Maybe Not

Updating Asset Quality

- Merge
- D7169
- TBP

TBP API 59.9
RCY API 59.9
AmSpec Interlaboratory Study April 2017
Four laboratories, duplicate – eight runs

ILCP Merge Data Overlay
D7900 and D7169

BP °F

Cumulative Mass % Yield
Rapid Yield Program

By Air
• IATA Shipping kits
  • “Excepted” Quantities Used to Minimize Costs
  • 40 ml VOA Teflon septum screw cap vials
  • 300 ml max shipping quantity

By Land
• Normal sampling and shipment procedures.

Provides the “best practice” platform to understand changes in physical assets near real time and relatively inexpensively.
New Technology – the VUV Detector

- VUV may be the most exciting new GC Detector in many decades
- Vacuum Ultraviolet Spectral Analysis may replace many traditional gas chromatographic techniques
- VUV may unlock hydrocarbon type analysis in mid distillate and heavier hydrocarbon fractions
- VUV may have applications in fine chemicals and in upstream – it’s the beginning.
- Researchers in China, India, Europe and the Americas are looking carefully at this technology

AmSpec has been working with this technology for six months expanding the understanding and knowledge of its application.
VGA-100: The World’s First VUV Absorption Detector

D-8071 is the first ASTM Method using this technology which shows equivalence to the D-6839 Multi Dimensional Analysis and other established methods.

- Vacuum Ultraviolet (VUV) Absorption from 120nm to 240nm
- Enables powerful detection capabilities
- Each hydrocarbon compound has a unique absorption spectra in this region.
- Unambiguous compound identification
- Deconvolve of co-eluting analytes
- Clear isomer differentiation
## Light Naphtha Comparisons

### VUV

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### D6730

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### D8071 Conditions

![Chart showing Average Absorbance over Time](chart.png)

- **D8071 Conditions**
### Heavy Naphtha Method Comparisons – Mass%

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VUV and D6839
- Aromatics near perfect agreement
- Total n-alkanes very close compared to DHA
- 6839 may be incorrectly identifying carbon number in naphthene's and iso-paraffins.

D6730-1 (2016)
“5.3 ….. Samples containing significant amounts of olefinic or naphthenic, or both, constituents above octane may reflect significant errors in PONA-type groupings.”
Time Interval Deconvolution Improves Quantitative and Qualitative Analysis

- Naphtha sample does contain significant co-elution
- Unique spectral profiles enable the determination of identities and/or class and relative concentrations of co-eluting compounds
The Rapid Yield is the heart of the “flash” assay and is accepted global best practice for monitoring liquid hydrocarbon assets.

The “excepted” quantity shipment under IATA allows 300 ml of crude oil to be shipped on passenger aircraft, facilitating near real time valuations of assets.

Haverly tools utilizing whole crude properties, molecular data in the gasoline range, and an accurate yield curve allows asset valuation and quality decisions critical to your company.

AmSpec is working with new technologies to advance applications and understanding.

AmSpec is committed to science and our clients.
Thank You

“The AmSpec Way” — DIFFERENTIATED Execution AND Service