Question 12: What operating strategies do you employ to successfully regenerate catalyst in a continuous catalyst regeneration (CCR) unit with a carbon content in excess of 10 wt%?

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The burn zone in a Honeywell UOP Platforming™ CCR Regenerator is designed for operation at 5 wt% carbon on catalyst or about 5.25 wt.% coke at the design catalyst circulation rate. We find that most units can operate normally at coke levels 40% above the design (about 7.4 wt.% coke) and some at even higher levels of coke.

Note: The design coke-burning capacity is determined with a clean regenerator inner screen and 100% of design regenerator burn-zone recirculating gas flow. If the inner screen is fouled with catalyst chips and fines, and if the regeneration gas flow is less than the clean screen flow, then the coke-burning capacity of the regeneration tower will be reduced.

For most units and most circumstances, the recommended approach to deal with a high level of coke will be to operate the regeneration tower in black-burn mode at a reduced catalyst circulation rate. During this period of operation, there will be only upper air introduced into the burn zone; the rate of combustion air will be controlled to ensure that the peak burn-zone temperatures are kept below 1100°F (595°C). The rate of catalyst circulation is adjusted to keep the peak burn-zone temperature below the top TIpoint in the catalyst bed. The burn-zone profile should generally retain its normal shape. It is important that the observed peak temperature in the burn zone is NOT at the TI point in the catalyst bed. If this is the case, it is possible the real peak temperature is actually at a location higher in the bed and at a higher temperature. This can happen when the catalyst circulation rate is too low for the current regeneration gas oxygen level. Note that organic chloride should be injected into the feed of the platforming unit to help maintain the level of chloride on the catalyst while the regenerator is operating in black-burn mode.

In some circumstances, it may be necessary to allow the operation of the regeneration tower to shift to partial carbon burn. This will happen when the coke level on the catalyst exceeds the amount that can be burned, given the constraints of the maximum burn-zone peak temperature and the location of the peak temperature below the top TI. The lower portion of the burn-zone profile will not have its normal shape; the lower temperatures will rise as coke burning is continuing in that section of the catalyst bed. It may be that you are only reducing the coke on catalyst by 5 to 7 wt.%. If the catalyst entering the burn zone has 11 wt% coke, it may have 4 to 6 wt% as it leaves the regeneration tower.

The severity of operations on the reactor side should be moderated to reduce the rate of coke formation. Depending upon the level of coke and the severity of reactor side conditions, it may take several cycles in black-burn mode to reduce the coke level on the catalyst leaving the last reactor to a level that is low enough that the regeneration tower can be safely switched to white-burn mode.

It is important to limit the number of cycles that the regeneration tower operates in black-burn mode as the platinum on the catalyst is not redistributed when the chlorination zone is not operating normally with the regenerator in white-burn mode. At some point, the agglomeration of the platinum will begin to affect catalyst performance (activity and selectivity).It may take several cycles in white-burn mode to return the catalyst to its previous condition.

If you find yourself in a situation where the coke level on the spent catalyst is above 7.5 wt.%, UOP recommends that you contact your UOP Regional Service Manager to discuss the appropriate path forward. In special circumstances, other techniques such as dual zone burning have been used to deal with catalyst that has a high level of coke. The details of these alternatives should be discussed with UOP.

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