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## **Question 75: What have refiners done to mitigate or eliminate coke buildup in reactors? How do you monitor and vary feed quality, reactor severity, catalyst formulation and other variables to impact coke formation. How does feed distributor operation and design impact reactor coke buildup?**

**Emerson Domingo (Sunoco)**

A lot of coke formation can occur during start-ups and shutdowns and upsets of the unit. During start-up, it is important to make sure that all the reactor internals are hot and at operating temperature before introducing oil. If the temperature is too low, the hydrocarbon will condense and form coke. It is also desirable to initially start-up during the first few hours without resid in the feed so there are less chances of heavy hydrocarbon condensing in cold spots.

Similarly, during a unit upset, feed needs to be pulled before the riser gets too cold. This is typically done at 900F. Once feed is pulled the riser and reactor should be completely purged with emergency riser steam so that the hydrocarbon is swept out of the system and pushed to the main fractionator.

It is also important to make sure that oil stays out of the riser by manually closing a main valve going to the feed nozzles. There have been instances when feed has been diverted at the proper temperature but by accident the feed is re-introduced into the riser without anyone knowing about it. This can be caused by valve misalignments or an automatic divert valve malfunction. Once feed is diverted, it is a good practice to close a manual block valve in the feed system. Don't rely on the automatic divert system as it may get re-opened. During normal operation, maintain riser and reactor temperature well above minimum at all times to avoid condensation of hydrocarbons. It is very important that the oil is well atomized and mixed well with the catalyst in the feed injection zone. Monitor the performance of the feed nozzles to make sure you have the right DP across the feed nozzles. At the end of a major turnaround, you should physically check each feed nozzle to make sure they are clear. Go through the entire feed nozzle check procedure before oil-in to confirm that there are no plugged nozzles.

in the reactor, there should be dome steam purge just above the cyclones to prevent coke build-up outside the cyclones and in the reactor head. The steam used should be superheated and is normally controlled with an orifice plate to ensure adequate flow. One of our risers has a T-inertial separator with a "shotgun" at the top of the riser. The "shotgun" directs some of the riser effluent to the reactor dome area to keep it from being stagnant. This "shotgun" extension is in lieu of reactor dome steam. Also, the stripper section should be well designed so it allows for a net upflow of steam towards the reactor cyclones and keeps velocities up in the reactor and prevents dead space.

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