Question 69: Our FCC unit is limited by coke burn and high regenerator temperatures. What catalyst and operational changes have you implemented to maximize the conversion of heavy feeds and increase the amount of resid we can process without running into our regenerator limits and increasing dry gas production?

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Considering the stated goals and constraints, particularly being limited by regenerator temperature and coke-burning capacity, it will be necessary to reduce delta coke without significantly increasing the reactor heat demand. For instance, reducing feed temperature would increase the required coke burning rate, violating one of the stated constraints. following changes in operation are indicated, assuming no capital expenditures:

Increase feed dispersion steam rate, optimize stripping steam rate, and lower reactor operating pressure. However, engineers should ensure that recommended feed nozzle exit velocities, as well as cyclone operating parameters, are not violated. Optimal feed nozzle operations for residue feed require much higher dispersion steam rates than VGOFCC feeds, typically 5 wt% compared to 2 wt% dispersion steam. Other items that will require consideration are the feed system hydraulics and catalyst circuit pressure balance, as well as the main fractionator overhead condensing and sour water systems. The existing systems may not be appropriate for operation at 5 wt% feed dispersion steam, but even incremental increases in steam rate will prove beneficial when processing residue.

If the unit has a CO boiler, run the FCC regenerator in a partial-CO combustion mode.

Optimize the catalyst formulation and addition rate for the new feedstock, balancing considerations of delta coke and catalyst activity.

Consider use of nickel passivator to lower delta coke and dry gas make.

Optimize the operation of FCC feed preparation units, such as solvent deasphalting units or feed hydrotreaters, to balance consideration of FCC unit constraints.

Secondly, assuming some capital expenditure:

Install new feed nozzles designed for optimum dispersion steam rates, better atomization, and improved feed distribution.

And if the stripper is operating above recommended catalyst flux rates, install new stripper internals designed for the higher flux. Finally, with a higher-level capital investment:

Install a riser with shorter contact time and/or a short contact time riser termination to control regenerator temperature, as well as dry gas make, and

Install a CO boiler, if needed, to operate in partial-CO combustion.

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Coke burn is determined by heat balance. A catalyst will not change the coke burn requirement, but it will help alleviate constraints such as regenerator temperature. From a catalyst standpoint, switching to a more coke-selective catalyst would help reduce the delta coke and lower regenerator temperatures. Improving coke selectivity can be achieved via two routes. First, improving nickelpassivation can reduce contaminant coke formation. Second, enhancing the inherent coke selectivity of the catalyst also reduces delta coke. High Z/M (zeolite/matrix) catalysts have improved inherent coke-selectivity and are thus more suitable for coke burn-limited units. From an operational standpoint, increased stripper efficiency to lower the hydrogenon coke content will also lower regenerator temperatures in full-burn units. Decreasing air rates to increase the CO/CO2ratio will also lower regenerator temperatures in partial-burn units. Finally, if capital is available, a catalyst cooler can be installed to provide the highest amount of flexibility.

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