Non-Traditional Refinery Preheat Fouling

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Timeline

- Light sweet crude refinery, historically no heavy sour injection
- 12/2010 - Started <10% Canadian crude (WCS/CLK) injection.
- Quickly recognized decrease in heat transfer in critical heat exchanger, final desalted crude.
- Cleaning cycle decreased 10X, from 24 months to 2.5
- Troubleshooting begins…
Initial Indication of Increased Fouling
Material was believed to be asphaltenes, had coked in tubes.

Observed increased rag draw on desalters, not alarming.

Pursued treatment options
  – Anti-foulant / asphaltene stabilizer injection downstream of desalter.
  – Injected stabilizer into heavy Canadian receipt at pipeline pumping station prior to blending with WTI for viscosity reduction.
• WTI and CLK included in sample set to evaluate stability test methods.
• Many methods showed same results, HOC discontinued pursuing a common method.
• HOC attempted to determine a correlation between compatibility and fouling.
• Traditional belief that fouling rate is related to asphaltene content, or stabilization of the asphaltene.
● WTI and CLK tested individually on Alcor HLPS for baseline fouling rate.
● Found WTI fouled worse than CLK, blend tests halted.
● HOC concluded that compatibility methods could not be used to predict fouling.
Conventional fouling should continue to worsen through the preheat circuit as temperature is increased.

- No fouling observed in preflash crude exchange or heater.
- All other crude heaters foul to some degree.

Fouling rate is related to % asphaltene.

- Alcor fouling of other refinery slates inversely proportional to asphaltene content: 0.6 > 1.1 > 3.4%
- Confident all asphaltenes are destabilized in 1.1% slate.
Fouling of Light Sweet Crude - 2010
Preflashed Crude – Light Sweet Crude w/ Heavy Injection
Preflashed Crude - Light Sweet Crude

![Graph showing the temperature change over time at different temperatures (200 C, 300 C, 400 C) as a function of time elapsed (0 to 5 hours)].

- Red line: 200 C
- Green line: 300 C
- Blue line: 400 C

The graph indicates that the temperature change increases with time and temperature, with 400 C showing the most significant increase compared to 200 C and 300 C.
Fouling of unit with 10% asphaltenes (destabilized) stops at desalted crude exchange.

Light sweet refinery fouls worse, through the heater.

Fouling rate from Alcor inversely proportional to %C7 isol.

Another fouling mechanism occurring in today’s light sweet crudes?