insight

Tracerco

Providing Insight Onsite

Volume 4 Edition 2

TRACERCO Technology Led By Our Customers

Pioneering The Way For Process Diagnostic Innovations

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As a major force in the industry, Tracerco has had a significant role in many successful developments across the world. Andy Hurst, Tracerco's Managing Director said "We are constantly investing in the development of our people and our technologies to ensure that Tracerco continues to offer the industry the most advanced solutions. Our ability to take on challenging projects and deliver them on time, within budget and to the highest safety standards has been a major factor in the continued growth of our business."

You may recognise Tracerco as the world leader in providing a wide range of scanning and tracer applications, or you may be familiar with Tracerco from its leading-edge technology in nuclear level, density and interface instruments, or have read about Tracerco's award winning Profiler for separator and desalter applications. We would like to provide you some insight as to how we have become the industry leader. Over the last fifty years Tracerco continues to invest in the research and development of specialised equipment and its implementation through the training of our staff to ensure we offer the safest, highest quality, and most accurate process diagnostics service available.

Wireless detectors developed specifically and exclusively by Tracerco reduce spark potential and eliminates electrical cables.

Tracerco has an expert staff, including many individuals with 25+ years of experience, dedicated to supporting our field crews and customers by developing new and improved scanning equipment, reviewing and advising on test procedures and the resulting data, and updating our customised software so that Tracerco provides the most authoritative information available to identify problems with industrial process systems.

At Tracerco, we recognise our staff as our main asset and represent the future of the business. With the health, safety and welfare of our employees and customers as our utmost priority Tracerco is committed to ensuring staff receive comprehensive training and support to enable the company to meet and exceed our clients' requirements. We are proud to report that Tracerco recently surpassed two and a quarter million man-hours worked without a reportable accident. A contributing factor to achieving this goal is the continuing employee safety training programmes both in the office and at the worksite.

We Have Listened To Your Needs - Wireless Data Acquisition Systems

After years of literally wrestling with and untangling yards of electrical cable, we knew there had to be a better way! A data acquisition system based on use of high voltage electrical cable is fraught with potential problems and potentially unreliable data. In 2006 Tracerco initiated an in-house programme to develop low voltage scanning electronics that would significantly reduce spark potential when compared to any other gamma scanning data acquisition systems in use. Tracerco's wireless detectors were designed and tested exclusively for use as scanning detectors. Our wireless detector eliminates electrical cable

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that can easily burn and expose high voltage wiring, and the inherent problematical cable connections that can so easily generate erroneous data. Tracerco's system utilises a signal validation protocol such that if the data signal strength is not correct no data is transmitted eliminating the possibility of recording misleading information.

Through the years we have witnessed the trend of separation and distillation equipment becoming larger and larger. The ultimate examples of this are recent startups of refinery vacuum towers exceeding 50 feet (19 m) in diameter with packing internals. Without advancement in radiation detection devices, scanning these large towers or thick walled vessels would require the use of larger and larger radiation sources. At some point, due to personnel safety and regulations on transport and use of radiation sources, the practical limit of using higher activity radiation sources is exceeded. Tracerco embarked on a research programme to develop more sensitive radiation detection devices. While our research programme is still ongoing, an initial success has been the development of a specialized detector that increases our radiation sensitivity by 30-40%. Highlighted in our last issue of Tracerco News was a case study where these special detectors were used to scan a tower with 7 inch thick walls. (Vol4Ed1 – Special Situations Call for Extraordinary Measures.) This recent development allows Tracerco to use conventional radiation sources to scan incrementally larger towers.

Optimising Packed Tower or FCCU Riser Diagnostics Using TRACERCO Diagnostics™ ThruVision

Determining the best approach to help diagnose your process problem is Tracerco's area of expertise. In the case of troubleshooting packed towers or FCCU Risers Tracerco has developed the TRACERCO Diagnostics™ ThruVision Scan procedure that provides data similar to a medical CT scan. This scan technology is used to obtain a density profile of a cross-section of a piece of process equipment such as a packed tower, piping, or FCCU riser at one elevation but with 360-degree coverage at that elevation. The TRACERCO Diagnostics™ ThruVision Scan provides a more detailed density profile than a conventional gamma scan and helps address the situation when different phases are poorly distributed or solids build-up occurs.

Case Study 1: Wash Oil Bed Liquid Distribution Pattern

A US refiner wanted to reduce their wash oil rates to their vacuum column wash bed as a cost saving to the refinery. A conventional TRACERCO Diagnostics™ Scan had demonstrated good liquid distribution into the top layers of packing. The liquid distributor was a typical pipe ladder type distributor. When trying to minimise liquid rates the concern was that some dry areas may develop that a grid scan could miss across the large diameter of the vacuum column. One way to observe if the wash bed packing was being properly wetted at different wash oil feed rates was to use a TRACERCO Diagnostics™ ThruVision Scan.

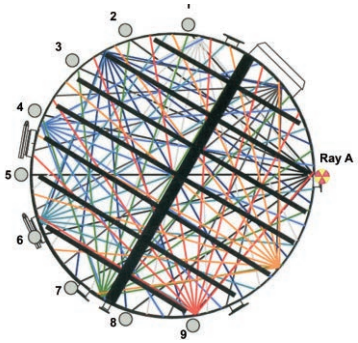

Figure 1 *TRACERCO Diagnostics™ ThruVision Scan orientation including the pipe distributor.*

The vacuum column wash oil bed was scanned using the TRACERCO Diagnostics™ ThruVision Scan application to determine the liquid distribution patterns at two different liquid rates. The inspections were performed to provide comparative data at the different flow conditions. The scan was performed at an elevation 12 inches into the wash oil bed at low and high wash oil rates. Figure 1 represents the TRACERCO Diagnostics™ ThruVision Scan orientation including the pipe distributor.

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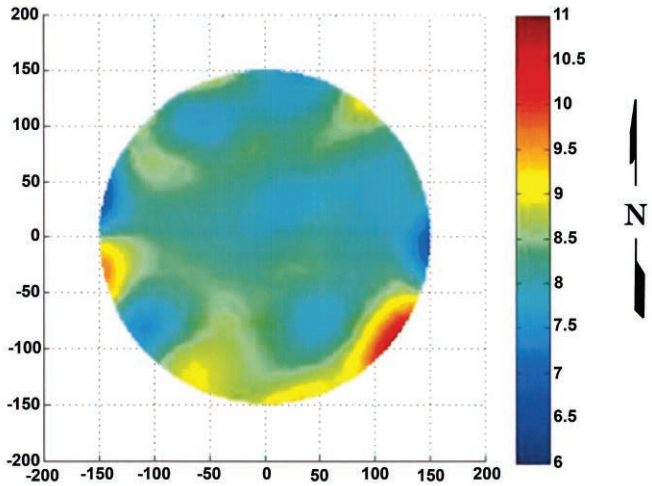

Figure 2 *First scan results at high wash oil rates indicated some higher than average densities near the column wall (1500 gpm wash oil rate).*

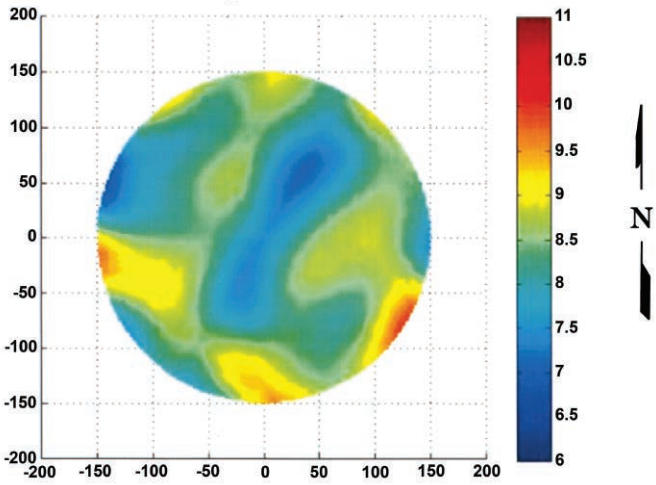

Figure 3 *The second set of results at low rates revealed a higher degree of poor liquid distribution (900 gpm wash oil rate).*

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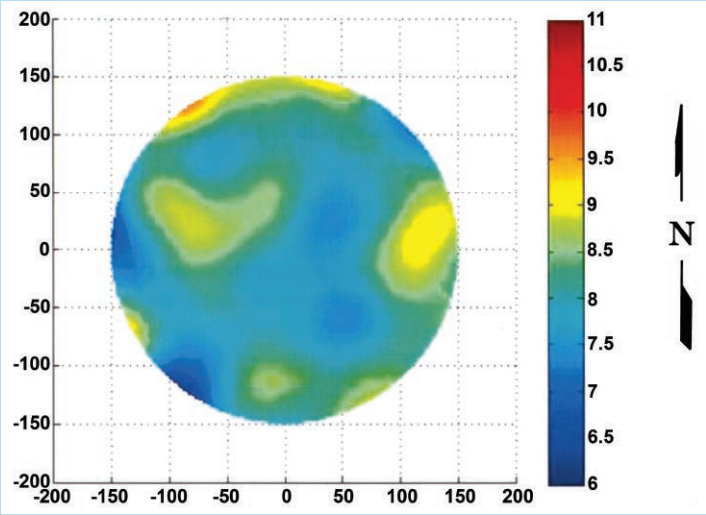

Figure 4 *Scan results the second day showed results in between the two extremes from the previous day results (1100 gpm wash oil rate).*

The first TRACERCO™ Diagnostics ThruVision Scan results at 1500 gpm wash oil rate revealed a relatively uniform density profile (7.5 to 9 lbs/ft^3) across the majority of the bed (Figure 2). However, concentrated near the column wall there were several pockets of higher than average densities and areas of lower than average density.

The second TRACERCO Diagnostics™ ThruVision Scan at 900 gpm wash oil rates revealed a higher degree of non-uniformity, translating to poorer liquid distribution (Figure 3). Most notable was an area of low density (6 to 7 lbs/ft^3) from the NE to the SW in the middle of the bed (along the distributor's inlet header) where low liquid flow would tend to allow coke to build up. There was also larger, more pronounced areas of higher densities (over 9 lbs/ft^3) where excess oil was being applied.

The following day the wash oil bed was scanned again at an intermediate rate of 1100 gpm using the same orientation as used before, shown in Figure 1. This scan showed results in between the two extremes (Figure 4). There was a small area near the NW wall with higher than average density readings of 8.5-9.0 lb/ft^3. There were areas of lower than average densities along the SW wall and in the middle of the eastern quadrant. This profile however showed an improvement over the profile at 900 gpm and did not show the high liquid traffic along the wall as experienced at 1500 gpm. Based on this data alone the optimal wash oil rate seems to be in between 1100 and 1500 gpm.

Benefits

The TRACERCO Diagnostics™ ThruVision Scans showed that the pipe distributor did not appear to work well when the oil rates were set at 900 gpm. At 1500 gpm there was areas along the column wall that had higher than average densities and also some areas with lower than average densities. The intermediate test at 1100 gpm showed improved liquid density distribution compared to the 900 gpm rate, but overall worse than the 1500 gpm. While there may be a rate somewhat lower than 1500 gpm where good liquid distribution is achievable it appears that with this distributor design the rate reduction possible without a decrease in efficiency may be minimal.

Unique Tracer Approach For Enhanced Solutions

An increasing number of our customers have been asking to find process leaks that are too small to measure using radioisotope technology. This customer requirement was presented to Tracerco's R&D department – satisfy the need to detect leaks smaller than 100 ppm. Tracerco has successful experience in developing tracers used in reservoir mapping and fuel adulteration programmes and the associated analytical measurement techniques associated with these. Experience in this area was used by our R&D experts to provide a solution for detecting process leaks down to 100 ppm or less. Tracerco has developed a range of tracer compounds that are chemically and thermally stable and can be readily detected in samples by a specialised gas chromatograph / mass spectrometer. These chemical tracers can be found in hydrocarbon samples at concentrations as low as 1 part per billion.

The following case study illustrates how two different chemical tracers were used to identify which of a pair of heat exchangers was leaking.

Case Study 2 – Chemical Tracers Detect Leaking Exchanger

Exchangers A and B were condensing naphtha from the crude column on the shell side using raw crude as the cooling media on the tube side. Lab results showed that the naptha was out of specification with regards to colour, indicating that there may be damage to the internals of the crude column or

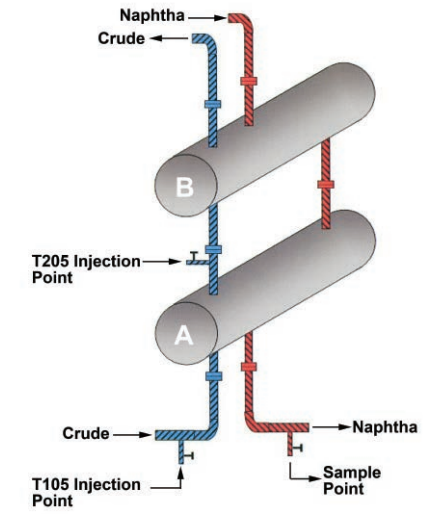

Figure 5 *Exchanger A and B schematic illustrating the two injection points and common sample point used.*

a leak in an exchanger. TRACERCO Diagnostics™ Scans were performed first on the crude column and results indicated that there was no damage to the column internals, nor operational issues such as flooding or severe entrainment. It was decided to perform a leak test on the two exchangers. The operating rates at the time

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of the tests were 8600 bbls/day of crude and 4300 bbls/day of naphtha. Since the leak was expected to be low, chemical tracers were selected as the best option.

A review of the Process and Instrumentation Diagrams (P&ID) showed that there was no sample point between the exchangers on the naphtha side, so a common sample point downstream of the bank of exchangers had to be used. However there was an injection point before each of the two exchangers on the crude side (Figure 5). The first Tracerco proprietary chemical tracer, T105, was injected into the high-pressure crude inlet to the bottom exchanger (A) of the bank of exchangers. This tracer passed through the crude side of the bottom exchanger and then to the top exchanger (B). As the tracer was injected into the feed, the first sample cylinder was opened and then closed after a 30 second interval. The other nine sample cylinders were opened and closed in sequence, each over a 30 second period.

After the 10th sample was collected from the first test a different chemical tracer, T205, was injected into the feed line between the exchangers. The second chemical tracer passed through the crude side of the top exchanger (B) only. The sample point was the same as for the first test.

Sample cylinders were packaged and sent overnight to the Tracerco lab in Pasadena, Texas where they were analysed for tracer content the following morning.

Analysis Results Confirm Leaking Exchanger

Flow rates of the crude and naphtha compared to the volume of the exchangers indicated that the residence time of the crude stream through exchangers A and B should have been about 2 minutes each. The naphtha is condensing in these exchangers and even though the naphtha rate is one half of the crude flow rate, the residence time of the naphtha through both exchangers was expected to be about 2 minutes through each.

Analysis of the first chemical tracer (T105) appeared in sample A5 with the maximum concentration of tracer seen in sample A6 (Figure 6). The residence times matching these samples were 2.5 and 3 minutes. Since the residence times were not known exactly, these results indicated a leak either near the crude outlet of the bottom exchanger (A) or near the crude inlet of the top exchanger (B).

The second tracer (T205) that had been injected into the crude feed to the top exchanger was seen in samples B2 and B3, with the highest concentration of tracer found in sample B2. Since the analysis only found tracer in the first 2 samples, the leak appeared to happen near the crude inlet of the top exchanger (B).

The test data showed a strong positive tracer response indicating that the top exchanger (B) was indeed leaking. But was the bottom exchanger (A) also leaking? The residence time of the chemical tracer found in the naphtha samples showed that the tracer had likely already passed through the bottom exchanger (A) and was near the entrance to the top exchanger (B). Therefore the conclusion was made that only the top exchanger (B) was leaking.

Based on the process rates through these exchangers, the amount of tracer injected, and the amount of tracer in the samples, the leak size was calculated to be approximately 100 ppm (0.01%)

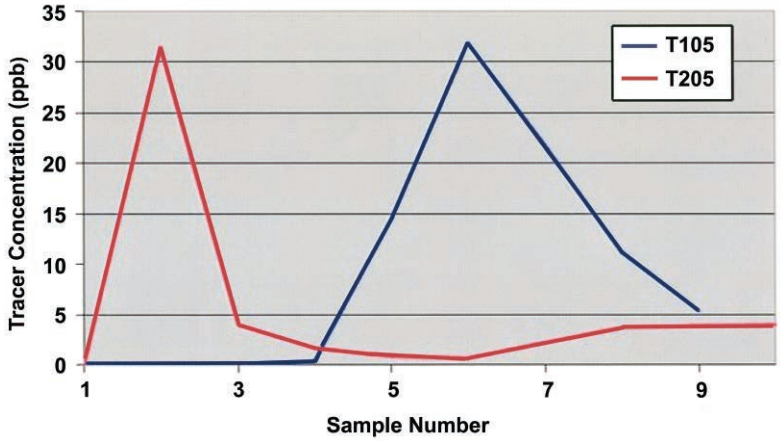

Figure 6 *Tracer analysis data revealed a strong positive tracer response indicating that Exchanger B was leaking.*

Benefits

These exchangers were floating head design, and experience shows that finding small leaks is very difficult and time consuming. With the knowledge that the B exchanger was leaking, the plant was able to shutdown and replace the leaking bundle with a new bundle and restart the unit with minimal downtime. After restart, the lab analysis showed the naphtha colour problem had been eliminated.

This chemical tracer approach is only offered by Tracerco and can provide plant personnel new alternatives for investigating plant operating performance with the goal of reduced diagnostic and shutdown time and reduced maintenance costs.

HYPERION™ LevelFinderPro – Lightweight, Low Power Gauge with Heavyweight Credentials

Next Generation Technology for Monitoring The Presence of Solids Build-Up in Process Vessels

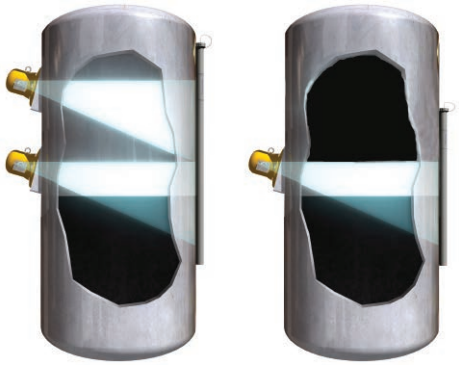

Figure 7 *External source variation for bulk level control, alarm and critical process shutdown.*

Tracerco provides a full range of nucleonic instrumentation solutions to the process industry, allowing detection of key parameters such as level, density and interface of liquids, gases and solids. Every instrument is custom designed and tailored to each customer's specific requirement providing "real time in vessel" measurements with no moving parts to eliminate mechanical failure or fouling.

Tracerco products are used in industrial sites worldwide to keep process systems on-line, diagnose processing problems or optimise operational parameters allowing customers to maximise product output at minimum cost. The power of the technology is in its ability to "see through" vessel walls to determine what is happening inside a particular process system without the need to shut down. Nucleonic Instrumentation is commonly used for continuous liquid level measurement in cases where other types of level control have failed due to the nature of material being processed.

A number of our customers expressed a concern regarding the accuracy of nucleonic instrumentation when installed in a process system prone to solids build-up such as coke within a vacuum tower bottoms or polymer within a reactor or crystallizer vessel. This concern is well founded. The principle of measurement uses a small source of gamma radiation housed in a lead filled container, which emits a collimated beam of radiation across the vessel. When the vessel is empty this penetrates the vessel wall, across the inside of the vessel, through the other wall and is detected using a radiation counting device. An angle is cut into the container that allows a specific vertical range to be covered. Figure 7 shows the general arrangement for the external source variation used for bulk level control, alarm and critical process shutdown.

As the level of liquid in the vessel rises across the detector vertical position, it attenuates the radiation reaching the detector. This causes a decreasing pulse rate to be produced by the radiation detector, which is then converted into a 4-20 mA and a digital output signal. If solids start to build-up on the vessel wall in the vapour space the solid material within the radiation beam reduces the amount of radiation reaching the detector. This in turn results in a lower than expected count rate that, when converted using calibration data within the instrument that relates count rate to liquid height, misinforms the control system that the liquid level is higher than reality. A nucleonic gauge that could reliably compensate for the presence of solids build-up on vessel walls would allow product throughput and quality to be maximised while ensuring the safety integrity function of level trips be maintained. In addition, having an insight as to how, where and how quickly product is building up promotes understanding and allows shutdowns regimes to be planned when needed.

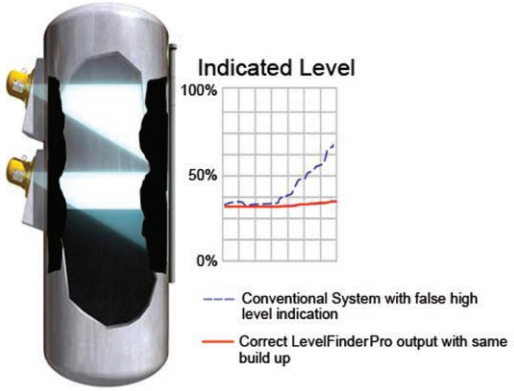

Figure 8 *Typical field equipment and illustration of level output in presence of build-up.*

Tracerco therefore developed The HYPERION™ LevelFinderPro to meet our customer requirements. This device can provide an accurate and repeatable level measurement in the presence of build-up and vapour fluctuations and can also give insight into what is occurring within the vapour region of the measurement range.

Benefits of HYPERION™ Technology

The patented HYPERION™ LevelFinderPro system (Figure 8) is the first and only instrument to provide true level indication in the presence of build-up and pressure fluctuations. The gauge also gives an indication of product build-up thickness within the vessel. In addition, unique processing algorithms allow a significant reduction in radioactive source sizes required. Up to 10 x smaller than other conventional systems. The detector is temperature stable, robust and extremely reliable. The technology is fault tolerant and proven at high temperatures without cooling systems.

This new dimension in measurement technology can significantly reduce down time, improve quality, allow process optimisation and increase times between shutdowns.

Instrument Overview

The HYPERION™ LevelFinderPro comprises of a field mounted detector and a compact control unit. The control module for the LevelFinderPro is a compact din rail

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HYPERION™ LevelFinderPro

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mounted unit, powered by 24Vdc with a 4-20mA and digital output to interface with a customer process control system. The instrument features digital technology communications and diagnostics using a windows based software package (Figure 9).

Product Supported by Expert Technical Service

All of the TRACERCO Diagnostics™ services and TRACERCO™ Instruments are backed up by a world-class field service team, able to rapidly respond to customers needs on a global basis with a 24-hour, 7 day-a-week customer call out system. Considerable resources are invested in training. All field service technologists are intensively trained using specialist classroom and field based study under the supervision of expert mentors to ensure all employees attain the standards of professionalism in technical and health and safety matters recognised by our customers anywhere in the world.

As you'd expect from a global services business, Tracerco has operational bases across the world. These regional service centers allow Tracerco to deliver products and services to customers anywhere in the world, while still retaining the important aspect of local service support to meet our customers demand.

If you would like to learn more about our specialist measurement instruments please contact a Tracerco representative in your area or visit our website at www.tracerco.com.

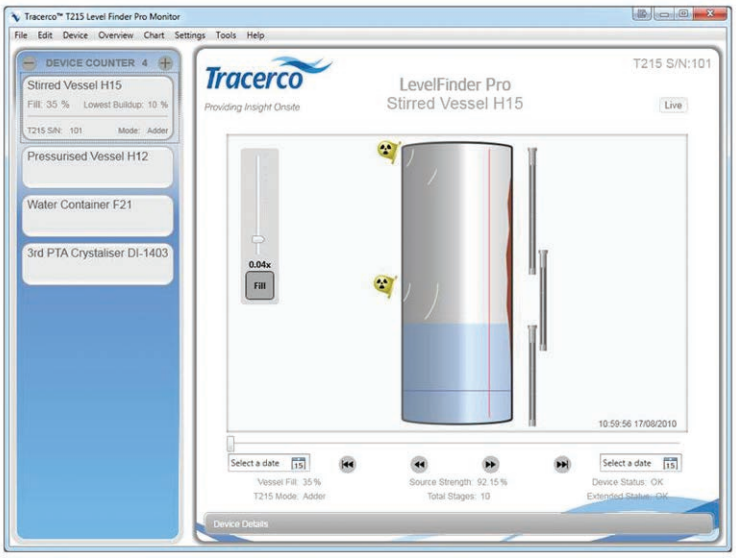

Figure 9 *Example screen showing equipment configuration, level output and build-up deposition.*

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