Tracerco

Providing Insight Onsite

Reactor - Distribution

Online distribution investigation of reactors can identify the causes of poor performance. Once identified, the best course of action can be determined to correct the problem in the least amount of time and with the lowest cost.

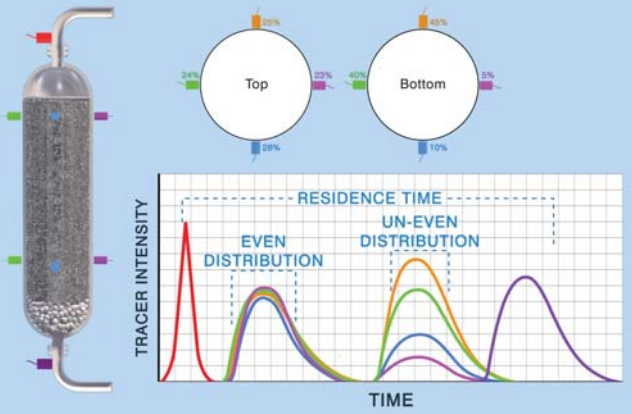
Project Field Test

A refinery with two hydrotreater trains was experiencing poor performance from one of the trains. The operations engineer hoped they had a leak in one of the feed/effluent exchangers, but the refinery was concerned there might be a problem with the reactor. Tracerco was asked to perform a leak test of the exchangers and a Tracerco Diagnostics™ Distribution study. To be sure of the conclusions, the engineer asked that a scan also be performed on the better performing reactor. The leak test of the feed/effluent exchangers was negative for a leak greater than 0.2% of the feed flow.

If a smaller leak existed, it would not have accounted for the poor performance of the unit. After completing the leak test, a Tracerco Diagnostics™ Distribution study was performed. The method involved the injection of a radiotracer into the feed of the reactor. The tracer material, typically just a few grams of material, briefly sticks to the catalyst. The reactor was scanned every 30 degrees. Data was collected from the top tangent line down to an elevation in the bed where the radiation readings became consistent with background.

Project Analysis

The results of the scans can be presented in two ways, a plot of radiation intensity versus elevation or a polar plot of radiation intensity as seen in Figure 1.



Tracerco Diagnostics™ Distribution studies are a means of identifying liquid, vapour or solid distribution characteristics in reactors. A Tracerco Diagnostics™ Distribution study will yield valuable information about the distribution of vapour or liquid allowing reactor performance to be measured.

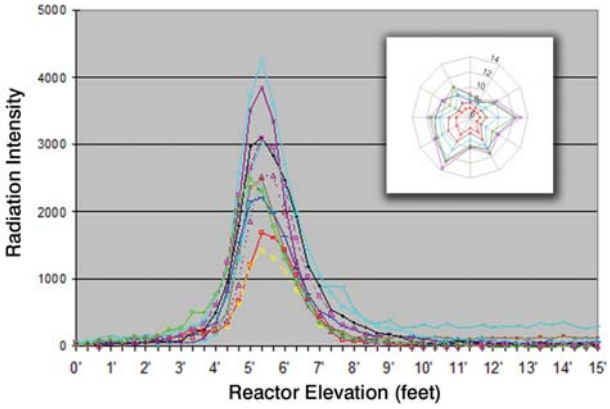


Figure 1 - Gamma scan profile plots show that some of the scan profiles were shorter and narrower than others. This is indicative of poor distribution. The inset polar plot is an alternative way of plotting the gamma scan data. The polar plot of the data at the top of the bed elevation (5' to 6'8") clearly shows the feed distribution was bias.

Process Diagnostics

In Figures 1 and 2 elevation distance from the top tangent line is shown on the X-axis and radiation intensity on the Y-axis. In this type of plot, the scan profiles are compared to see if they are consistent in height, width and elevation. Figure 1 shows that some of the scan profiles were shorter and narrower than others. This is indicative of poor distribution since larger (taller) and wider curves were produced by greater amounts or longer residence times of radiotracer near those scan positions.

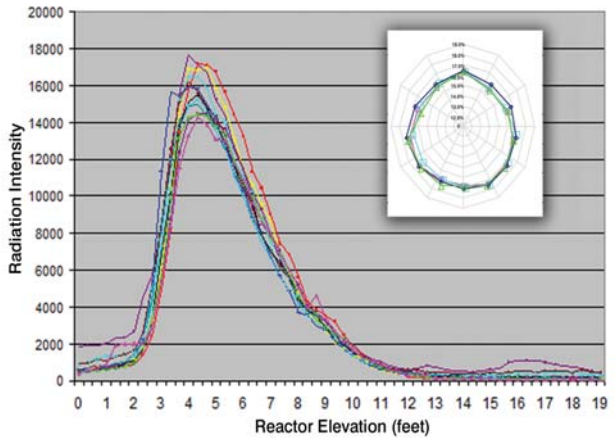


Figure 2 - Radiotracer was injected into the reactor of the sister hydrotreating unit for comparison data. The results indicated fairly even gamma scan profiles. In the polar plot illustration the process appeared to be flowing into the catalyst bed in a relatively uniform manner.

The polar plot uses the data from all twelve scans at one elevation to produce a circular data reference. Data from different elevations are shown with different colored circles. For example, the data from the 1.8m elevation for all twelve scans are represented by the light blue line. This line and the other lines on this plot show that more radiotracer was deposited in the southern half of the reactor than in the northern half. It further shows that the southwest section of the reactor had the highest deposition of radiotracer. Since the radiotracer was carried by the feed, these results also show how the feed was being distributed.

Radiotracer was also injected into the reactor of the sister hydrotreating unit for comparison. The data from this reactor showed fairly even gamma scan profiles as shown in Figure 2. The polar plot made it noticeable that there was a slight imbalance in flow toward the north side of the reactor. This degree of feed flow imbalance was not affecting the performance of this train.

Customer Conclusion

With the knowledge gained from the reactor distribution study, the customer was able to save many times the cost of the investigation just in avoiding lost production.

A baseline scan just after a turnaround, while the reactor is operating under normal conditions, will identify the distribution characteristics under ideal conditions. It will also identify normal tracer penetration into properly operating fresh catalyst. This information will provide a "benchmark" for future reactor scans. It will assist scan interpretations if subtle maldistribution is an inherent design characteristic of the distributor.

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