
Question 89: Are there advances in cyclone lining material or cyclone designs to make them more erosion resistant allowing higher cyclone velocity or longer run lengths?

Mike Teders (Valero)

We limit the regenerator cyclone inlet velocity to 75 fps to make 4 – 5 year runs between turnarounds. Reactor cyclone inlet velocity limit is 80 fps if there is a riser termination device that reduces the catalyst loading to the cyclones. The hex mesh cyclone lining orientation, control of water addition and ramming techniques are key variables to erosion resistance. Hex mesh lining should be strength welded to the base metal and oriented in the opposite direction of flow as long as it can be securely welded to the base metal. Hex provides a better anchoring system than single anchors such as S Bars. Shop applied refractory can have 20 – 30% more hardness than field applied refractory. Valero has a refractory subject matter expert who carefully monitors as-installed physical properties and maintains communication with both installers and suppliers to ensure that both understand that the objective is to achieve the best possible abrasion resistance and the lowest possible shrinkage. Special refractory inspectors are used to monitor the refractory application process to get the best results.

Tom Lorsbach (UOP)

There haven't been any breakthroughs or big step changes in cyclone lining materials. There have been a number of incremental improvements over the past 10 years or so.

1. Over the years the abrasion resistant lining materials have generally become more erosion resistant. Testing by ASTM C704 (Abrasion Resistance of Refractory Materials) show an improving loss trend, going from 5 - 6 cm³ to 3 cm³.
2. with increased FCC unit run lengths the cyclone abrasion resistant lining thickness has typically been increased from 3/4" to 1".
3. Hexmesh should be rolled the easy way in cyclone inlets, barrels and main cones to avoid having the hex ribbons running parallel to the direction of gas and catalyst flow. This avoids presenting double thicknesses of hex metal (where the metal ribbons are clenched together) which are more susceptible to metal erosion.
4. Some refiners have used additional thicknesses of lining in problematic areas of the cyclone, e.g., at least one refiner uses 3" thick abrasion resistant linings in cyclone dust bowl cones and the upper section of the diplegs.
5. UOP now specifies 2" thick abrasion resistant linings in cyclone dust bowls and dust bowl cones.

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6. The use of fully lined diplegs is also becoming more common with the extension of FCC run lengths to 6 or even 7 years.
 7. Cyclone designs are evolving with a trend to longer cyclones and longer dust pots.
 8. One cyclone vendor designs a sub-hopper below the conventional dust bowl to better contain the gas vortex and to mitigate erosion and catalyst re-entrainment.

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2011