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**Question 83: As the time between FCC unit turnaround events are continuously being extended, what areas have you identified as having a high likelihood of failure due to erosion and what preventive measures can be taken to avoid such failures?**

**Peter Blaser** (CPFD Software, LLC)

Erosion due to catalyst impact is often a strong function of particle velocity. However overall operating conditions, such as superficial velocity, are often insufficient to predict local erosion characteristics in FCC equipment where the likelihood and severity of erosion is influenced by local catalyst acceleration and impact. The mass, velocity, angle of impact, surface material and other factors all influence this local erosion behavior.

One approach to minimize erosion damage and avoid related failures is to use computational fluid dynamics (CFD) software to simulate the gas/catalyst flow in FCC units and components to assess the likelihood that a particular combination of design and operating condition will result in excessive erosion. This type of modeling and analysis is often used to compare the relative performance of alternative designs.

For example, one published instance of this approach utilized CFD modeling to predict the observed erosion pattern in reactor cyclones at the Marathon Petroleum Catlettsburg Refinery. The validated model was then used to compare the erosion characteristics of alternative proposed design changes and to ensure the planned changes did not have a detrimental effect on other aspects of system performance. The attached images show the erosion damage as visually observed during a turnaround and a comparison of the CFD-computed erosion for the original design compared with two alternative designs.

For more information see: *'Blaser, P., Thibault, S., and Sexton, J. "Use of Computational Modeling for FCC Reactor Cyclone Erosion Reduction at the Marathon Petroleum Catlettsburg Refinery", Proceedings of World Fluidization Conference XIV: From Fundamentals to Products, 347-354, (2013)'*.

Use of CFD modeling to predict or prevent erosion on FCC equipment has been successfully applied to reactor and regenerator vessels and internals, as well as downstream equipment such as flue gas slide valves and flue gas orifice chambers with excellent success. Understanding the likelihood of erosion and the underlying root cause enables engineers to avoid erosion-prone designs prior to construction and installation.

**Tina Syvret** (NALCO Champion)

Removal of nitrogen in refinery effluent water relies on biological processes. Nitrates can be handled by

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modifying a secondary treatment system with an anoxic reactor upstream of an aerobic reactor. The activated sludge containing nitrates formed in the aerobic reactor as a result of the nitrification process (ammonia to nitrate) are returned to the anoxic zone where they are converted to nitrogen gas.

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