Question 72: When replacing coke drums with larger diameter drums, what process and operational changes do you expect?

Jeff Lewellen (HollyFrontier)

In 2009, we completed a group of projects at El Dorado involving larger coke drums and a deep cut vacuum tower. The coke drum project limited the scope to drum replacement with minimal changes to the balance of the unit. Some of the more significant changes to the unit included:

Fractionation/Wet Gas Systems -

• Higher wet-gas volumes due to higher coke yields.

• Larger swings in gas rate due to drum switching activities. Unit Operators reported this was a significant change in operation.

• Some shift in liquid product yields affected by slightly lower drum pressures, lower drum outlet temperature, and longer drum cycles.

Charge Heater -

• Lower outlet temperature and fired duty requirements to achieve target VCM/coke quality. This is mostly influenced by longer drum cycle times, and less HGO in the feed.

• Increased tube fouling rate leading to shorter times between heater tube decokings.

Drum and Drum Cycle -

the drum volumes approximately doubled with required cycle length extending from 12 to 18 hours.

• Drum superficial velocity decreased with drum diameter, which improved carry-over and entrainment issues (no significant pressure changes).

• The reduced velocity also decreases foam height. However heavier feed and lower drum temperature created more stable foam that can be difficult to collapse.

• The large drums also lengthen drum air freeing, pressure test, and warm-up cycles.

Quench/Blow-down Systems - Our modifications to this system were limited to additional quench pump and air cooler/condenser capacity. The quench tower was also reconfigured with limited success.

• More quench water needed leading to more storage (surge capacity)

• Higher sour water production – proportional with coke yield

• Higher off-gas rates

• More quenched oil/slop from the system

• Marginally sized quench system struggles.

Coke Storage and Handling - We replaced railcars with a feeder-breaker/conveyor system due to logistics of the additional rail and cars. The heavier feed also shifted our coke to much more shot coke production leading to more drum fallouts that are difficult to manage with a railcar system.

• Greater surge volumes are needed in the

o Pit/slab/bin storage area

o Crusher/slurry pump, feeder-breaker/conveyor, or bridge crane/loader systems

o Shipping logistics – railcars, truck, barge

Jet Pump/Cutting system – We operated for several months with the original low pressure/volume jet pump system until the new unit was delivered and installed.

• The smaller jet pump/cutting system led to a significant increase in coke fines to the jet pump system due to extended cutting times. Cutting times more than doubled from previous drums. Extended cycle times or unexpected feed changes led to even greater cutting durations.

o Significant reliability problems developed from erosion issues in the decoking valve, cutting tools, and eventually the jet pump.

o Restrictions in instrumentation and small-bore piping from the additional coke fines.

• After the jet pump/cutting system upgrade was complete, the reliability and the operation of this system improved greatly. However, some of the changes impacting this operation include:

o Decoking rates are limited by bottom unheading device/dump chute plugging limit. Cutting rates are higher in tons per hour, but duration remained longer than the smaller drums.

o the longer cutting times (and potentially changes in feed and coke handling) led to more fine's generation than original drums. However, much improved over the previous 6 months.

o Retrofitted additional settling/fines separation capacity to improved water quality.

Gary Gianzon (Marathon Petroleum Company)

The larger drum can take longer to quench and cut assuming that your blowdown system and cutting water system are not designed for the larger drums.

Eberhard Lucke (Commonwealth E&C)

The extra capacity gained by installing larger diameter coke drums can be used by either increasing the unit throughput or by taking advantage of a longer drum cycle time at the same unit charge rate. Due to the larger diameter, steam stripping and quenching can be more challenging and the probability of hot spots may increase. Before installation of larger diameter coke drums special attention has to be paid to the jet pump pressure. If the jet pump discharge pressure is lower than the recommended pressure for the new coke drum diameter, coke cutting will take a lot longer and will create significantly more coke fines due to the grinding effect of the broader water jet. Jet pump and drill/cutting tool may have to be replaced or revamped to ensure proper coke cutting. Also, the capacity of the coke handling system – pit, pad, attached breaker or feeder-breaker system, slurry system – receiving a larger amount of coke has to be checked for adequate capacity.

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Vacuum Tower

Year

2011