Tracerco

Providing Insight Onsite

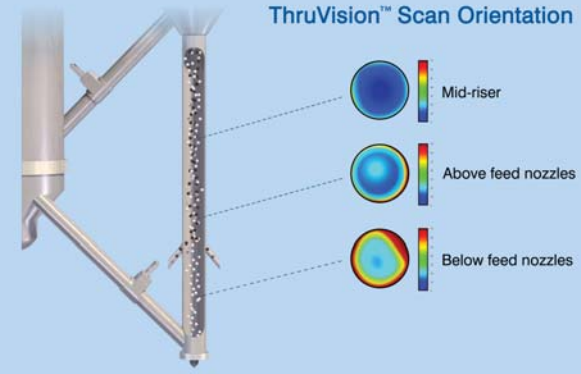
FCC Riser - Density Profile

Tracerco has developed several non-intrusive radioisotope technologies to meet customer critical measurement needs that are able to diagnose FCC riser problems or optimise process design and conditions to maximise product throughput.

A Tru-Scan™ of the riser can be used to evaluate the performance of the injection system. Results from a riser Tru-Scan™ provide a catalyst density profile through the length of the riser. The results provide information on the length of the expansion zone where hydrocarbon mixes with the catalyst and cracks. (Figure 1).

Poor fluidisation or poor mixing of the catalyst and hydrocarbon cause localised variances in the oil-to-catalyst ratio and cracking reactions. Over-cracked portions of the feed generate low-value light components, while at the same time the under-cracked portion produces more heavy residues.

While a Tru-Scan™ provides a vertical density profile down the length of the riser, a ThruVision™ study is performed at a fixed elevation on the riser cross-section to generate a detailed cross-sectional density profile showing flow distribution. Several measurements at selected vertical positions allows not only flow distribution to be measured but also changes to this as materials move upwards through the riser.



ThruVision™ scans performed at a fixed elevation on the riser cross-section generate a detailed cross-sectional density profile of the riser showing flow distribution.

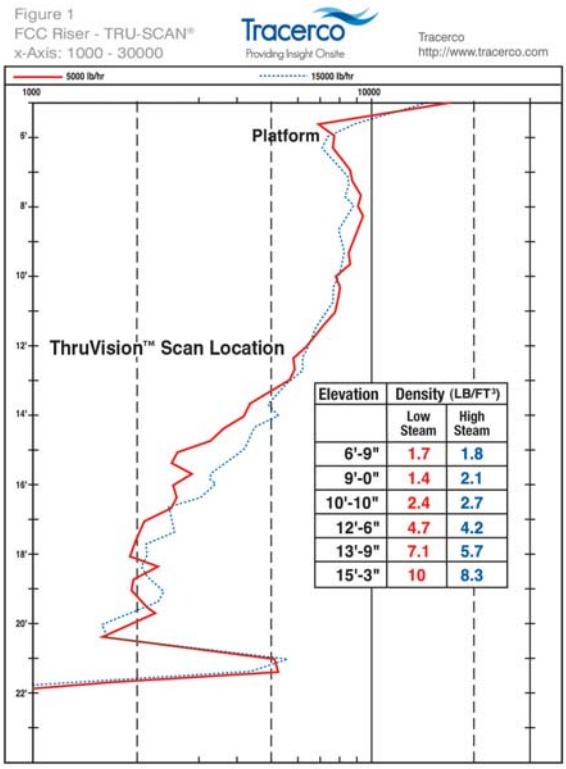


Figure 1 - Results of a Tru-Scan™ density profile of a FCC riser help determine the fixed elevation location for a ThruVision™ cross-sectional density profile.

Project Field Test

A refiner requested riser ThruVision™ scans be performed for comparison of scans carried out two years previously to determine ongoing operational performance. Two ThruVision™ scan elevations were selected on the reactor riser with each scan segmented into multiple scan chords at the same elevation as illustrated in Figure 2.

Process Diagnostics

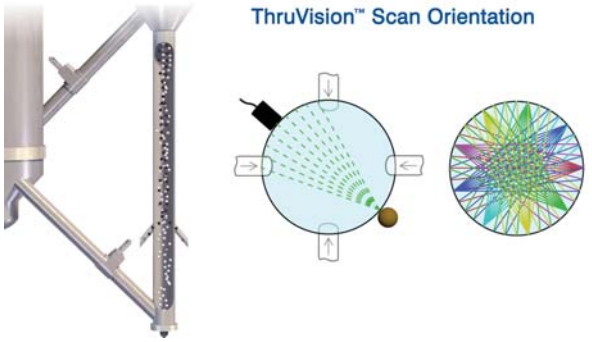


Figure 2 - Each scan used multiple scan chords at the same elevation.

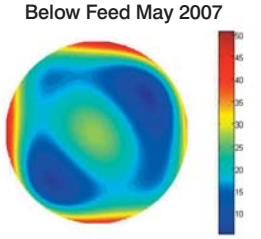


Figure 3 - 2007 ThruVision™ scan results indicated a dense core in the center of the riser and two low density areas in the NE and SW quadrants.

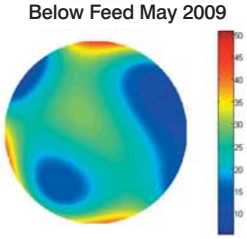


Figure 3a - Recent scans illustrated that the dense core had shifted slightly to the NW and the two low density areas were not as large as indicated in 2007.

Project Analysis

The first set of results illustrates density comparisons of scans performed below and above the feed nozzles. The 2007 scans (Figure 3) indicated a dense core in the center of the riser and two low density areas in the northeast and southwest quadrants. The recent scans illustrated that the dense core in the middle had shifted slightly to the northwest and the two low density areas in the northeast and southwest quadrants were not as large as indicated on the 2007 scans (Figure 3a).

The scan results from the second elevation, above the feed nozzles, are illustrated in Figures 4 and 4a. Results of the scan performed in 2007 (Figure 4) showed the density to be very symmetrical with four very low density areas, a dense core in the middle, and concentric rings of increasing density along the walls. The density ranged from 16kg/m^3 to above 320kg/m^3 along the walls, with the majority of the flow between the 48kg/m^3 to 96kg/m^3 density range.

ThruVision™ scan results from 2009 (Figure 4a) indicated that the feed distribution had significantly improved from 2007 showing a more consistent density pattern with the lowest density between 48kg/m^3 to 96kg/m^3 along the east northeast wall of the riser. The central core density had increased from 96+kg/m^3 to 144+kg/m^3 and the majority of the area was now between 96kg/m^3 to 144kg/m^3. The concentric rings of higher density that were present in 2007 scan results disappeared, with the highest densities now on the south and west walls.

Customer Conclusion

Density profiles obtained from scans of the reactor riser can be useful to determine the uniformity of distribution between catalyst and feed, and to identify flow inefficiencies such as catalyst maldistribution. Tracerco Diagnostics™ FCCU studies have diagnosed operating problems and helped improve the performance of all major components of FCC units. Each project is customised to provide information needed to optimise or troubleshoot a specific process.

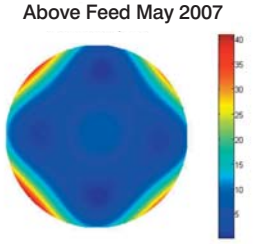


Figure 4 - Results from 2007 scan above the feed showed the density to be symmetrical with four very low density areas.

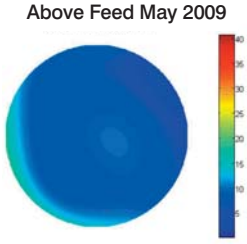


Figure 4a - 2009 ThruVision™ scan results indicated that the feed distribution had significantly improved from 2007 showing a more consistent density pattern.

For further details email: process.diagnostics@tracerco.com or visit: www.tracerco.com/processdiagnostics

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