Tracerco

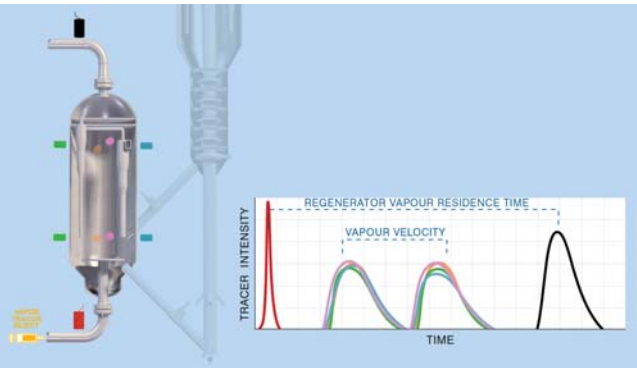
Providing Insight Onsite

FCC Regenerator - Air and Flue Gas Flow Studies

A major contributor to the production capacity of the modern refinery is the Fluid Catalytic Cracking Unit.

Small changes in the operational and mechanical performance of the equipment can have a huge impact on the performance of the FCC. Understanding the impact of changes to the unit and locating the root cause of problems is no easy task, particularly when the symptoms observed could be caused by a variety of factors. Tracerco's Tru-Scan™ and specialist tracer techniques are used to identify the air rate, flue gas rate, and bed level elevation in the FCCU regenerator.

Both the air and flue gas rates in the regenerator can be measured simultaneously with a single injection of a short lived gaseous radioisotope. A group of radiation detectors are placed a known distance apart on the air supply line to the regenerator and another set on the flue gas line leaving the regenerator. The flow rates are measured by converting the velocities to volumetric flow with respect to line diameter, process pressure and process temperature.



Tracerco Diagnostics™ Flow studies can measure both the air and flue gas rates in the regenerator simultaneously with a study of the air distribution from the air grid and/or the vapour distribution to the cyclones.

The same injection used to establish the air and flue gas rates may be used for measuring the air distribution and superficial velocity through the regenerator with the addition of more detector placements. Separate injections in the air line and spent cat line will produce the desired distribution characteristics for the two phases.

Project Field Test

A refiner was experiencing poor catalyst regeneration. Tracerco was requested to perform Tracerco Diagnostics™ Distribution studies to measure the flow parameters around the regenerator.

When a radioisotope gas tracer was injected into the air ring, the size of the response of each detector was directly proportional to the amount of tracer that flowed near each detector. For a normally operating air distribution system, all of the detectors should have measured similar amounts of tracer, producing similar responses. However, this test showed that some detectors had much larger responses than others. A second vapour tracer injection was made into the spent cat riser.

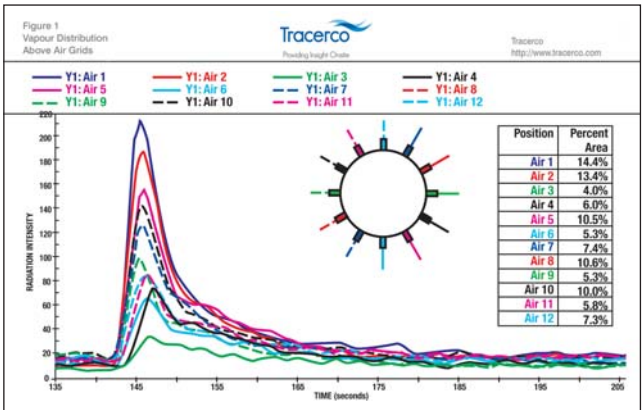


Figure 1 - Vapour distribution results for gas test injection into the air ring.

Process Diagnostics

Project Analysis

Significant differences in radiation readings between the detectors indicated maldistribution. By calculating the area under each response curve, totalling the areas, and then comparing each detector area to the total, the responses could be converted to flow. (Figure 1) The largest response was from the detector at the 1 o'clock position where the response was almost double the expected 8.3 %. The smallest response was at the 3 o'clock position where the flow was less than half of the expected 8.3%.

The results of the second injection (Figure 2) showed that the NE, N, and NW detectors had 80% of the response. It was suspected that the distribution "lid" on the end of the spent cat riser had broken loose on the north side and the hat was directing the flow to the north side of the regenerator.

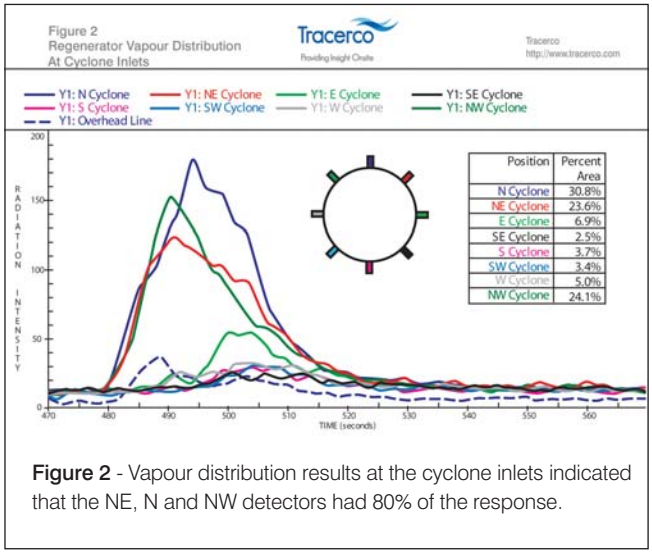


Figure 2 - Vapour distribution results at the cyclone inlets indicated that the NE, N and NW detectors had 80% of the response.

Customer Conclusion

This information justified a short outage and the distribution "lid" was found to be damaged just as suspected. At shutdown, the customer found that in each high percentage area the nozzles on the ring had been eroded away, allowing much more air flow than designed. Incomplete combustion was occurring in the other areas that were receiving inadequate air.

Whether benchmarking an FCC after a turnaround, planning modifications for the next turnaround, or troubleshooting abnormal operation, the FCC process engineer can pull radioisotope technology tools from their tool bag to better understand operational and mechanical problems. This leads to better performance of the FCC and higher profitability.

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For our worldwide offices: www.tracerco.com/processdiagnostics/our-people