

Integrated answers

Environmental project on FCCU delivers 5% capacity bonus

Suncor Energy (U.S.A.) Inc.'s (Suncor) Commerce City refinery near Denver, Colorado, USA, provides a vital link between the company's large-scale oil sands resource in Canada and the growing US energy market. The same fluidised catalytic cracking unit (FCCU) has been at the refinery's heart since 1952. This unit is key in assisting the 90,000-barrels-a-day refinery to supply Colorado with both gasoline and diesel. An FCCU revamp completed in April 2006 achieved significant environmental benefits while improving the overall operation and yields.

MACT II with integrity

The United States Environmental Protection Agency (EPA) has established emissions standards for US refineries. These standards, known as the maximum achievable control technology (MACT), require the maximum achievable emissions reduction for a particular source category, such as refineries, to be met.

Suncor entered a consent agreement with the EPA and the State of Colorado to bring the Commerce City refinery into compliance with these standards. The project's objectives were to meet the MACT II particulate emissions of 1 lb/1000 lb (1 kg/1 t) of coke burn-off and to improve the unit's reliability.

Before the FCCU revamp, the unit was experiencing catalyst circulation problems, particularly at start-up; the flue gas opacity was averaging 18%; the regenerator afterburn was in excess of 50°F (28°C); and there were reliability problems. Coke on the catalyst is burned off in the unit's regenerator. However, the regeneration process was not operating efficiently, and the carbon monoxide was burning to carbon dioxide in the flue gas. This situation is known as afterburn and was causing the elevated temperatures and the subsequent mechanical damage.

An integrated package

Mary Richardson, Senior Process Engineer, Suncor, had the following reasons for selecting Shell Global Solutions to help with the revamp:

- The submission of a very detailed proposal. Suncor could easily understand the licensed technology.
- A proven track record with refineries that operate under more stringent particulate emission limits.
- Shell Global Solutions offered the lowest emissions performance.
- Suncor needed FCC expertise to help with the revamp.

Modifications

To meet the MACT II limits, Suncor replaced the regenerator cyclones and the flue gas outlet plenum and installed a new third-stage separator system. The regenerator air grid and spent catalyst distributor were replaced to help improve the unit's reliability.

A key feature of the new regenerator cyclones is their vortex stabilisers. Without these devices, the movement of the vortex inside the cyclone is chaotic. The vortex tail attaches to different parts of the cyclone body in a similar way to the touchdown of a tornado tail, and this can damage the cyclone body. The stabiliser provides an anchor for the vortex at the centre of the cyclone. This helps to prevent damage to the body and reduce catalyst attrition. The new cyclones can be designed to be shorter, which makes them good candidates for revamping small regenerator vessels.

The air grid and spent catalyst distributor licensed by Shell Global Solutions have improved the efficiency of the regenerator, which has reduced the afterburn that had threatened the FCCU's mechanical integrity.

The new third-stage separator system has been arranged vertically above the fourth-stage separator so that they fit into



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the limited plot size. These systems were integrated into the FCCU to reduce its final particulate emissions.

Lower emissions, increased capacity

The particulate emissions level was independently tested once the FCCU was operating. These tests confirmed that the average particulate emission was below the maximum allowed MACT II level of 1 lb/1000 lb coke burn, and that this requirement would be met over an extended operating cycle. The average stack opacity was reduced to 3% compared with an average of 18% before the project. The project has also reduced the carbon monoxide in the FCCU flue gas by 85%, which has resulted in a reduction of approximately 74 tonnes a year of carbon

monoxide emissions. The unit is more stable, and afterburn is less than 50°F. On this basis, Suncor plans to extend the FCCU's turnaround interval from four to five years.

Richardson says, “The air blower no longer appears to be a summer-time constraint, and we have observed a 5% increase in capacity utilisation, which was not a project objective. The economics of the unit change daily, but this 5% capacity increase speaks for itself.

“We recently acquired another refinery adjacent to the Commerce City site, and are proceeding with a similar project to make its FCCU MACT II compliant by 2009. This work will also be with Shell Global Solutions. The distance between our facilities and Shell Global

Solutions' resources has not been an issue. Furthermore, it has been a pleasure to work with the Shell Global Solutions teams in Houston and The Hague, the Netherlands. I look forward to another safe, successful and on-budget project,” she concludes.

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