Automatic Sampling/Quality Measurement
Crude Oil

Crude Oil Quality Association
San Antonio, TX
March 7, 2013
Crude Quality – Why the sample is important

“A sample is the basis upon which we acknowledge receipt of a crude oil cargo delivery and base our payment.”
- BP Oil Refinery

• Physical evidence
• Statement of faith
• Proof of purchase
• Legal ‘document’
• Fair trade
What defines the Crude Quality?

- < 1.0% of Sediment & Water
- Density,
- Viscosity
- Sulfur content
- Wax content
- TAN
- RVP
- Etc.
Quality Measurement Drivers

- Custody Transfer
- Allocation /Taxation (Royalties)
- Legislative Compliance
- Other
  - System Balance
  - Tariff Incentives

- Quantity ± Quality = Net Batch Value
- Reduce the risk of dispute
Automatic Sampling System Standards

• IP 6.2 1987
• ISO 3171 1988
• API 8.2 1995 (Re-approved 2000)
• API 8.3 1996 (Re-approved 2000)
• API 8.4 1995 (Re-approved 2000)
API 8.2 – Automatic Sampler

A device used to extract a representative sample from the liquid flowing in a pipe that generally consists of a:

• Probe
• Sample Extractor
• Associated Sample Controller
• Flow Measuring Device
• Sample Receiver
API 8.2 - Automatic Sampling System

A system that consists of:

- Stream Conditioning
- An Automatic Sampler
- Sample Handling & Mixing (Analysis)

- Each step contains uncertainty
The Chain of Uncertainty

Pipeline Mixing

Sample Extraction

Sample Collection

Sample Handling and Remixing

Sample Analysis
Crude oil tanks are not homogenous/consistent quality
Mixing different crude oils is not easy

Quote from a ‘tank mixer’ manufacturer’s website

When blending easily miscible liquids of similar viscosities, an agitator will produce satisfactory results. But where there is a significant difference in viscosity between the two liquids, an agitator tends to move the two liquids around without actually blending them together, and it can take a long time to achieve a uniform blend.

MIXING ENERGY NEEDED IS VISCOSITY AND DENSITY DEPENDANT
Pipeline Mixing - Sources

• **Natural Turbulence**
  Elbows, valves, reducers, velocity etc.

• **Mixers**
  Obstructive or dynamic

---

[Diagram showing static mix, power mix, and jet mix]
Basic In-Line System
Fast Loop System
Sample handling

- Minimum number of steps from sampler to laboratory
- Must have a facility for mixing prior to extraction of sub-sample
- Portable receivers recommended for multi batch applications
  - Easier to handle
  - Easier to clean
Laboratory analysis

• Receiver Mixing (API 8.3)
  • Avoid too much heating
  • Sub-sample must remain representative

• Analysis Methods
  • Water - Centrifuge (API 10.3 & 10.4) or Karl Fischer Titrator (ASTM D4928/ API 10.9)
  • Sediment by Extraction (ASTM D473 / API 10.1)
  • RVP (ASTM D4928)
  • Density @ 15oC (ASTM D5002)
  • Salt content by conductivity (ASTM D3230)

• Sample storage/retention
Sampler Location (Pipeline)

SECTION 6—PIPELINE METRING SYSTEMS

Figure 1—Typical Schematic Arrangement of a Meter Station with Three Displacement Meters

1. Pressure reducing valve, manual or automatic (as required)
2. Filter, strainer, and/or vapor separator (as required for each meter or whole station) (optional)
3. Displacement meter and register
4. Thermometer
5. Pressure gauge
6. Check valve
7. Back pressure valve
8. Double block and bleed valve
9. Sampler

Note: All sections of the line that may be blocked between valves should have provision for relief.
Ratio Control Blending

Blend Controller

Flow PID
Ratio PID
Set Point = Flow

What about the Quality?
Quality Trim Blending

Blend Controller

- Trim PID
- Flow PID
- Ratio PID
- Set Point = Density

Mixing & Analyzer Loop

Control Valve

Flow Meter
Quality Trim Analysis System
System Certification Test

• **Water Injection Proving Certification Test**

  • Procedure outlined in API 8.2, Appendix A

  • Designed to prove the entire sampling *system* operates within an acceptable uncertainty

    − Stream Conditioning
    − Automatic Sampler
    − Sample Handling, Mixing & Analysis
Selecting the Right Solution

- In-Line System
- Fast Loop System

What works best ?????
Dead Volume Comparison

Fast Loop System

In-Line System

Minimal batch cross contamination

High batch cross contamination
Long sample line with water trap
Outdoor Installations Need Love, Too!
Look at the hoses!
Selection Criteria

- Measurement Requirements??
- Product Type(s) & Characteristics??
- Site Specifics?
  - Area Classification
  - Physical Layout
  - Available utilities
- Environmental Requirements?
- Material Specifications?
- Operational Requirements?
Operational Considerations

- Institute & follow procedures
- Train operators & third party inspectors
- Monitor performance factors
- Do the preventative maintenance
- Upgrade “old” installations
- Keep good records
  - Maintenance
  - System Performance
Final Thoughts

• Don’t “cherry pick” the standards!

• Think System not Components

• Demand accountability for system performance

• Focus on representivity & handling
  • From “Grab to Lab”

• Install system correctly & maintain it properly

QUALITY is as important as QUANTITY, so… **DO IT RIGHT or DON’T BOTHER!!**
QUESTIONS??

Alan Stearns – Sales Manager, The Americas
Desk: (281) 582 9670    Cell: (713) 449 4236

ADDITIONAL INFORMATION
www.c-a-m.com/jiskoot