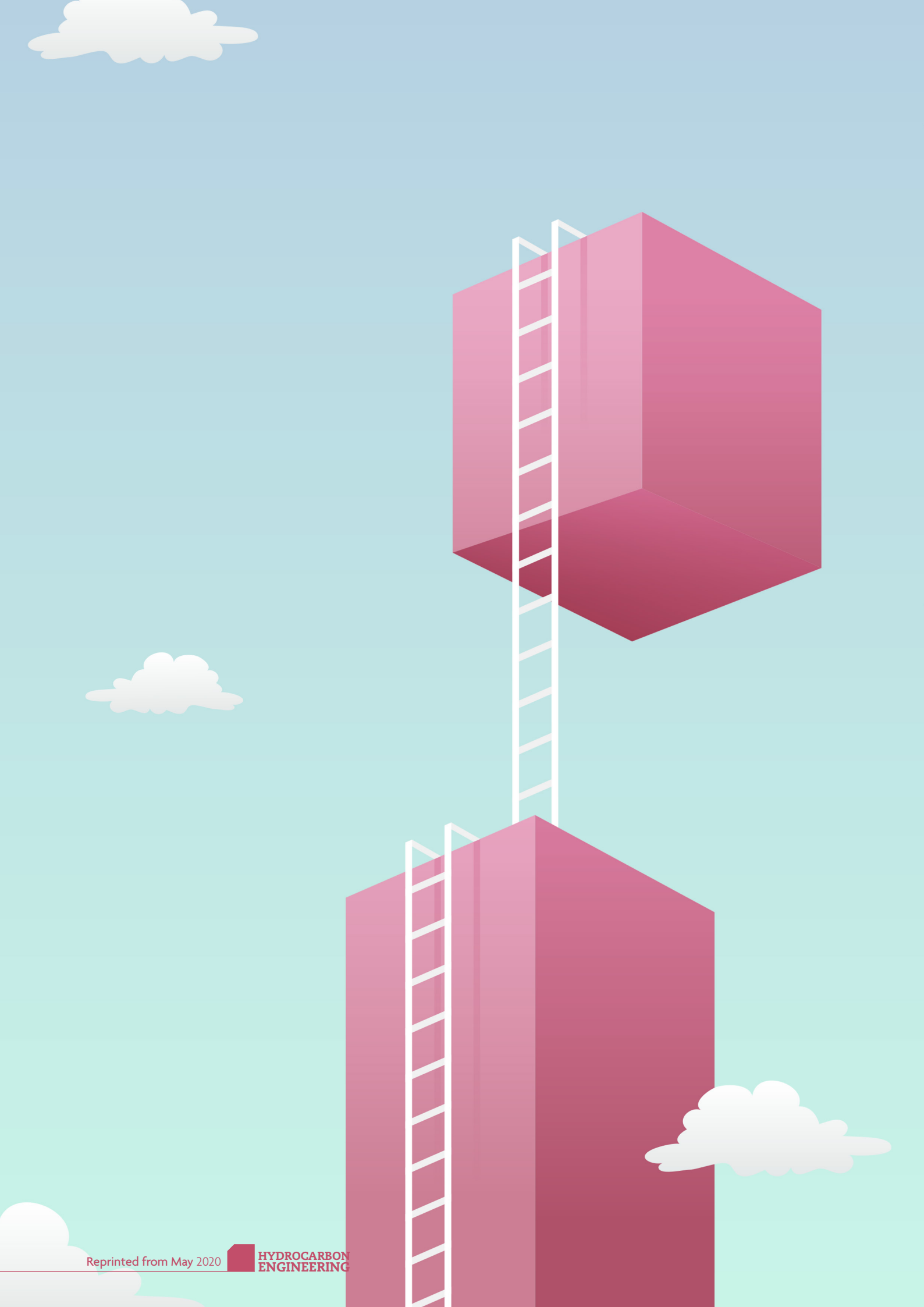




A WHOLE NEW LEVEL OF UNDERSTANDING

Graham Barker, Tracerco, UK, outlines the important role measurement has in controlling refinery feedstock composition in the desalter.

Historically, refineries distilled predominately light feedstocks. Nowadays, however, real financial benefits can be realised by blending these lighter crudes with heavy or opportunity crudes. The delta between light and heavy crudes can vary dramatically and when this reduction in feed costs per barrel is applied to the refinery throughput, substantial savings can be seen. Feedstock costs are the major operational cost for a refinery (above 80%). If operators can reduce these costs, they can increase margins within the refinery, which ultimately leads to additional profit. However, a full understanding of how these blended crudes will impact the operation of the refinery needs to be understood to ensure safe and continuous operation of the plant.

From a material perspective, many refineries are not constructed to withstand heavy and corrosive crudes. Therefore, removal of these elements within the desalter vessel allows for these blended crudes to be refined with minimal infrastructure change within the overall refinery.

Desalting the feedstock

Blended feedstocks contain numerous contaminants that can cause issues within the process stream. Suspended solids, inorganic salt, sand, and drilling mud all need to be

removed to ensure a high-quality refined product. These contaminants are washed from the crude oil by injecting water into the desalter vessel.

Blended crude containing contaminants is heated and mixed with washing water utilising either a mixing valve or static mixers to maximise the contact between the contaminated crude and the wash water. This mixed emulsion solution then enters the desalter vessel where it gets separated into organic and aqueous phases. This separation occurs by electrostatic coalescence, where electrical fields are generated to create water droplet coalescence within the mixed emulsion solution. As these water droplets increase in size, they fall out of the emulsion due to gravity. Dissolved within the water droplets are the contaminants previously suspended in the blended crude.

Control is key

Numerous measurement technologies are utilised for trying to identify and control what is happening in the desalter. Some external bridle mounted systems fail – not down to the measurement principle but its location. Formation of emulsion solution within the vessel is simply not replicated in an external bridle. This can lead to the emulsion band increasing in size (without the operator

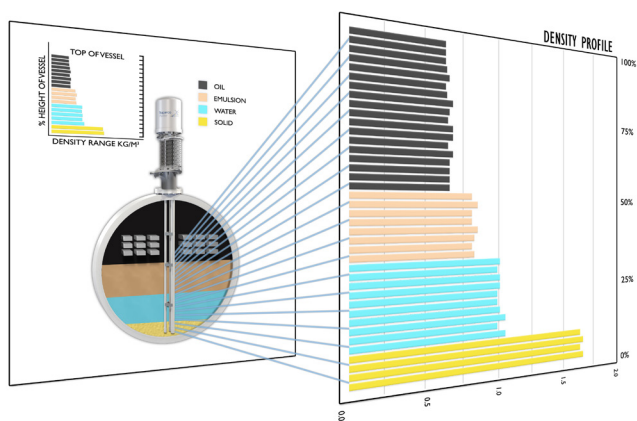


Figure 1. Desalter density profile.



Figure 2. The Tracerco Profiler.

knowing), resulting in a shorting out of the electrical grids and a loss of production.

Some vessel mounted solutions also come with operational challenges. A conventional differential pressure measurement is based on the specific densities of the phases within the vessel. However, as blending is likely to change the overall density, this solution is fraught with constant maintenance issues. These issues may also be compounded by solid deposition within the vessel take-off points.

Internal displacer instruments consist of a submerged chamber suspended in the fluid, the weight of which is balanced by an upward force exerted on it by a particular level of fluid. As the level changes, the force increases or decreases, resulting in a small movement in the displacer which translates to a change in interface level. Similar to the differential pressure solution, the force exerted depends on the densities of the fluid involved; therefore, if these characteristics change, which is probable due to the blending process, this will be interpreted as a change in level. When emulsions are present, which are actively encouraged in the desalting process, the output will be based on the average density present and the extent of some emulsion will not be highlighted. It is normal

procedure to place the displacer in a stilling well to provide protection for the displacer tube and some damping from the fluids being measured. Solids that are being washed from the crude can build up around the stilling well, resulting in the displacer becoming lodged and changes in level not being indicated by the device.

Guided wave radar (GWR) works in much the same way as a conventional through-air radar, where electromagnetic energy is transmitted from an antenna. When it reaches a level surface, some of the energy is reflected back. Time domain reflectometry measures the transit time to the level surface and back, hence calculating the level. GWR uses the same principle along with a guide which is wetted by the process to transmit a signal along the guide with any reflected signal being utilised to calculate the level present. However, if no level surface is present (which again is probable within the desalter due to the emulsion solution being created), the transmitted signal has no interface to reflect from. This results in the transmitted signal continuing to the bottom of the guide before reflecting back.

Measurement solutions

Numerous Tracerco Profiler™ systems have been developed and deployed to enable operators to see the formation of emulsion and deposits in a desalter in real-time. This critical process measurement provides the data required for operators to implement actions to optimise production and reduce the impact on plant operation and the environment.

The instrument comprises a two (or three) dip pipe assembly, similar to a thermowell, that protrudes into the vessel from a flanged vessel connection. The dip pipe assembly is supplied in accordance with the vessel design criteria and ensures the items placed within are free from contact with the process. One of the mentioned dip pipes houses a vertical array of sources, similar to those found in domestic household smoke detectors. In domestic smoke detectors, it is the alpha particle that is stopped by the presence of smoke, which activates the alarm, however the source also emits a weak gamma energy. This weak gamma energy is enough to pass through the dip pipe assembly and process fluids and is then detected by a detector installed in the other one (or two) dip pipe(s).

In order to obtain the required measurement accuracy, the system adopts a collimated design which ensures the detecting element is focused at a particular elevation. This design also allows for ease of isolation, with a single movement isolating the system providing safe access into the desalter for routine maintenance and inspection requirements.

Since its initial deployment, the Profiler has been adapted to meet clients' ever-changing and more demanding requirements. This includes reducing the lower temperature range so that it can be utilised within the LNG market and increasing the higher temperature limits so that a full picture and understanding of what is

happening within a high temperature desalter can be understood. Driven by clients' needs for a no moving parts, no maintenance solution, the technology has also been utilised in a number of subsea separation applications in accordance with ISO 13628-6 subsea production and control systems.

Case study

Following a discussion with a national oil company based within the Gulf Cooperation Council, a Profiler was installed on a trial basis due to the existing level measurement technology, a displacer type system, being unreliable. The vessel had historically operated with severe emulsion problems, requiring a high demulsifier usage. Electrical low voltage of the grids (shorting) of the electrostatic grid was also an issue due to emulsions reaching the grid array.

Feedback from the trial highlighted that before the installation of the new instrument, the plant had suffered over 400 electrical grid shortages in 250 operational days, averaging around 49 per month. Since its installation and over approximately double the amount of operational days, the vessel averaged 12 shortages per month. Of course, there are many factors which could change the frequency of grid electrical shorts, however the major operational change during this period was the installation of the new measurement device.

The instrument is very effective in accurately measuring the interfaces and vertical distribution of oil, water, foam, solids and emulsion. Emulsion thickness

measurements can be extremely useful in evaluating the efficiency and dosage requirements of individual demulsifiers. During the trial, a change in demulsifiers occurred with an instantaneous change in emulsion thickness being indicated by the Profiler at the time of the chemical change. The new chemical performed significantly better, essentially removing the emulsion layer. This improvement was obtained even with a slightly lower injection rate. Several days later the demulsifier was changed back with the thick emulsion band returning. The Profiler provided a real-time measurement that was used to optimise chemical usage. This can save the facility several million dollars per year.

Conclusion

Feedback from the trial found that the Profiler was extremely reliable and of significant value for daily operation of the facility; operations staff, for example, were able to see into the vessel. Since the trial and to date the system has experienced no interruption or downtime, allowing operation of the facility to become easier. The Profiler was found to be responsive in readings, excellently reflecting accurate fluid levels and emulsion thickness which facilitated various process operations such as, skimming, cyclic control valve opening and changes in demulsifier injections. It was envisaged and ultimately realised that lower demulsifier usage resulted in cost savings once the equipment was placed into an automated level control loop. 