Question 37: Do you extend the time between de-coking the furnace by cutting coil outlet temperature or cutting furnace charge? How often are spallings done in coker furnaces? What is the temperature recovery after spalling?

MICHAEL KIMBRELL (Becht Engineering)

Heater fouling is dependent on several variables that include the process film temperature, residence time at temperature and coke precursor concentration. I like to target a coke drum outlet temperature of 825°F before quench injection, which normally requires a Coker heater outlet temperature of 925°F. Lowering the heater outlet temperature will reduce the process film temperature which will reduce the fouling rate. It will also reduce the coke drum outlet temperature which will result in a higher coke yield and fewer liquid products. I recommend keeping the coke drum pre-quench outlet temperature above 815°F as an absolute minimum. This would translate into a Coker heater outlet temperature of approximately 915°F. The lower outlet temperature will result in a lower firing rate which will lead to lower process film temperatures. Heater fouling is exponential in temperature, so a small reduction in the film temperature should result in significantly longer heater run lengths. If the unit is coke drum capacity limited, then lowering the heater outlet temperature will require a reduction in unit throughput. The run length of the heater must be balance against the loss in liquid product yields and unit capacity that occurs when the heater outlet temperature is lowered.

The time between spalls on Coker heaters is very dependent on the issues described above. The time between spalling ranges from 60 to 90 days on one end of the spectrum to six to nine months on the other end. There are examples of shorter and longer times, but the range of 90 to 120 days would be a reasonable estimate. Typically, the allowable increase in tube metal temperature is approximately 200°F (from 1000°F at the start of run to 1200°F at the end of run). At a fouling rate of 1°F per day, the time between decokes is 200 days or just over six months. At a fouling rate of 3°F per day, the time between decokes is 65 days. Typical Coker heater fouling rates are in the 1°F to 3°F per day range. As I stated earlier, there have been higher and lower fouling rates recorded.

A good on-line spall will result in tube metal temperatures returning to start of run temperatures or nearly so. Post spall tube metal temperatures of 1000°F to 1050°F are expected.

SAM LORDO (Consultant)

If H2S scavengers are going to impact a Coker it would be in two ways, depending on the classification. One way is due to amine loading that could result in amine salting in the upper section of the main fractionator. This would be from amine triazine type products. Some of the amine byproduct from the triazine would come from the Coker feed if it is preheated thru the main fraction tower bottoms.

Another impact would be from additional solids loading if the H2S scavenger is a metal salt type (e.g., Zn, Fe). If there is a Coker feed desalter then desalter design and desalting aid used must account for the inject solids which can result in stabilized emulsion. Solids removal via chemicals designed to address the sulfide salt or a cuff draw can be used.

EZEQUIEL VINCENT (KBC)

(Part 1 of Question)

The Coker heater approach to spalling should be controlled with changing the pass flow rate. This becomes more of importance if all passes foul with the same F/day such that the spalling of the passes can be staggered.

If you want to adjust the rapid fouling of one pass only, then the temperature of that pass may be reduced but with compensating by raising the temperature to the other passes in order to obtain the same heater outlet temperature (to provide enough heat to the coke drums). Cool drums generate more coke yield (which is generally undesirable in a fuel coke production) and even worse may promote hot spots or a foam over.

The heater balancing from pass fouling perspective should not be done early but towards the end of run. Unless temperature indicators are very reliable, the flow should be adjusted first. Changes in pass flow rates linearly impacts the fouling while the temperature changes have an exponential effect on pass fouling.

(Part 2 of Question)

Spalling is generally done every 12 days for bad fouling rates to 6 months for good operation with a typical 3 months between spalling.

(Part 3 of Question)

The recovery temperature after the spalling should be same as the original start of run (SOR) temperature. Failure to reset to the SOR temperature means the spalling was not efficient (not enough thermo-cycles or not enough spalling medium) or it may be a sign of inorganics presence that can only be removed using pigging as the decoking method.

(Other general observations to add on this Question)

Heater spalling rates are dependent on the processed crude slate, Coker feed contaminates, heater design and unit operating philosophy.

The two main reasons for the Coker heater decoking are:

- Some heaters run to a coil inlet pressure limitation, but the number of these units is small.

- Most of the heaters run to a maximum allowable tube metal temperature (TMT).

The fouling rates are highly dependent of the type of crude slate being processed. Crude compatibility dictates the probability of asphaltenes dropping out of “solution” (or flocculating) as temperature rises (this is extremely important when mixing asphaltenic and paraffinic crudes). This asphaltene flocculation is, in large part, a cause for fouling of the tubes as the molecules deposit on the tubes’ surface and, due to the high temperatures, get dehydrogenated and turn into coke.

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