MILESTONE
Heater Fouling Control

2006 Coking.Com Seminar
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Agenda

- Overview of MILESTONE Technology
- Performance and Economic Benefits
- Technology Development History
- Case Histories
- MILESTONE Differentiators

MILESTONE is a trade mark of Baker Hughes Incorporated
MILESTONE Heater Fouling Control

Advanced Process Heater Fouling Control Technology

- A new fouling control program developed for high severity resid heaters but also applicable to crude, vacuum heaters
  - Outstanding commercial successes
- Novel, multi-component fouling control solutions
  - Custom designed based on feedstock characterizations and comprehensive fouling root cause investigations
  - Proprietary feedstock characterization methodologies
  - Extensive feedstock property benchmarking database

MILESTONE Performance Benefits

- Maintain maximum unit throughput, where unit is heater capacity-limited
- Process higher rates of lower cost heavy crudes, where refinery is bottoms processing-limited
- Maintain maximum unit distillate yield/conversion, where heater outlet temperatures are reduced during a run to maintain target throughput
- Reduce fuel consumption
- Reduce heater tube de-coking costs
### MILESTONE Economic Benefits

**Value of incremental unit throughput**
- Typically largest benefit of fouling control
- Ranges from $15 - $30/barrel coker feed
- 2% throughput loss on average coker = $6 million/year

**Fuel cost savings**
- Typical 40 MBPD coker uses 200 MMBTU/h fuel
- 2% fuel savings @ $8/MMBTU = $280 K/year

**Maintenance / de-coking cost savings**
- $50K per heater side for pigging services
- 50% reduction in cleaning costs typically $200 K/year

Current customers achieving minimum 10:1 return

### MILESTONE Development History:
Bench Scale Investigations

**Successful Heater Fouling Control Programs Must...**
- Withstand high temperature at tube wall surface
- Polar alignment to active coking sites
- 3-D blocking to hinder coke formation
- Asphaltene solubilization or stabilization
- Disperse inorganic particles
MILESTONE Development History:
Bench Scale Investigations

MILESTONE Technology Functions in Two Ways:

- Reacts with metal surfaces to reduce reactivity
- Acts to stabilize compounds in the feedstock to inhibit precipitation of unstable compounds

MILESTONE Development History:
Pilot Scale Demonstrations

JIP – Joint Industry Project, Using Department of Energy (DOE) Pilot Delayed Coking Unit (U. of Tulsa)

- Investment by major refiners to study coker operating variables, including coker heater fouling
- Pilot unit studies confirmed suspected heater fouling mechanisms
- Pilot unit tests also confirmed efficacy of Baker Petrolite fouling control technology
MILESTONE Case History 1

Problem: Severe Coker Heater Tube Fouling
- 5 - >10°F/day tube skin temperature increases
- Dropped heater outlet temperature 8°F to control tube skin increases to 10°F/day
- Tube pigging on rotating basis every 2-3 weeks, requiring throughput reductions

Results
- Record unit run lengths
- Tube skin temperature increases held to less than 1°F/day
- Increased heater outlet temperature by 50°F
- Pigging/cleaning procedures reduced dramatically
- Throughput increase over 1%

MILESTONE Case History 2

Problem: Coker heater convection section tube fouling
- Firing limited by tube skin temperature limits
- Fouling in all four heater tube passes
- Do have steam spalling capability

Results:
- Over 20% increase in unit throughput
- Over 50:1 payout on program investment
MILESTONE Differentiators

New, novel approach to heater fouling control

• Developed by Baker Petrolite technologists
• Proven effective in independent JIP study on DOE pilot scale coker at University of Tulsa
• Commercial applications have confirmed results of bench scale and pilot scale evaluations
• MILESTONE technology controls fouling due to:
  ➢ Thermal degradation of oils
  ➢ Asphaltenes destabilization
  ➢ Catalytic effects of feed metals and equipment surfaces
  ➢ Precipitation of solids

MILESTONE Differentiators

Proprietary methodologies used to select a custom fouling control approach for each application

• Coker Stability Index (CSI) test
• Analysis and evaluation of feedstock component ratios
  ➢ Saturates, aromatics, resins, asphaltenes
• Deposit analyses

Assures high probability of program success

CSI Coker Stability Index
Furnace Feed Stability
MILESTONE Differentiators

- Coker feedstock properties benchmarked vs. information in Baker Petrolite data base
- Proprietary fouling control product application methods
- Proven program performance!

Questions

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