Troubleshooting Process Operations

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On many crude units, steam stripping of naphtha, kerosene, and furnace oil appears adequate. On the other hand, stripping of FCCU feed is frequently poor. Figure 1.5 shows the effect of stripping. Hydrocarbons boiling below 500°F belong in naphtha reformer feed or kerosene, not in the FCCU charge.

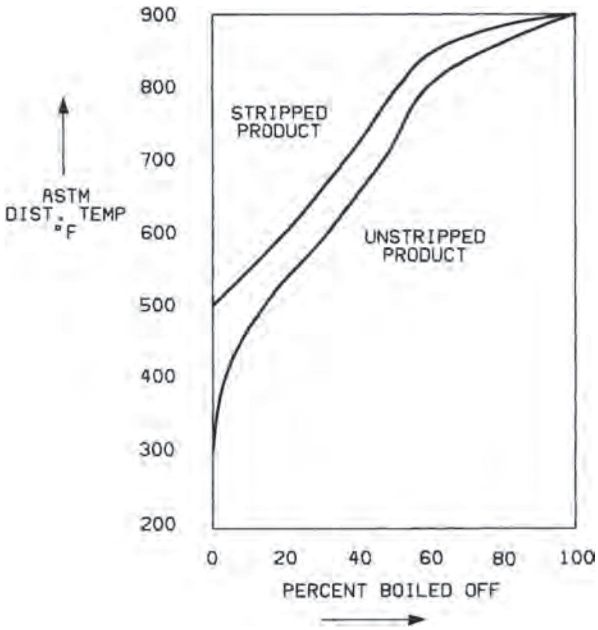

Figure 1.5. The effect of steam stripping.

Obtain a sample of FCCU feed produced at the crude unit. Run an ASTM atmospheric distillation. Ask the lab technician to stop the distillation at 680°F; this avoids thermal cracking. If more than a few percent is distilled off below 500°F, examine the operation of the FCCU feed stripper.

Causes of inadequate stripping

Several reasons have been observed for inefficient stripping. Operators note correctly that preheat is improved and steam is saved by minimizing stripping steam. However, far more energy is wasted by unnecessarily running naphtha and kerosene through the FCCU.

Perhaps someone has retrofitted the stripper feed to preheat crude before it flows to the stripper. This is a good energy-saving scheme for the crude unit; however, a steam stripper will not work on subcooled feed. The feed must be at its bubble point (i.e., the tower drawoff temperature). Otherwise, the steam will not be an effective stripping agent.

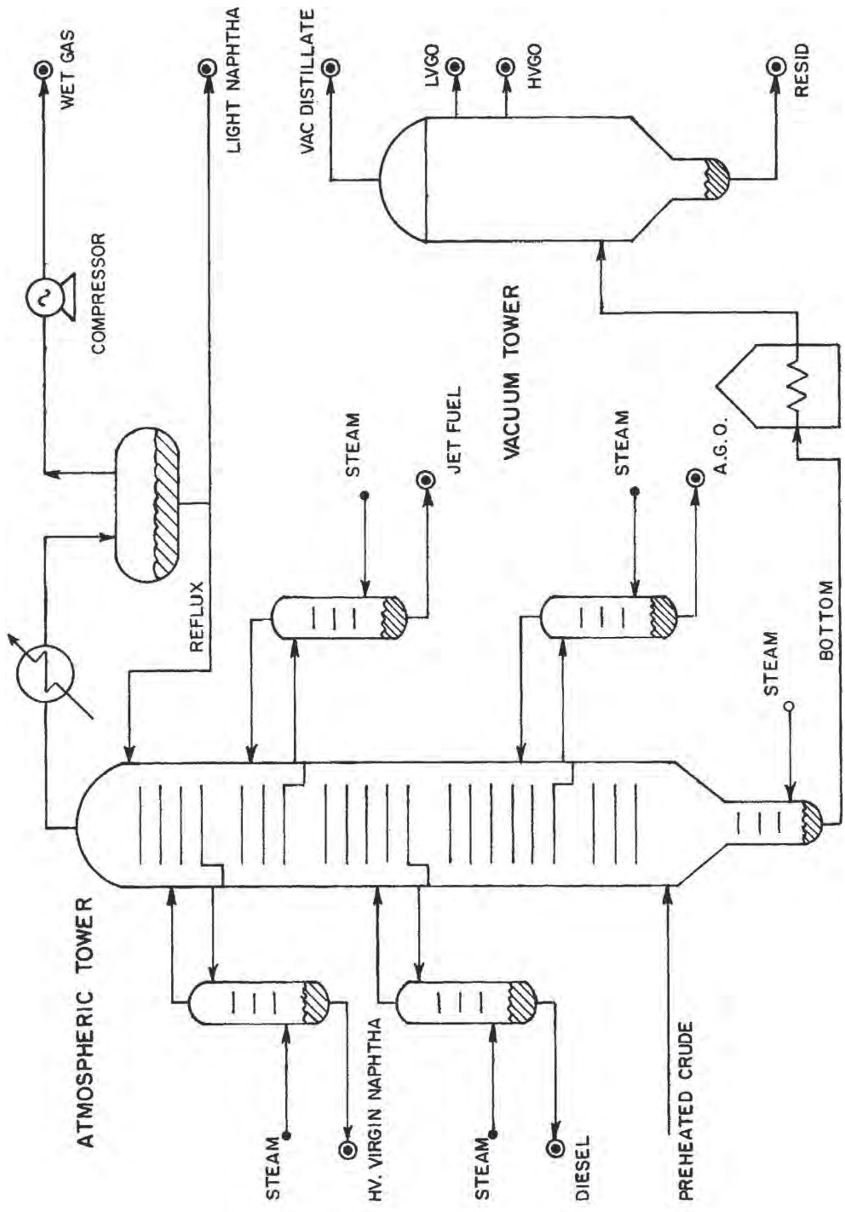

Figure 1.6. A crude unit with side-stream strippers.

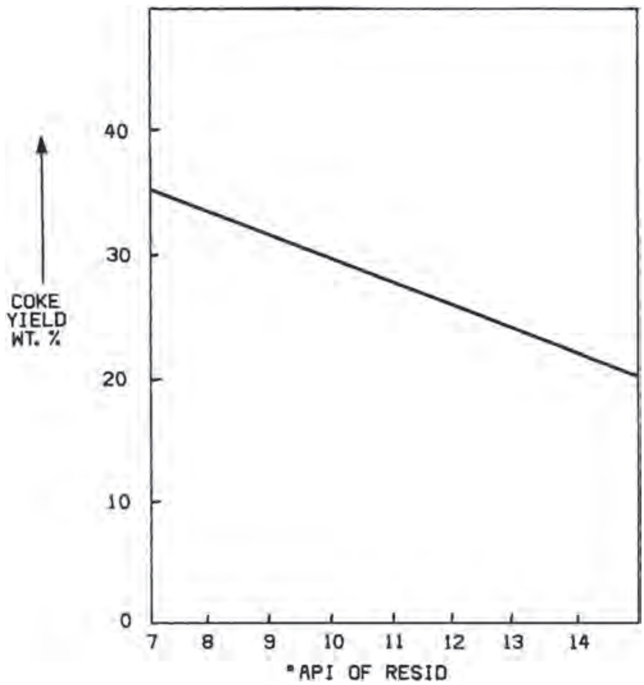

Figure 2.4. Lower gravity charge will quickly fill a coke drum.

When switching feed out of a full coke drum into an empty drum, the pressure on the full drum will drop. Experienced operators carefully observe the pressure on the full drum during a switch. Allowing the pressure to drop too rapidly will start a foamover. A drop of 1 or 2 psi every five minutes is about right. The top radiation level indicator will show when a foamover starts during the feed switchover. To stop this foamover, the vapor valve on the full drum should be pinched closed until the drum pressure rises a few psi.

This all shows the importance of examining the coke drum pressure recorder chart when troubleshooting a foamover. This chart is analogous to the fingerprints left at the scene of a crime. The process engineer should be able to tell from the pressure recorder the portion of the drum cycle that was taking place at a given time.

During steaming, a full drum may suddenly start to carry over. At this point in the cycle, the coke drum overhead is usually lined up to the blowdown or quench system and not to the combination or fractionator tower. Since several pairs of coke drums may be served by a single blowdown system, a carryover into this system can incapacitate an entire coking complex.

A full coke drum that has been produced at an overhead vapor temperature of 770˚F or less will have 5 or 10 feet of partially coked resid lying on top of the

8. The first pass of the cutting head should enlarge the pilot hole to 4-5 feet in diameter at the top of the coke bed (with water flowing on both the downstroke and the upstroke).
9. Make two more passes with the drill stem turning at 8-10 rpm. After the third pass, the level of coke in the drum will be reduced by about 20 feet. This means that, to save time, the cutting head should not be raised to the original starting point after each pass. Gauging the residual level of coke in the drum can be done by observing the evolution of steam from the top head. If no coke is being cut and no coke is falling through the drum, steam evolution will increase. Experienced operators can also note the sound of water striking the metal sides of the drum, indicating coke has been removed from that level in the drum.
10. The fourth and subsequent passes should be made with the drill stem readjusted to rotate at 6-8 rpm. Reducing the head rotation speed keeps the tangential velocity of the water jet at the coke interface at a relatively constant value as the coke wall approaches the drum wall.
11. In a typical operation, four to six more passes will be required to fully remove the remaining coke. Each of these remaining passes will take about 10-12 minutes.
12. After the last cutting pass, a tough ring of coke, several feet high and several feet above the bottom of the drum, will adhere to the drum wall. This can be removed using the high-energy jets of the combination tool. This generally takes only a few minutes. With other head types, this layer has to be removed by grinding.

The procedure depends on a good source of clarified water supply to the cutting head and frequent inspection of the cutting nozzles for wear.

The procedure will reduce cutting time for large coke drums making primarily fuel-grade coke. Field experience indicates that the procedure can decoke drums containing up to 1,000 tons of green coke in about two hours.

Heading up

As soon as the cutting water pump is shut down, the decoking crew immediately begins replacing the top and bottom heads. Both heads must be worked on simultaneously. Flange surfaces are prepared while the coke cutting is in progress. On this basis, heading up the coke drum and reconnecting the resid feed line takes about 30 minutes, assuming the last section of resid feed-line piping is integral with the bottom head.

Hot coke

If a refiner is to operate on a short coke drum cycle, he can expect to encounter pockets of hot coke that the drum cooling water has not had time to quench. During

Troubleshooting Checklist for Delayed Coker Cycle Problems

Foamover Effects

High coke drum pressure

Plugging combination tower bottoms screen

Coked heater tubes

Coke lay-down on trays

Plugged blowdown system

Foamover Causes

Incompletely drained coke drum

Low overhead vapor temperature

Erroneous foam level indication

Failure of silicone antifoam system

Overfilling drums

Pressure surges

Foamover during steaming

Putting a drum on circulation

Caustic in coker charge

Coke Quality

High volatile combustible matter

Coke too hard

Drum overhead temperature

Time and pressure affect hardness

Shot coke

Needle coke

Long Coking Cycles

Watch full drum pressure during switch

Use little water instead of big steam

Add quench water to hold maximum drum pressure

Avoid plugged steam inlet nozzle

Steam purge through separate vent

Aggressive use of the warm-up valve

Plugged condensate drain line

Coke Drum Warm-up Condensate Recovery

Do not send to refinery slop

Wet condensate to FCCU feed

Hot condensate to combination tower

Green wax plugs system

Environmental effects

Venting to atmosphere