SPR Crude Oil Quality

Crude Oil Quality Group
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Acquisition Specifications

- Originally developed in 1975
  - Includes whole crude properties such as density, sulfur, viscosity, and yields
  - Initially, six categories of crude oil, later seven, now two, both 30-45° API
    - Sweet (<0.5% S)
    - Sour (0.5 – 2.0% S)
- Revised several times in response to comments from NPRA, API, industry
- All crude oil for SPR must conform
Near-term quality assurance

- All deliveries analyzed to ensure conformance to specifications
  - At minimum, °API, sulfur, and S&W
  - Periodically, complete inspection done
- Comprehensive assay performed on any new crude oil or one not received in last 3-5 years
Storage strategy

- Similar crude oils commingled
  - Multiple caverns comprise drawdown streams
    - Enhances operational efficiency

- Two segregations at each site
  - Medium gravity sour (33° API, 1.5%S)
    - Dominant component Mexican Isthmus
  - Medium gravity sweet (36°API, 0.4%S)
    - Dominant components Brent/Forties/Ninian
Long-term quality assurance

- Caverns sampled every 7-10 years
- Comprehensive assay performed
  - Analysis format revised periodically in response to industry comments
  - Data entered in H-CAMS
  - Assays available for every SPR cavern
- Assays critical in defining composition of commingled stream
Quality control measures

- Standardized test methods
- Participation in ASTM crude oil ILCP
- Rigorous review of data
- Industry scrutiny
Does cavern storage affect quality?

- Detailed studies have shown:
  - No adverse effect on physical or chemical properties
  - Geothermally-driven convective mixing prevents layering
  - Despite presence of viable bacteria, biodegradation does not occur
  - Some sludge forms, but it is limited in amount (<0.5%)
    - Oilfield chemicals implicated
Other quality issues

- Elevated vapor pressure
- Hydrogen sulfide
- Mercury
Elevated vapor pressure

- Results from geothermal heating and intrusion of gases from salt
  - Some CH$_4$ and N$_2$ observed likely brought in with crude oil
- Stocks may exceed 14.7 psi at delivery point
- Periodic degassing of stocks and use of HX during drawdown minimizes problem
Hydrogen sulfide

- Emissions may exceed permissible levels during a drawdown
- Health hazard and public nuisance
- Scavenger may be necessary during drawdown
  - Tests to commence in February to better define existing levels
Hg: Why the general concern?

- Contributes to increased corrosion rates
- Accumulates in cooler zones of towers, posing health hazard during maintenance
- Poisons catalysts
- Environmental emissions pose severe health hazard
- Subject of API/EPA/NPRA project to “determine the Hg content of crude oil processed in the U.S.”
And, why SPR concern?

- SPR samples requested for study
- Numerous studies have indicated “no reliable analytical technique”
- Questionable methodology of participating labs
- Unknown losses due to volatilization, sorption, & settling during transportation and storage
NIST Hg Technique

ID-CV-ICP-MS has several advantages over other widely-used techniques:

- Ashing system destroys sample matrix
- No need to correct for analyte recovery
- Closed system reduces both contamination and analyte loss
- Lower limit of detection ~50 pg/g

Very good repeatability observed
NIST results

- The ~80 samples analyzed to date include
  - All SPR streams
  - Several cavern sludge samples
  - 12 Canadian streams
  - Numerous domestic & other foreign streams
- Concentration from 0.03 – 10.5 ng/g (ppb)
  - Mean: 1.14 ng/g; Median: 0.51 ng/g
  - All <<< EPA default value of 1.5 µg/g (ppm)
  - Cymric, CA: <2 ng/g
    - Commonly reported as containing 30 µg/g
Depth, ft.

W.H. 9

THg ng/g

0.01 0.10 1.00 10.00

3210 3530 3531
Collaboration with others

- Long-term relationship with LOOP
- Member of international stockpiling committee with 18 other countries
- Biennial customer service visits with refiners and traders
- Participation in industry forums
Questions?