
Question 24: During the oxidation step in the regeneration of fixed-bed catalytic reformers, how does varying the length and oxygen concentration affect the unit performance?

DUNHAM (UOP)

The length of the oxidation period will vary from a minimum of 11 hours up to 24 hours. The timeframe will depend on the amount of platinum agglomeration, surface area, oxygen content, and chloride injection rate. Minimizing the burn temperature during the primary burn will minimize agglomeration. So, if you are dealing with low surface area catalyst, you will need a richer chloride environment, which is a lower hydrogen-in-chloride ratio, when you are in that step.

Historically, oxygen contents were held lower. But recently, these concentrations have been going up as high as 12%. Some of the safety issues have already been addressed. Higher concentration of oxygen increases the rate of metal redispersion. When you get finished with this step, if you have catalyst samplers, you can get a sample of the catalyst. A nice creamy color tells you the oxidation step was done right.

PATEL (Valero Energy Corporation)

Unless time is critical, adding extra time could result in an advantage. Improvements have been noted in catalyst appearance when extending the oxidation period from the typical 11 to 16 hours up to 24 hours. Holding in the oxidation state for up to 36 hours could also be acceptable except that beyond that, there is a little benefit to the catalyst and there is a high risk of increased corrosion in the unit because you are still injecting a lot of chlorides and making up the caustic.

For the oxygen concentration, increasing the amount of oxygen partial pressure will speed up the rate at which the oxidation is complete. Also, a high concentration of oxygen should increase the rate of metal redispersion. Prior to increasing any oxygen concentration beyond the recommended minimum 5%, the compressor configuration should be reviewed because centrifugal recycle compressor with lube oil sealed system may hit the exploding limit with higher oxygen concentration.

CLAY MARBRY (Roddey Engineering Services, Inc.)

That was a good point about the lube oil system and potential ignition of the compressor lube oil. If you get more than 8% oxygen, you can start to see some problems there. We have also seen some coke ignite in the feed effluent exchange section. If you get above 8% oxygen, some harder-to-burn coke, such as graphitic coke, can ignite. The form of this coke can be debated; but in our experience, we have seen coke in the feed effluent exchangers ignite at higher oxygen concentrations.

An additional thought on increasing oxygen concentration: The higher the oxygen concentration you reach during the oxidation step, the longer the purge step will take to reduce the oxygen concentration to acceptable levels before hydrogen introduction in the reduction step.

As far as extending the oxidation step time is concerned, that is a fantastic maintenance hold period if you have an upset or a problem. We have been in regenerations where we have held the oxidation step for multiple days. You run the risk of corrosion, and you are using up caustic the whole time. There is a cost associated with extending the oxidation step, but this is the safest time, for the catalyst, to extend the regeneration.

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2015