insight
Volume 8 Edition 2

Tracerco
Providing Insight Onsite

Optimising Desalter Performance Is Just One of Tracerco's Specialties We Proudly Provide.

Desalter vessels are a refinery's first line of defence to reduce the amount of unwanted salts present in the feed inventory. Prior to crude oil entering a refinery processing stream it undergoes a water washing stage where the water used during this process is separated using Desalter vessels. In these vessels the oil and water mixture separate from each other using gravity and high voltage coalescing plates. The water phase contains the washed salts as well as other suspended solids. Desalting and separation prevents water and salts from entering the crude unit furnaces, distillation towers and other downstream equipment. Salts, sediment, and other solids will foul the process and can undergo chemical change to produce corrosive chemicals that cause damage to process metallurgy. It is therefore important to efficiently separate wastewater from crude feedstock within the Desalter vessels.

Tracerco Tru-Scan™ technology provides you detailed data on where the oil/water interface level is, determines if there is a significant "rag" or emulsion layer or detects how many solids are built up in the bottom of the Desalter. In addition to performing these applications our advanced tracer studies are used to provide residence times of the oil and water phases and distribution within the vessel. Further to our scanning and tracer technologies that can aid plant personnel in optimising your process, our award winning Tracerco Profiler™ HTX instrument provides accurate phase measurement including oil, emulsion (rag), water and solids/sludge in real time. The installation of the Tracerco Profiler™ HTX can eliminate unplanned Desalter shutdowns, reduce chemical usage, increase fluid throughput and provide the capability to handle more challenging crude blends.

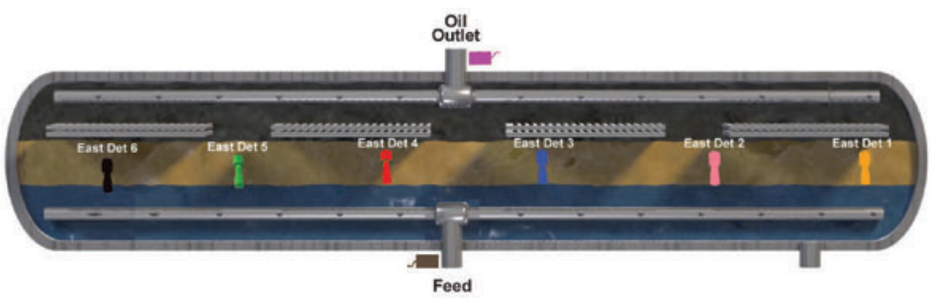


Figure 1 – Detector placement illustration. Tracer was injected through the inlet distributor located in the middle of the Desalter.

Case study: Desalter distribution study

Recently a customer contacted Tracerco asking if we could provide an answer to his question: "Is the liquid that is being introduced into my Desalter being evenly distributed via my distributor? They suspected the inlet distributor on their Desalter may not be functioning properly. A Tracerco Diagnostics™ Distribution study was performed to help the customer determine what was actually happening within their Desalter.

In this study, an organic tracer was used to verify the oil distribution through the inlet distributor which was located in the middle of the vessel. (Figure 1) Sensitive detectors were placed on the feed inlet and oil outlet as well as various locations on the East and West sides of the vessel to monitor for the presence of the tracer and evaluate the quality of distribution at the entrance and exit points. Each of the detectors should have equal area response if there is good distribution as illustrated in the example shown in Figure 2.

The results of the study are illustrated in Figure 3 shown on page 2. The data indicated a much different flow pattern when comparing the detectors on the North side of the vessel (red, green, black) as those on the South side (blue, pink, orange). On the South side of the vessel, the detector response curves were sharp with well-defined leading and trailing edges. By comparison, the detector response curves on the North side of the vessel showed very broad curves with leading

(Continued on page 2)

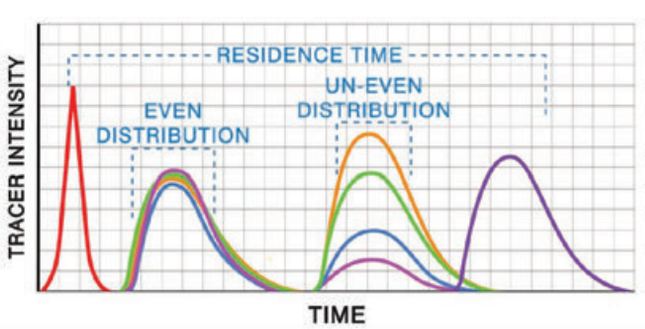


Figure 2 – An example of the response from each detector in a distribution study directly related to process flow close by its location. For a normally operating system, all of the detectors should detect similar amounts of tracer, producing similar responses. However, when tests show that some detectors have much larger responses than others, maldistribution is indicated.

Inside this Issue…

Desalter Performance

(Continued from page 1)

and trailing edges spread out over a very long period of time. This was an indication that the feed distribution was not properly distributing the feed to both sides of the vessel. There appeared to be a much higher flow of feed to the South as compared to the North. If the distribution would have been even, then the North and South detectors would be expected to have shown uniform response curves.

Conclusion

Online investigations of desalters 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. With a Tracerco Diagnostics™ Distribution study you can identify problems before they reach a critical point.

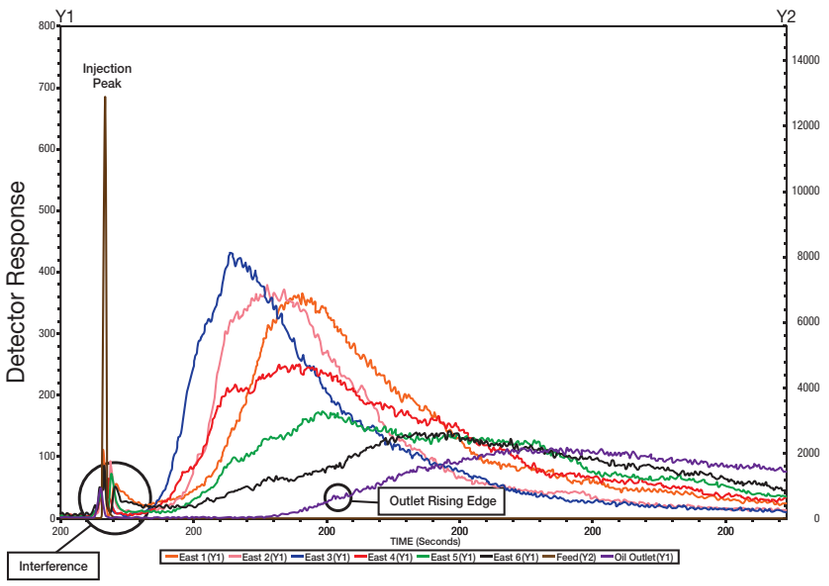


Figure 3 – Test results indicated a significantly slower flow in the North end of the Desalter indicating maldistribution.

Making Desalter vessels transparent to optimise crude processing...whatever the blend

Efficient separation requires the use of accurate and reliable interface control to manage its position and quality. An increasing number of refiners have successfully deployed the Tracerco Profiler™ HTX for Desalter interface control. This device provides an accurate measurement of the density distribution within a Desalter, offering continuous high resolution imaging and control of each phase. This allows the most efficient operating conditions to be maintained as well as monitoring the effectiveness of chemical additive and mud washing.

With repeatable, accurate and reliable real-time process measurements, the Profiler™ HTX provides operators with interface confidence. If the interface can be controlled, it is feasible to raise the interface level closer to the coalescing electrostatic grid system which in turn enhances separation of crude from water. By optimising separation to improve feedstock flexibility, upstream Desalter mixing can be increased to maximize wash water contact, thus removing more undesirable materials.

In a Desalter, the electrostatic grids prompt the coalescence of the water molecules, which causes them to fall out of the oil, taking the solids with them. Then the solids can be removed from the bottom of the vessel. Efficiency of this process increases when the vessel can be operated within the ideal interface range.

In Figure 4 you can see from the screen shot taken from Profiler™ results, you are able to visualise the electrostatic grids and understand how operations is able to maintain at the ideal position.

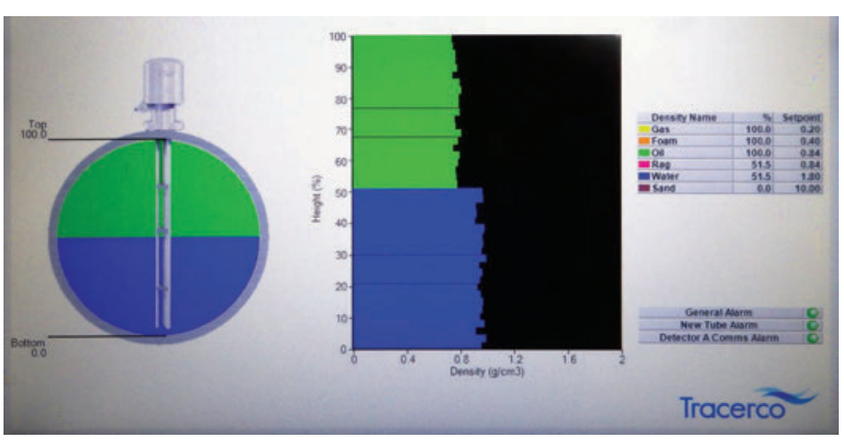
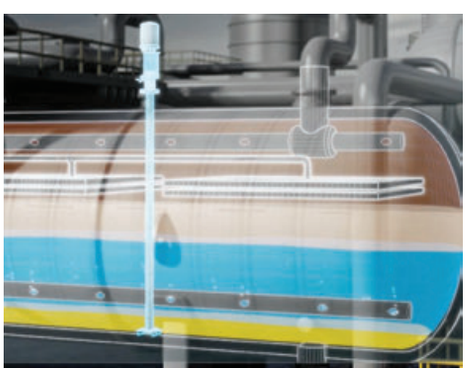


Figure 4 – In this figure you can see from the screen shot from Profiler™ results, you are able to visualise the electrostatic grids and understand how operations is able to maintain at the ideal position.



Solving the problem… long or short term

A Tracerco Diagnostics™ Distribution study is often requested by our customers to detect maldistribution issues in real-time, eliminating the guess work when trying to resolve process issues.

Installing our Tracerco Profiler™ HTX as a permanent solution will help visualise what is happening inside your process and to gain the confidence to increase fluid throughput and automatically control interface levels within the DCS system.

The Tracerco Profiler™ HTX can eliminate unplanned Desalter shutdowns, reduce chemical usage, and provide the capability to handle more challenging crude blends.

If you would like to learn more on all the products and services Tracerco offers to help optimise your Desalter contact a technical advisor in your area.

Crude Vacuum Tower Wash Bed Optimisation

A Novel Approach

Marathon Petroleum Company LP's (MPC) approach for operation of their vacuum tower wash bed is a novel approach. MPC regards the packing in the wash bed as a consumable item. The goal - fully consume the useful life of the packing by the end of the operating cycle to maximise operating profit by maximising HVGO yield. MPC uses Tracerco's ThruVision™ technology to routinely monitor the wash bed density to help manage the wash bed useful life during the operating cycle. The ThruVision™ technology provides a detailed density map at a specific vertical elevation that can pinpoint specific areas of liquid maldistribution or solids/liquid build-up.

Operation Challenge

The challenge was two-fold: first, what operating variables could be manipulated to control the coking rate and second what could be used to monitor the coking rate in the packing? At the beginning of a cycle run a baseline Tru-Grid™ Scan and ThruVision™ scan were done. Figure 5a shows the initial ThruVision™ scan results.

Thereafter the scans were repeated on a periodic basis, approximately every three months. The vacuum tower wash bed was operated very aggressively during the first cycle - minimum wash oil to maximise HVGO yield. This was purposely done to set parameters for aggressive operation. The first section of the graph in Figure 6 shows the average wash bed densities calculated from the ThruVision™ scan data for Cycle 1. Figure 5b shows the ThruVision™ scan from the end of this cycle run. Over the 2-year period there was a 40% increase in packing density due to coke build-up and/or excess liquid retention.

After the two-year period there was an opportunity shutdown due to a problem unrelated to the coking. Subsequent shutdown and inspection showed the packing severely fouled with coke and the packing was replaced. The next cycle run was purposely operated with less aggressive operation, higher wash oil rates to retard the rate of coking. This cycle run also lasted approximately two years. As seen from the second section of Figure 6, over the two-year cycle run the average packing density increased by a little more than 20%.

Figure 5

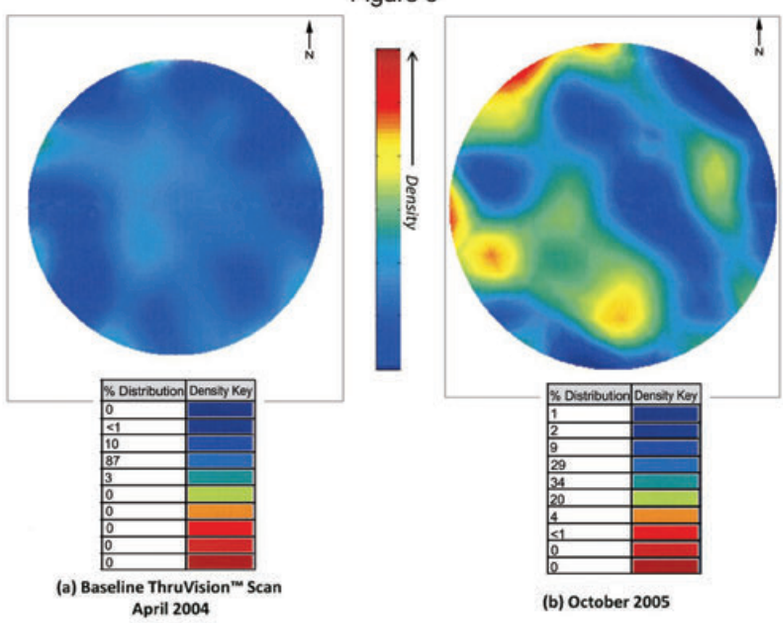


Figure 5 – (a) Baseline scan results of crude vacuum tower wash bed; (b) ThruVisionTM scan result at the end of Cycle 1.

Data Analysis

Cycles 1 and 2 established boundaries for operating parameters between very aggressive operation and conservative operation. Several operating parameters were compared to the average packing density from the ThruVision™ scans to correlate the best operating parameter with the rate of coking.

The third cycle run lasted almost six years. This cycle run can be divided into three segments due to the operating demand placed on the refinery. In late 2010, management decided to lengthen the cycle time beyond the original five years. Therefore, the over-flash rate was dramatically increased in order to retard the coking

(Continued on page 4)

Figure 6

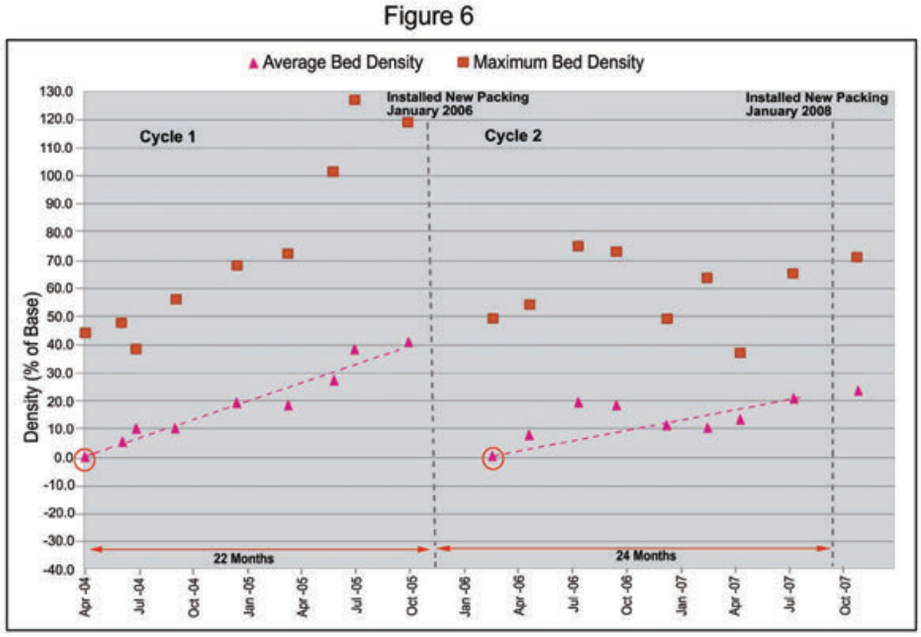


Figure 6 – Cycle 1 wash bed densities when vacuum column operated aggressively. Cycle 2 wash bed densities when vacuum column operated more conservatively.

Crude Vacuum Tower

(Continued from page 3)

rate at the expense of some HVGO yield. Then in mid-2012, management advanced the planned end of the cycle run. At that time, operations reduced the over-flash rate to increase HVGO yield. Knowing the wash bed packing was going to be replaced allowed operations to tolerate an increased coking rate. However, to have a little cushion the decision was made to not be as aggressive as was done during Cycle 1. Figure 7 shows the over-flash rate versus the packing density during this entire 69-month cycle run.

ThruVision™ scans were used to monitor and determine the average wash bed packing density through the cycle run. While the primary purpose for doing a ThruVision™ scan is to study liquid distribution through a bed, the primary use for this application was to track the bed density to monitor the build-up of coke or the retention of liquid in the packing due to coke fouling.

Figure 7

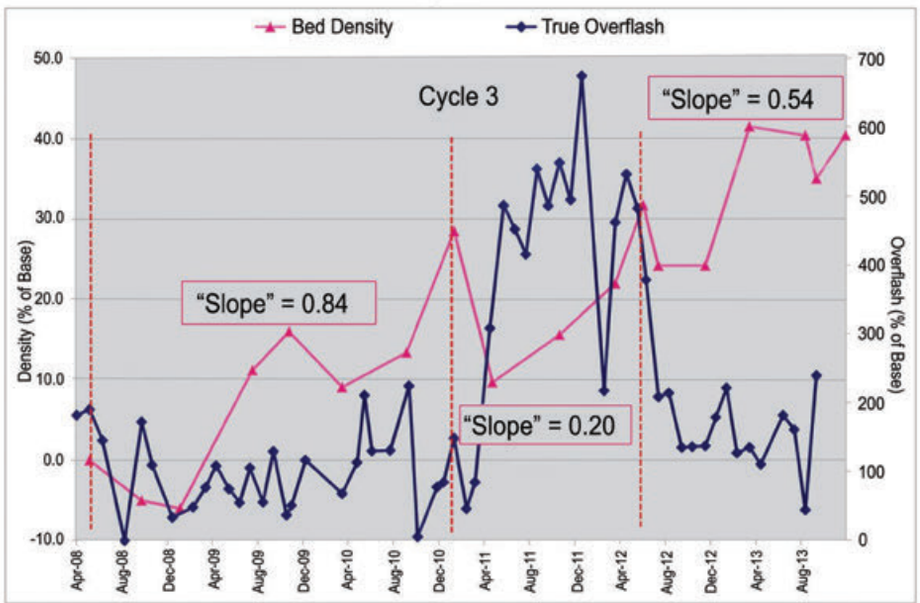


Figure 7 – Trend of wash bed packing density versus true overflash over the 69 month run of Cycle 3.

Conclusion

Marathon Petroleum Company manages crude vacuum tower operating conditions to maximise HVGO yield through a complete cycle run. ThruVision™ technology provides a detailed density map yielding extensive cross-sectional coverage to monitor fouling/coking in packed beds. The operating stratagem of using Tracerco's ThruVision™ technology to routinely monitor the crude vacuum tower wash bed density for increases in density signifying coke build-up and adjusting the column operating true over-flash rate is used to control the rate of coking, maximising profit from HVGO yield and regarding the wash bed packing as a consumable expense.

For a copy of the entire paper, email tracerco@tracerco.com and reference Crude Vacuum Tower Wash Bed Article in the subject line. Upon receipt of your request we will email you a pdf version of the full article.

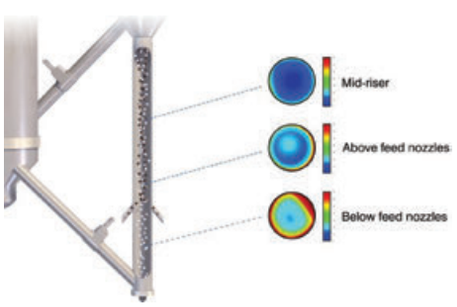
If you would like to learn more on how ThruVision™ scans can help personnel gain a much better understanding of the coking process within the wash bed of a Vacuum column contact a Tracerco technical advisor.

Applications Note – ThruVision™

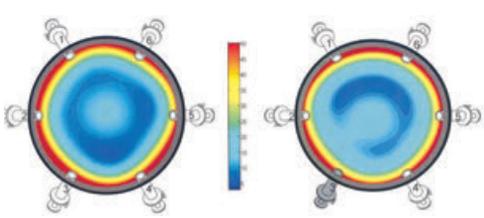
On-line Distribution Analysis In Packed Beds, Piping And Fluidised Catalyst Systems

Tracerco's ThruVision™ scan technology, similar to a CT scan, is a diagnostic technique that generates a cross-sectional density profile of a reactor riser, distillation column, piping or other equipment where knowledge of process flow distribution is vital to performance. The ThruVision™ scan system is transportable and adaptable for scanning equipment while on-stream. This unique scanning technique has been used by our customers to identify liquid maldistribution in packed bed columns, monitor the coking process in a vacuum tower wash bed, investigate damage in a mist eliminator pad, or generate a detailed cross-sectional density profile of a FCC Riser showing catalyst flow distribution. It is often used to evaluate changes in design and operation of feed injection or lift steam nozzles. Scan results can determine if a nozzle is plugged or fouled.

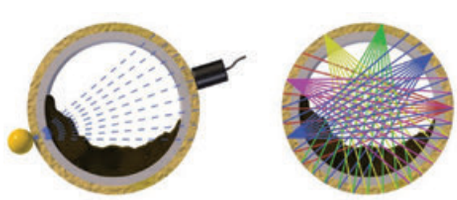
Application of the ThruVision™ scan technology has provided a new "window" for observing phase distribution inside industrial process units in real time at an economical cost.



ThruVision™ of FCC Riser



ThruVision™ scan simulated plugged nozzle.



ThruVision™ technique on piping to detect build-up.

Manage and Control Your Turnaround Costs to Avoid Possible Surprises.

A Tru-Scan™ or Tru-Grid™ Scan will assist in defining and developing a turnaround critical path project scope at an early stage ensuring that your turnaround meets your goals. The most common use of gamma scans is to give process engineers and operations an online tool that results in understanding how a column is performing. This data can be used in advance of a turnaround to identify tray or packing damage and other process problems without having to shut down the column for internal inspections. These results will fully prepare turnaround planners with the knowledge they need for critical path decisions that must be made prior to a shutdown. At other times the results from a Tru-Scan™ or Tru-Grid™ Scan can either justify an unscheduled shutdown or identify options that will enable a plant to continue operating until the next scheduled shutdown.

Tower scans are used to evaluate the mechanical integrity and hydraulic performance of trayed columns by measuring froth levels on tray decks, liquid backup in downcomers, and clarity of liquid disengagement zones. Damaged or missing trays or packing, plugged downcomers, feed issues, and tray fouling are examples of problems with columns that can be diagnosed with a Tracerco scan.

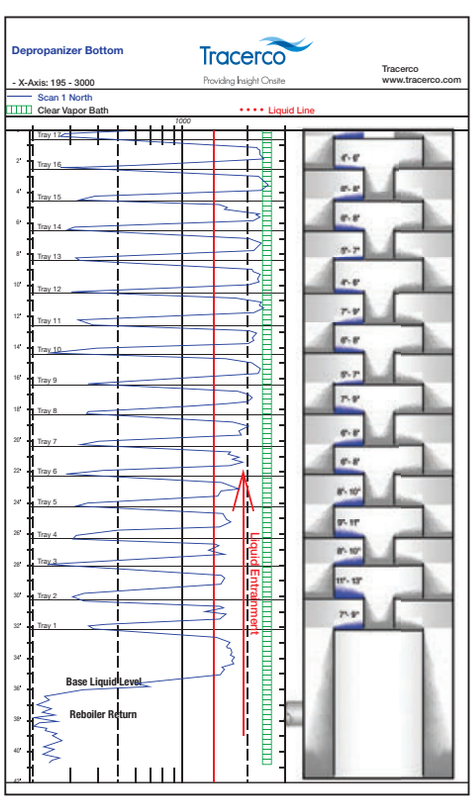


Figure 8 – Tru-Scan™ results decided the course of action for the refinery during their turnaround. Modifications to the tower were made instead of preparing to replace damaged trays which scan results found were not necessary.

When damage is found, a turnaround coordinator can accurately define what trays and/or packing are needed, estimate the cost, and procure the needed hardware weeks in advance of a scheduled turnaround. Tru-Scan™ or Tru-Grid™ Scans performed five to six weeks prior to a scheduled shutdown usually provides enough time to order new equipment without expediting charges and to schedule the required manpower. Should an upset occur after that point additional scanning could be performed to identify if any new problems have developed that would require a revision to a critical path item.

Case Study: Depropanizer Scan Data Determines Damaged Trays Was Not The Problem

A refiner requested that Tracerco perform scans on all of their towers within six processing units prior to an upcoming turnaround. A good illustration of how a Tru-Scan™ aided in their critical path decisions is from the results found in a Depropanizer column. The Depropanizer had to be run with a high base liquid level in order for the column's reboiler to operate properly. The base liquid level routinely covered the reboiler return nozzle.

The ΔP of the Depropanizer was higher than normal. Operations suspected flooding, probably as a result of some tray damage to the lower trays due to the high base liquid level. The scan results did show the high base liquid level covering the reboiler return nozzle. As a result of the reboiler return vapor mixing with the base liquid there was a lot of liquid entrainment below the bottom tray (Tray 1 in Figure 8). The bottom trays were flooding but had no apparent damage. These scan results decided the course of action for the refinery during the turnaround. Plans were made to modify piping so the reboiler would operate correctly with the proper base liquid level instead of purchasing trays when scan results indicted the existing trays were not damaged.

The refinery turnaround planners utilized scan data results from all the columns prior to their scheduled turnaround to order replacement equipment and help schedule the manpower required for the turnaround. The data indicated mechanical problems in three towers, process problems in six towers and no problems were indicated in the eleven remaining towers. Entry into these eleven columns could be avoided if there was no history of corrosion or other inspection needed.

This information essentially set the turnaround plan and avoided potential surprises on items that could have disrupted the original critical path. A chart of the results is shown in Figure 9.

Conclusion

Strategic use of Tracerco's Pre-Turnaround scan technology will enable you to identify equipment that does not need to be included in your turnaround project, evaluate the status of historically problematic process equipment, and establish the equipment dictating the critical path. A unit manager can avoid shutting down a column based upon the mere suspicion of tray damage, when the real problem may be related to process conditions. A turnaround coordinator can accurately define, estimate, and procure trays, packing, and other hardware weeks in advance of the turnaround schedule. The largest payoff from using Pre-Turnaround gamma scans is when a unit manager can avoid shutting down a column altogether.

Summary of Problems

Crude Unit
Atmospheric Tower
All trays in place
Vacuum Tower
LVGO distributor plugged or damaged
HVGO draw tray leaking or wash oil distributor damage

Crude Unit
Main Fractionator
Trays 21 and 22 damaged, all other internals in place

Alky Unit
Isostripper
High reflux rate or subcooled reflux causing flooding on top four trays, lower accumulator tray leaking
Depropanizer
Severe liquid entrainment throughout the tower, no indications of mechanical damage
Acid stipper
No problems indicated
Acid regenerator
No problems indicated

Unsat Gas Plant
Isobutune Absorber
Flooding Present on top 32 trays

Amine Absorber
No problems indicated
Debutanizer
No problems indicated
Depropanizer
No Tray Damage. High base liquid level covering the reboiler return inlet.
Naptha Splitter
No problems indicated

Sat Gas Plant
Stripper
No problems indicated
Amine Absorber
No problems indicated
Debutanizer
Severe flooding throughout the tower
Depropanizer Dryer
High reflux rate or subcooled reflux flooding top three trays, Tray 10 heavily loaded - possible downcomer restriction
Sponge Oil Absorber
No problems indicated
Main Absorber
All trays in place

Delayed Coking Unit
Coker Fractionator
No problems indicated

Figure 9 – Turnaround planners utilised scan data results from all the columns scanned prior to the scheduled turnaround to order replacement equipment and schedule the manpower required.

New Product Announcement: PED-ER and PED-ER+

Tracerco has added to its award-winning range of radiation monitors with two new Personal Electronic Dosimeters (PEDs) – the PED-ER and PED-ER+. With an extended dose rate range of up to 1 Sv/h (100 R/h), an energy range of 48 Kev to 3 MeV, and a light, compact, robust and reliable design, the PED-ER and PED-ER+ provide the ultimate radiation monitoring, measurement and management solution for those working in challenging environments.

As per our existing PEDs (the PED-IS, PED Blue and PED+), the PED-ER has been designed to keep things simple. With one button operation and an easy to follow menu system, the device can be easily operated with no training needed. Audio and visual alarms with a vibration function, also ensure that personnel are immediately notified if a set dose rate is reached or exceeded.

The PED-ER+ has the same unique features as the PED-ER in terms of portability, an IP67 rating and the ability to provide immediate data on an intuitive, large clear display, however it also boasts a number of additional features. Most notably, the PED-ER+ can be used as both a Personal Dosimeter and a handheld dose rate survey meter, ensuring that the safety of both the worker, and those personnel that are in the area of the event is never compromised. Pop-up message alarms (when dose limits are reached), to the user, also allow personnel to organise, plan and respond to radiation more efficiently.

The PED-ER+ comes complete with Bluetooth technology, meaning live dose rates can be transmitted to an Android device located in a safe area. This allows the management and monitoring of situations to be undertaken in real time, away from a potentially hazardous event. The addition of GPS tracking also provides location data alongside dose data, giving a map of potential radiation hazards when data is downloaded.

Graham Barker, Senior Commercial Manager noted "The capability to act quickly and safely to incidents in dangerous and hazardous environments is extremely important for industrial Non-Destructive Testing (NDT) workers, the emergency services and first response teams (CBRNe). The development and launch of the PED-ER and PED-ER+ will ensure that upon entry into both known (for example those working in the Industrial NDT market) and unknown (for example first responders) scenarios, that personnel are equipped with the correct radiation monitoring equipment to ensure any radiological hazard is detected and any exposure to radiation is monitored carefully".

To request more information on our Tracerco range of personal radiation monitors email us at radiation.monitors@tracerco.com.

Billingham, UK
Tel: +44 (0) 1642 375500

Brussels, Belgium
Tel: +32 (0) 2 465 85 20

Villefontaine, France
Tel: +33 (0) 4 74 94 79 88

Milan, Italy
Tel: +39 02 90989971

Bergen, Norway
Tel: +47 55 36 55 40

Perth, Australia
Tel: +61 (0) 8 9209 3905

Rio de Janerio, RJ, Brasil
Tel: +55 (21) 3385 6800

Kuala Lumpur, Malaysia
Tel: +603 7803 4622

Baku, Azerbaijan
Tel: +994 12 5141619

Singapore
Tel: +65 6316 3626

Abu Dhabi, United Arab Emirates
Tel: +971 (0) 2 554 1672

Muscat, Oman
Tel: +971 (0) 2 554 1672

Maharashtra, India
Tel: +91 2227401427/428 Ext: 321

tracerco@tracerco.com www.tracerco.com

Johnson Matthey
Inspiring science, enhancing life

XM1357/0/0