COQA Conference June 2013

Opportunity/Non Conventional Crudes
Good News?
Sometimes Unexpected Surprises!
Good News?

- Opportunity/Unconventional Crudes can mean making lots of money while spending less
- Opportunity crudes
  - High sulfur / heavy / synthetic / contaminated/ dumb bell/variable quality
    - Lower price
  - In-house unconventional Crudes – ours not theirs
    - For example Shale oil
- Shale oil - Good News
  - Back out expensive crudes
  - Allows feeds to be processed such as Canadian Synthetic Crudes
  - Major Impacts can be predicted with planning tools and simulation tools such as Petro-SIM™
  - So do we need to worry about anything?

™Petro-SIM is a trademark of KBC Advanced Technologies plc, and it is registered in various territories.
Example - Shale Oil

- Low Sulfur and Indigenous
  - Naphtha/diesel yield is increased
  - Bottoms yield is reduced
  - Diesel poor cold flow property issues that are fixable
  - Allows poorer quality feeds to be processed
    - Paraffinic so watch out for incompatible mixes

- All aspects predictable using models such as Petro-SIM/Incompatibility tools
  - Main issues appear related to transportation and variability
  - So what should we worry about? Yields/Chemicals/Solids, etc?
Condensates and Naphtha

- Diluent and shale oil have increased the quantity of naphtha in refineries
- While reducing the quality of the reformer feed
- Naphtha/light end balances are becoming increasingly constrained
  - Will put additional pricing pressure on shale/tight oils if current production and processing trends continue
- Alternative processing schemes should be considered to maintain gasoline volumes within country?
- Main factors affecting the future markets include
  - Increased NG price resulting from
    - Export of LNG from the US
    - Coal fired power plants converting to NG
  - Price of shale oils relative to other light sweet crudes
  - Environmental regulations on hydraulic fracturing
Shale Oil Issues

Low Cost Natural Gas

Problems with cold flow properties

Lower octanes/yields

Low Utilization

Low Yields

Waxy, Fouling

Crude Feedstock

Crude Tower

Vacuum Tower

FCCU

Coker

Utilities

Utilities to Units

Hydrotreated Naphtha

FCC Naphtha

Alkylation

Reformate

HT Jet

HT Diesel (ULSD)

Synthetic Jet/Diesel

Cutter Stock for Fuel Oil

Fuel Oil Pool

Oil Movement and Storage (OMS)

Coke

Crude

Desalter

Middle Distillate

ATM Gas Oils

Naphtha

Diesel DHT

Kerosene DHT

HT Diesel

Vacuum Resid

Coker Gas Oils

C3s and C4s

FCC Gas Oil

CFHT

GCHT or HCU

Vacuum Gas Oils

FCC Gas Oil

Naphtha

Vacuum Ohds

Wild Naphtha

Wild Naphtha

Vacuum Resid

Atmospheric Resid

Coker Gas Oils

C3s and C4s

Coker

Cracks well

High olefins

Low Rate
Shale Oil Naphtha Yields Impact

- One Issue is high yield of paraffinic Naphtha and high LPG Yield
  - Lower aromatics production at a constant reformer conditions
  - Lower reformate yield and H2 production
  - Increased LPG production
  - Some refiners are beginning to see this effect
    - Impact smaller at reformer as severity already turned down in many cases

- Naphtha prices
  - Will want to minimize production
  - Exports already impacting Europe
Opportunity/Unconventional Crudes - Reliability issues hidden till later

What else should we worry about?

• Shale Oil/Opportunity Crudes/Synthetic mixes may have reliability issues
  ▪ High metals such as Ni/V/Arsenic/Si – some less common
  ▪ High chlorides (organic?)
  ▪ High solids like clays may impact desalting
  ▪ Compatibility issues when crude/residue high in paraffins, low in resins
  ▪ Requires more chemicals upstream to deal with extractions and downstream to deal with contaminants entering the refinery
    - Plus more issues with unconventional /Syncrude co-processing

• A highly profitable mix of Shale Oil and Synthetic crudes for example may contain a complex well/transport additive cocktail
Naphtha and Diesel Hydrotreaters may have exchanger leaks and tower corrosion/fouling

- Salt and Chloride corrosion
  - One cause is often organic chloride source corrosion
    - Crude (extraction chemicals, H2S scavengers?)
    - Onsite organic chlorides (amines once they react with HCl are also essentially organic chlorides)
      - Often treated again and again

- Reactor Fouling
  - Fine solids
  - Corrosion products
  - Chemical precipitation

- Unexpected catalyst activity loss
  - Silica, arsenic, now more metals reappearing like lead

- Tower fouling
- Solids/precipitated chemicals from feed system
A Cross Section History of Fouling

Multiple issues of inorganic precipitation and fines

Sometimes something new – sometimes something typical
Things are not always what they seem

- Top – black oily sludge
  - 95% FeS

- Bottom - black oily deposits
  - 95% Coke
Prepare for the Unexpected

• Increase unit monitoring
  ▪ Normalized system delta p
  ▪ Monitor Fractionation Deterioration
  ▪ Check likely corrosion locations

• Analyze feed qualities more frequently

• Complete Material balance of key contaminants around units

• Improved analyses of foulants and location and look for real root cause in RCFA
  ▪ Develop sample analysis protocol

• Expand Monitor of Waste waters - chemicals used may not contaminate at origin source water but could impact effluent/sour waters e.g. Mercury
Mitigate / Prevent the Potential Issues

- Calculate salt precipitation/high velocity locations
  - Not just at crude unit
  - Real time monitoring
  - Anywhere there is water

- Estimate contaminant build up on reactors

- Improve hydrocarbon water separation and water washing
  - Will help avoid multiple corrosion/treating

- Optimize use of contaminants traps
  - Minimizes chemical usage
Maximize Value of Opportunity/Unconventional Crude processing

• Good Prediction and Mitigation of unexpected problems will maximize Opportunity/Unconventional Crude Profits
  
  ▪ Set up Good modeling/Simulation of unit operations with new Crudes with tools such as Petro-SIM
  
  ▪ Improve monitoring of feeds and downstream process streams and equipment
  
  ▪ Carry out effective Equipment Foulant RCFA (Root Cause Failure analysis) and deposits analysis protocols
Questions?