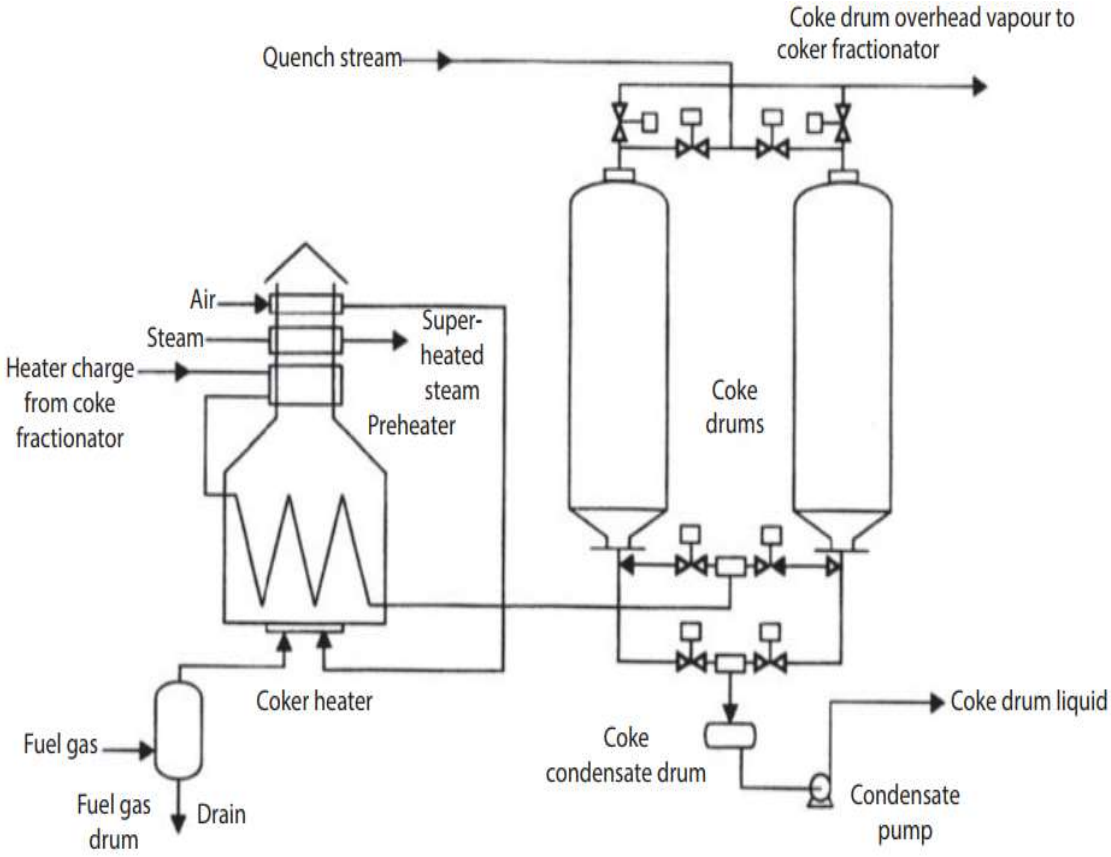
Thermal Cracking Processes Coking

Coke Drums

Lecture 14

Coke Drums

- Vacuum residue from **VDU** is preheated in preheat exchangers against heavy coker gas oil **HCGO** and heavy coker gas oil pumparound and passes through the fractionator boot where it is heated by mixing with the heavy fractions, and the resulting heater charge enters the coker heater coil at a high velocity.
- Steam is introduced into the coil **which prevents coke deposition in the coil.**
- The hot and partially vaporized mixture enters the coke drum. The coke drum is charged with the hot mixture to **1/2 to 2/3** of the height of the drum.



How does the hot-mix level measured in the coke drums?

- The level of the hot-mix in drums is measured and controlled by a cathode-ray monitoring device.

What is the time required to charge the drum? What will happen after the after the charging is complete?

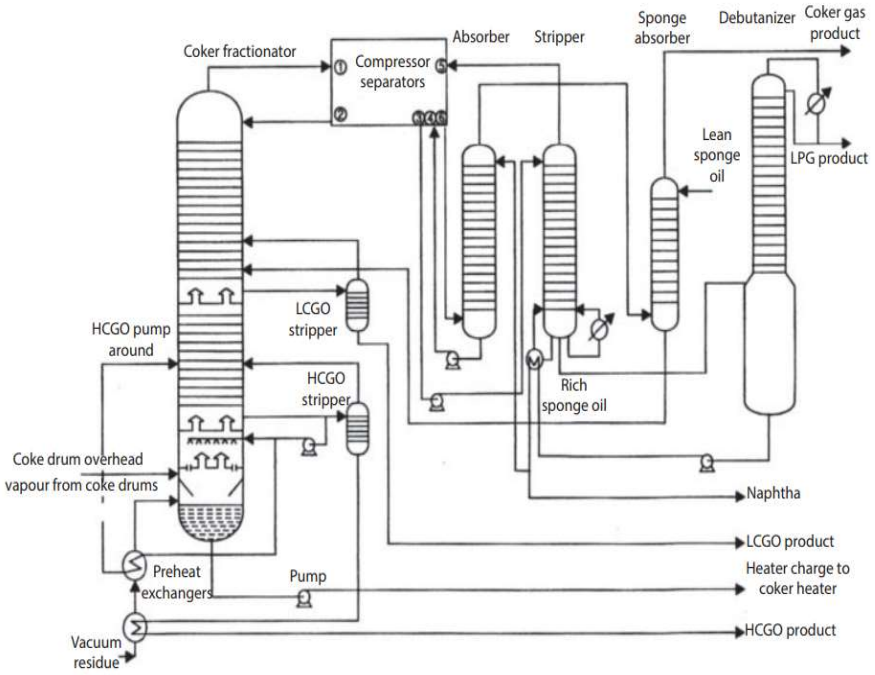
The charging of a coke drum may require a period of 4–5 hrs. Once the charging is complete, the drum is isolated from the stream. Effluents of the coke heater are then switched to the second drum.

What is the time required for the coking?

- Coking is a slow process, and it usually takes a period of 10–16 hrs. The time of charging coke drums must balance the time of coking and decoking operations.

Explain the process of coking?

- The feed is mixed with the stripped liquid (internal recycle) at the bottom of the coker fractionator. This recycled stream is heavier than the heavy coker gas oil and condenses in the wash section of the column.
- The mixture is referred to as the heater charge. The introduction of relatively cool coker feed into the fractionator bottom reduces the tendency of coke formation in the column bottoms.
- Fractionator bottoms liquid level is maintained by regulating the flow rate of coker feed from the coker feed drum.
- A side stream of fractionator bottom liquid is continuously circulated through the fractionator bottoms strainers by the fractionator bottoms recirculating pump to remove the coke fines.



Process continues…

- The coker heater charge is pumped by the coking heater charge pump, as **the primary function of the coker heater is rapidly to heat the feed to the required reaction temperature while avoiding premature coke formation in the heater tubes.**
- This steam is used for stripping light coker gas oil (LCGO) and heavy coker gas oil (HCGO).
- The coker heater combustion air is also preheated against flue gas in the convection section to increase efficiency.
- The coker heater is fired with fuel oil or fuel gas or combination of both fuels.
- A heater fuel gas drum separates any condensable liquids in the fuel gas before they reach the coker heater.

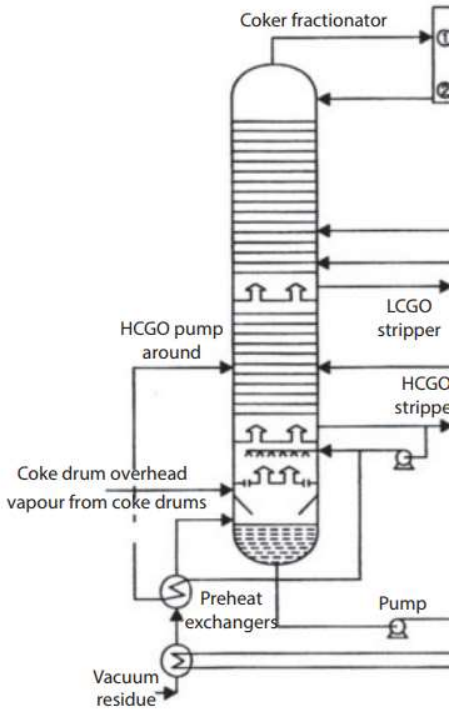
Some important points about the coke drums

- What is benefit of using two-heater configuration in the coke drum?
  - A two-heater configuration would allow offline decoking of one furnace without having to shut down the entire unit.
- The coke drum feed leaves the heater at ~ 1040 °F (506 °C) and 4.0 kg/cm2. The coke drum inlet switch valve diverts the hot coker feed to the bottom of the filling or coking mode coke drum.
- In the coke drum, the hot feed cracks to form coke and cracked products. Each coke drum is filled in a 24-hour period.

- Why we need to use an antifoam chemical into the coke drums?
  - An antifoam chemical is injected into the coke drum to prevent foam going into the coker fractionator.
- How we can prevent the coke formation in the coke drums?
  - The cracked product leaves the top of the coke drum at 842 °F (450 °C) and 1.05 kg/cm2, which is quenched to 799 °F (426 °C) or less with heavy coker gas oil to stop the cracking and polymerization reactions, and thus to prevent coke formation in the vapor line to the coker fractionator.

Fractionator column

- The fractionator column of 24 trays and a spray zone divided into two major sections by the heavy coker gas oil (HCGO) draw pan.
- The quenched coke drum effluent vapor flows upwards through the spray chamber, with some degree of cooling accomplished by contact with HCGO wash liquid.
- The heavy recycled liquid is condensed and collected on the wash section chimney and flows to the bottom sump to combine with fresh coker feed.
- The product vapor flows to the upper section of the column through the vapor risers in the heavy coker gas oil draw-off pan.
- This vapor consists of the products and steam. Heat removal and fractionation are accomplished in the upper section of the fractionator



Heavy Coker Gas Oil (HCGO) Production

- HCGO draws are taken from the same draw tray and used for quenching, pumparound and HCGO stripper feed.
- The HCGO quench, HCGO wash and HCGO pumparound are pumped by common pumps.
- The heat in the pumparound is also used to produce steam.
- The HCGO product draw from the coker fractionator flows under level control by gravity to the stripper. It is steam-stripped in the stripper, and vapors are returned to the fractionator.
- The stripped HCGO product is pumped by the HCGO product pumps to heat the fresh feed, which is then utilized in generating steam in the medium pressure (MP) steam generator.
- Finally, the HCGO product stream is cooled to 176 °F (80 °C) in the HCGO product air cooler and is routed as cold HCGO product to the refinery fuels blending section.

Light Coker Gas Oil (LCGO) Production

- LCGO is withdrawn from the chimney tray below tray 15 of the coker fractionator, and flows by gravity under level control to the light coker gas oil stripper.
- Medium pressure superheated steam is used for stripping LCGO product, which is then successively cooled to 104 °F (40 °C) and flows to the coalescers and salt driers and finally to storage and blending.