Reduced FCCU Opacity and Improved Reliability with FCC Catalyst Treatment

Minimum opacity, improved catalyst retention and better reliability of power recovery trains via removal of fines and minimization of microfine formation

A Fluid Catalytic Cracking Unit (FCCU) is one of the most important industrial processes to convert petroleum to gasoline and other valuable products within a crude refinery.

The longer an FCCU can be kept online between turn-arounds, the higher the potential for profits. Therefore, it is in refiners' interest to keep these units operating continuously, and consequently, run cycles have increased steadily throughout the years.

Different refiners face various challenges when trying to maximize the profitability of their FCCUs, some of them include:

- Opacity limits that must be met in order to operate within compliance.
- Catalyst losses due to end of cycle cyclone performance or running the unit beyond design. The average e-cat has a 4-5 wt% 0-40 micron content. The average fresh catalyst has 15 wt% 0-40 micron content and 10-13% of all catalyst added is lost rapidly from the process.
- Power recovery units (PRU) reliability is challenged by build-up of catalyst particles on the turbine blades, typically micro-fines smaller than 10 microns. Some of these micro-fines are created by attrition of surface irregularities in the fresh catalysts.
- Dilution of slurry fines to protect slurry circuit

Furthermore, some FCCUs may need to use a sub-optimal catalyst type in order to meet their operating requirements.

On the other hand, some FCCUs have special circulation limitations due to designs with long standpipes and can benefit from improved particle size distribution (PSD) provided by the addition of external fines.

Our experience over the years has shown that some catalysts are more prone to microfines production than others and that this depends on various factors, such as the binding technology.

Quanta has extensive commercial experience reducing harmful microfines production by:

- 1) Removing the fresh catalyst fines that are not retained by the cyclones. This involves control of the 0-40 micron fraction by removal of most, if not all, of the 0-30 micron particles while retaining those particles that stay in the unit and aid the fluidization of the catalyst.
- 2) Pre-attrition of the catalyst before it enters the FCCU, whether it is fresh, e-cat or environmental additives, to remove many of the micro-fines which are responsible for a large portion of the opacity. The typical size of these materials is 2-3 microns.
- 3) Most importantly, by subjecting the catalyst to a pre-attrition process in our plant, refiners can also minimize the material that would contribute to increased erosion in downstream equipment, such as power recovery turbines and slurry pumps, improving their reliability and extending the equipment life. A reduction in slurry fines concentration could also reduce the rate of tubes plugging in the heat exchanger circuit at the bottom of the fractionator.

It is important to mention that proper reduction of the amount of 0-30µ material in the fresh catalyst before it enters the FCCU will not result in reduced circulation capacity because a) this is material the cyclones do not retain well to start with and b) Quanta can also modify the APS of the catalyst by removing the coarse portion of the PSD if needed. In other words, the Umb / Umf factor can be kept equal or even improved by selecting the right combination of 0-40 removal and APS factors in the treated product.

Based on treatments that we have performed for various customers over the years, the typical microfine yield is between 0.5 and 2.5w% of the incoming amount of material. The fines fraction is a function of the starting PSD of the catalyst. A typical fresh catalyst has a 0-40 micron content between 10 and 15%. Our customers have requested reductions of the 0-40µ micron content to as low as 2% without any impact on catalyst circulation.

In summary, refiners can benefit from our proprietary patented process by removing the opacity precursors from the fresh catalyst, e-cat or additives, while also reducing catalyst losses and improving the reliability of downstream equipment. Finally, by proper selection of the fines fraction and APS, refiners can preserve or improve the circulation capacity of their FCCUs.

Table 1: Commercial Examples of Fines and Microfines Removal

Material	% of Total DB	APS
Incoming Material		78 (0-40 of 12 wt%)
Product	89.4	85 (0-40 of 2wt%)
Fines	8.1	35
Bag House Microfines	2.5	2.5
Total Product	100.0	

Material	% of Total DB	APS
Incoming Material		75 (0-40 of 12 wt%)
Product	90.0	80 (0-40 of 3 wt%)
Fines	9.5	32
Bag House Microfines	0.5	2.5
Total Product	100.0	

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