# THE RISE OF INSTRUMENTATION

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**Neil Murch, Tracerco, UK,** details the use of nucleonic instrumentation and technologies to deliver efficiency and performance gains in downstream refinery processes.

As the energy industry looks to align with other global industrial trends to decarbonise production operations and become more sustainable, greater emphasis will be placed on the downstream oil and gas sector to meet climate change targets, such as those set out by the Paris Agreement. Operators have a key role to play in delivering increased energy efficiency and reductions in greenhouse gas (GHG) emissions by investing in technology to enable process improvement and asset optimisation. There are significant investment and operational challenges associated with emerging initiatives such as electric cracking and replacing feedstocks, but there are other, lower-cost options that can be implemented over a much shorter timeframe to improve efficiency and potentially reduce emissions.

Instrumentation is a vital part of process control – it provides information to operators to assist in decision making, and acts as a safety function to prevent unplanned or unsafe conditions from occurring. However, it can often be overlooked as an area for improvement. There are technologies that lend themselves to troubleshooting production problems and process optimisation, such as neutron backscatter (NBS), tracers, and gamma scanning, along with fixed instrumentation that can offer more than just a conventional signal output. Only by having a complete understanding of the process through these valuable insights can operators make the changes required to deliver safer and more efficient production.

The refining process is energy intensive, and searching for opportunities to reduce energy consumption – especially when considering the volatility in the wholesale gas market – is becoming more of a priority. The industry is shifting to greener energy production and a number of oil and energy majors have recently announced plans for blue and green hydrogen production facilities. While greener sources of process energy are important, so too is optimising oil and gas processes to reduce consumption.

## Gaining process insight

Following a number of recent projects in crude desalter units (CDUs) for Tracerco's refining customers, the company found that process insight through scanning and instrumentation has given operators more confidence through evidence-based analysis to deliver more efficient operations. The use of NBS to preliminarily identify ongoing issues and upsets to guide process improvement, whilst maintaining continued control for ongoing efficiency, is achieved through instrumentation. While scanning can provide a snapshot in time, an advanced nucleonic instrument facilitates the continuous monitoring of process fluids in process vessels to enable efficient control of multiple interfaces, reducing demand for electrical grid transformers and improving salt removal efficiency (SRE) to decrease overhead corrosion and heat demand.

Figure 1 shows NBS scan line data from three sections of a first stage desalter. The technology works by using the nucleus of the hydrogen atom to slow down high-energy neutrons, thereby turning fast neutrons into slow neutrons. Fast neutrons penetrate the vessel wall and interact with the process contents, and if hydrogenous, slow neutrons diffuse back out to the detector adjacent to the neutron source. The signal level or intensity at the detector fluctuates rapidly when the hydrogen concentration behind the vessel wall changes, which is at the following interfaces: vapour and liquid, liquid and liquid, or liquid and solid. The analysed signal data in Figure 2 illustrates that solids removal performance is good in this vessel, although the operating levels are low, and an average of 22% by volume of the vessel is made up of emulsion. Other scans as part of the study on the second stage desalter were as high as 30%. It is apparent from the data that the emulsion layer can be reduced, increasing the available volume in the vessel, by adjusting chemical additive dosing to the appropriate level.

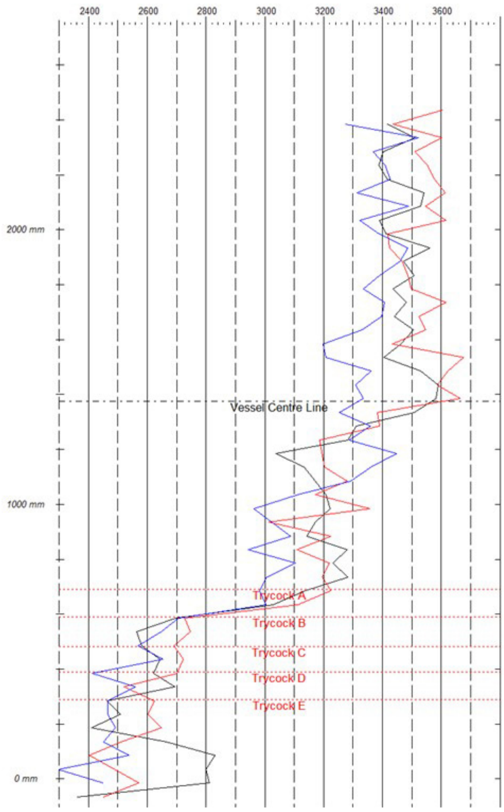


**Figure 1.** Tracerco NBS scan line data.

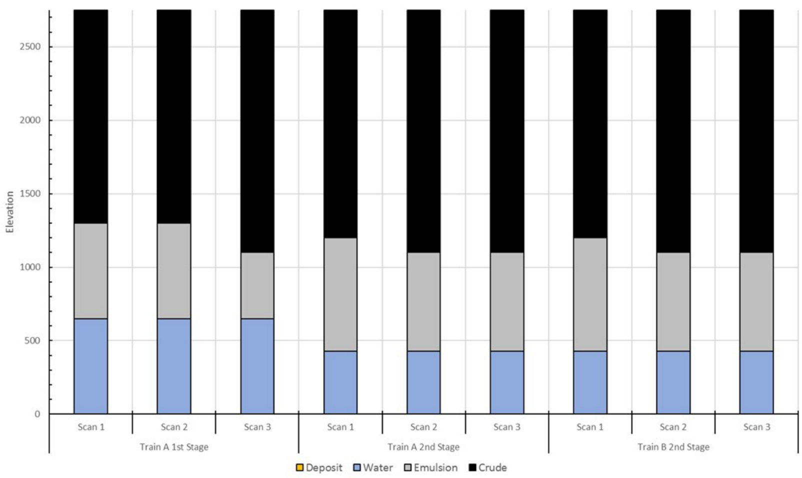


**Figure 2.** Tracerco analysis of scan data.

Additional scans at varying intervals can start to build a process picture, however ongoing monitoring of multiple data points over the operating ranges can provide greater insight. Trending operating levels continuously over time provides the next layer of process analysis, with the ability to inform process set points and maintenance regimes based on proven data, while also offering the capability to diversify crude blends. Emulsion control is one challenge related to crude blending, while maintaining continued operations and efficient removal of water, chlorides and other base impurities is equally important to the ongoing separation efficiency of the unit.

## Proven solutions

Tracerco's Profiler$^{TM}$ technology allows data to be captured across all of the process fluids, in order to build a true process fluid profile. The instrument is customisable to the measuring range requirements and utilises low-energy gamma to differentiate fluid density over its discrete point detector array. The Profiler takes the field signals and applies proprietary algorithms to deliver high-resolution measurements for use with the asset's distributed control system (DCS). While providing this information to the operator in real time, the instrument is also capable of offering trend functionality where information can be displayed in an easy-to-interpret format that enables unit engineers to visualise and analyse process data to better understand upsets and bottlenecks, leading to increased efficiency. The Profiler can be used for monitoring or interface control, even in shutdown functions.

Having limited visibility of the position or extent of interfaces due to inappropriate instrumentation can lead to increased demand on electrostatic grids, ultimately resulting in a trip or a greater amount of oil in water due to carry under. This could potentially affect wash water quality. Figure 3 is taken from the Profiler trend analysis and shows an unplanned process outage from a first stage desalter. The water and emulsion phases can be seen to increase, reaching the electrostatic grids, and overloading the transformers. Outages such as these are entirely preventable when the correct technology is deployed to monitor and control process levels.

Efficient separation is key to high-performing refinery CDUs. Having increased levels of chlorides in desalted crude can lead to issues such as reduced product quality, overhead corrosion, and potential catalyst deactivation further downstream, among others. Figure 4 shows monitoring of the increasing emulsion layer over time, which can stem from blending alternate feedstocks, overmixing of wash water, or overdosing of emulsion breakers. The visualisation provided by utilising high-resolution measurement allows refinery operators to achieve more precise interface positioning, leading to optimised mixing valve pressure drop, wash water droplet size, and desalter separation performance.

When attempting to categorise other effects to downstream processes through instrumentation, it is important to have the technology toolkit available to diagnose and address issues. There are a number of diagnostic techniques available using isotopes to assess liquid levels in columns, for example, and nucleonic technology overcomes some of the most challenging processes. Conventional nucleonic level instruments using scintillators provide a very accurate form of measurement, although the reliability of measurement can be susceptible to changes in process conditions. Gamma-ray absorption systems function on the principle of measuring a difference in the radiation field between two process densities, namely liquid and gas. Liquid is denser than gas and attenuates most or all of the signal, allowing the detector to measure the top of the liquid. Upsets occur when there are changes in the gas field in the form of solid deposition on the vessel wall, or liquid fall from overflowing trays. These increases in density impact the detector signal and affect the overall level output of the instrument. The segmental technology of the advanced nucleonic instrument Optimus™ overcomes this challenge.

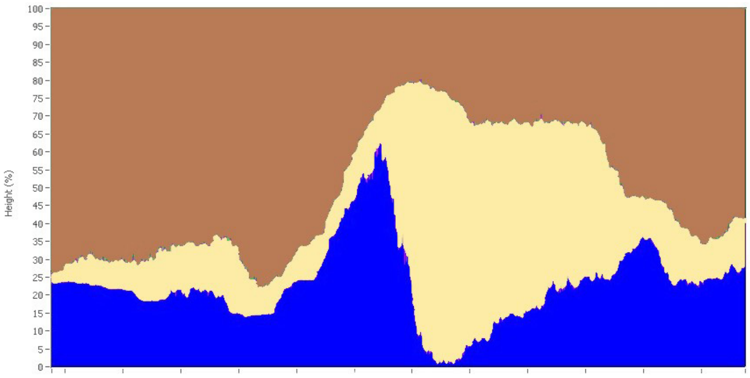


**Figure 3.** Process outage trend from Tracerco Profiler.

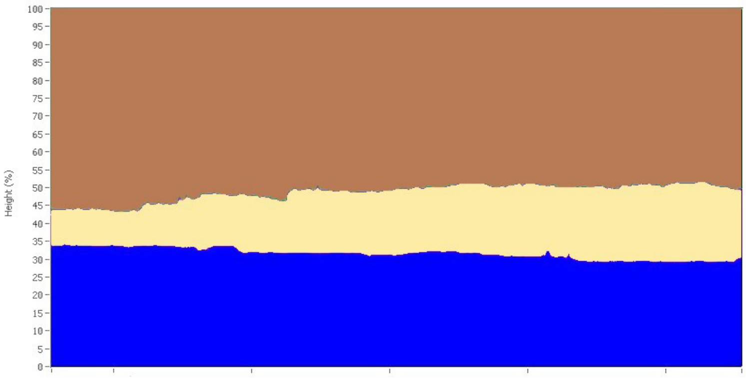


**Figure 4.** Emulsion increase trend from Tracerco Profiler.

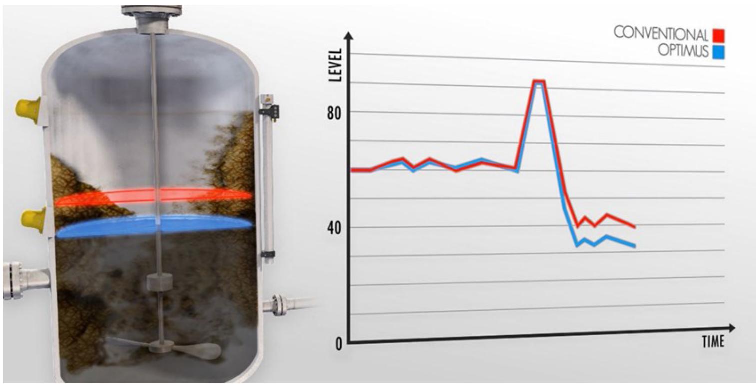


**Figure 5.** False level change due to build-up.

Figure 5 shows the representative change in level output due to changes of density in the vapour section of the column bottom, vs the corrected signal output of Optimus. By using multiple measurement points along the instrument's detector length, as well as specially-designed algorithms, the instrument can differentiate between false liquid level and true liquid level. This additional level of insight reduces the possibility of liquid carryover or gas blowby in the event of a false level, providing a versatile and reliable instrument in a range of measurement applications. The system offers a conventional analogue output to the DCS, as well as over 150 variables through HART to provide corrected process level, build-up levels and, in some cases, foam height. The technology is non-contact with the process, making it ideal for retrofit level applications where non-segmented measurement technology may be struggling to meet unit performance requirements.

## Conclusion

Accurate and reliable instrumentation systems are a necessity to operate safely, productively and efficiently, while offering added value to refinery operators and process engineering teams who are looking for additional levels of insight to make better-informed operational and process decisions. The use of nucleonics and these field-proven technologies is not limited to the most challenging applications, but can be deployed to optimise process measurement and control on a variety of level, density or interface applications across downstream process systems.

Tracerco is recognised for delivering technologies that enable operators to make informed decisions on the condition of their assets. The technology outlined in this article has been field-proven across hundreds of installations, and acts as the level and interface control solution for millions of barrels of oil processed every day.