

MILESTONE Heater Fouling Control

2006 Coking.Com Seminar

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South Shore Harbor Resort

League City, TX

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MILESTONE Heater Fouling Control

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

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Baker Petrolite

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 Heater Fouling Control

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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



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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

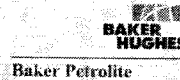


Baker Petrolite

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



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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



Baker Petrolite

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

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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
 - Asphaltene destabilization
 - Catalytic effects of feed metals and equipment surfaces
 - Precipitation of solids

MILESTONE Differentiators

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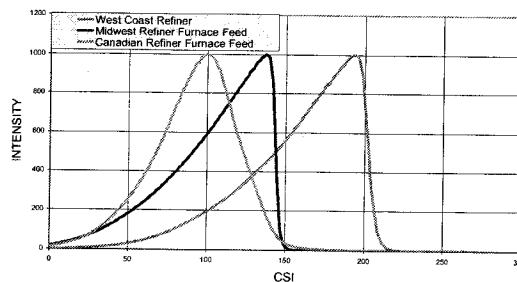
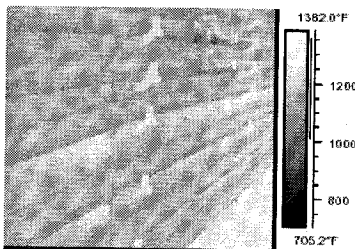
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Proprietary methodologies used to select a custom fouling control approach for each application

- 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

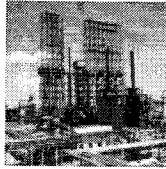


MILESTONE Differentiators

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- 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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