Fred Brown, Athlon, a Halliburton Service, USA,
presents the importance of best practices to help ensure optimal desalter performance.

BACK TO DESALTER BASICS

When managing a customer's crude oil desalters, chemical service suppliers receive various calls for assistance. These range from effluent brine quality concerns, setting up the proper mud washing routine, erratic volt/amp readings, to helping manage an upset condition and/or train personnel. Thus, a chemical service provider's performance can weigh heavily on perception.

Involvement with the customer helps ensure that expectations can be managed while also addressing concerns. Perceived desalter upsets can negatively affect customer relationships with a chemical supplier. A high frequency of real desalter upsets should bring scrutiny upon a chemical supplier. On the other hand, perceived upsets should be identified, evaluated, and resolved.

The focus of this article is sharing basic desalter 'blocking and tackling', defining desalter upset conditions, including some possible causes, chemical supplier expectations, and a look at a recent increasing trend of 'perceived' upsets.

Oil composition is changing

Even though US refineries are processing lighter crude slates since the introduction of light tight oil in the last 10 years (Figure 1), these lighter crude slates contain more solids and contaminants than light oils from 30 years ago. Some of these crudes are offered at a discount due to the contents and variations in the constituents. Most refineries are not prepared to handle the issues that arise from processing these discounted crudes. Unfortunately, due to an attractive financial advantage of processing this crude, it is purchased, arrives and begins charging to the unit with just the basic tests completed on the crude.

Next, these crudes are metered into the crude diet at some percentage. Speciality chemical suppliers have varying levels of inclusion into this process. In a best-case scenario, the companies receive crude samples early on in the process, test it, and can recommend process adjustments to prepare for the new crude blend. In a more common scenario, notification to the unit engineer, operations and the chemical supplier occurs after a new crude has been introduced to the unit, and often following a desalter upset.

What is an upset?

A specific definition of an upset will change depending on who in the refinery is asked. A unit operator will define an upset as any reason a desalter's performance takes him out of his daily routine. For example, if he gets a call to check the trylines, the desalter must be upset. A waste treatment operator is likely to call solids in the desalter effluent brine a desalter upset. If a competing supplier is managing the waste water plant, they will call light brown desalter effluent brine an upset. For this purpose, this article will define an upset as significant oil in the desalter effluent brine (more than 1%) and/or inclement desalter performance (i.e. water carryover leading to uncontrollable downstream pressure increases) requiring a reduction in the crude charge rate.

The starting point

A logical start is focusing on delivery, storage and equipment for crude. Check for elevated levels of contaminants, solids, and potential asphaltene incompatibility problems.

Crude, no matter the method of delivery, enters the refinery environment with its own challenges. Recent asphaltene compatibility studies have shown crudes with high levels of asphaltenes can be stable. These same crudes can remain stable until blended with other stable crudes with varying levels of paraffins and resins. Although independently stable, when blended, these crudes can become unstable, leading to asphaltene precipitation.

The best option is to identify these blends, segregate them in storage, and treat with an asphaltene stabiliser prior to mixing to charge to the crude unit. Most refineries do not have the storage capacity to accommodate proper crude segregation. Therefore, new crudes arrive at a refinery, dispersed into several tanks of various blends and charged to the crude unit. Slowly, many refineries are realising the advantage of pretreating the problematic crudes prior to mixing them.

Another trend in crude storage is the tank design, function and upkeep of the mixing equipment. As stated earlier, incoming crudes are becoming lighter but with more solids and contaminants. Refineries are investing significant money into improving their infrastructure to accommodate these new crudes. Tank mixing is an often overlooked area, which can be considered low priority.

The mixing equipment in place was designed for the lighter crudes with less precipitates. These crudes place more loads on the mixer motors and blades. At many refineries, more than 50% of the tank mixers are either turned off or are out-of-service. In some cases, there is a fear of stirring up solids build-up on the tank bottoms so the mixers remain off, even though they are operable. Eventually, enough solids build up high enough to render the tank useless. Tank cleaning involves a significant project cost as well as removing the tank from service for a lengthy period.

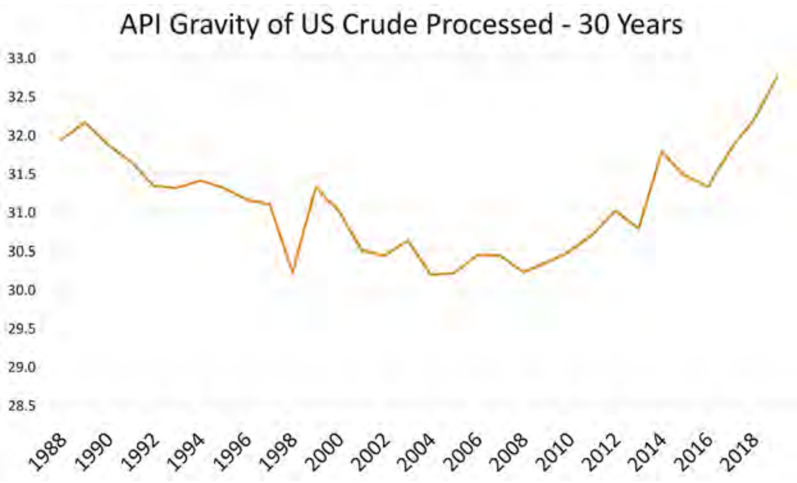

Figure 1. After dropping between 1989 – 2004, the API gravity of US crude processed has risen in the last 15 years.

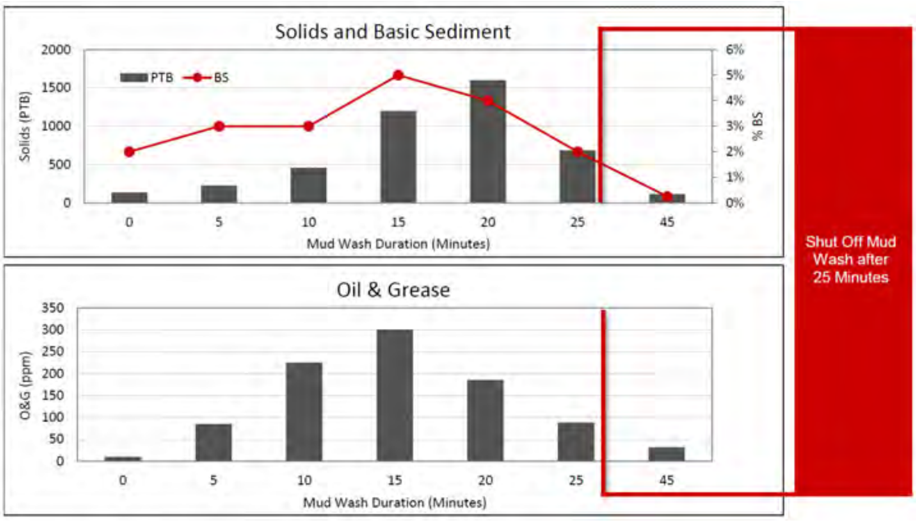

Figure 2. Proper mud washing reduces solids, basic sediment, oil and grease, and produces cleaner water as the oil-coated solids are removed from the desalter.

Back to desalter basics

In order for refineries to receive the best practices in desalter management from their chemical supplier, they need to go back to basics when choosing their provider. There are a minimum number of requirements that refiners should expect from their desalter chemical supplier.

Mix valve study

This should be performed in order to determine the optimal water droplets size required to maximise salt/solid contact. At the same time, too small of a droplet size can result in a difficult-to-break emulsion. A mix valve study conducted five years ago may be obsolete due to different crude slates,

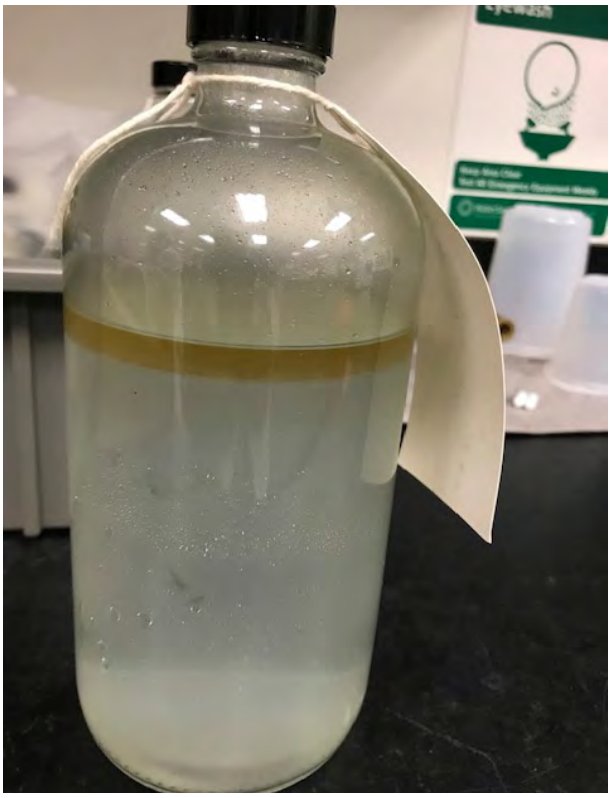

Figure 3. Often times, the vacuum tower overhead water is combined in the desalter wash water. The entrained hydrocarbons can affect the desalter wash water as well.

process equipment changes, and any number of changes in the process that can directly or indirectly influence the desalter's ability to make and resolve emulsions.

Mudwash survey

Removing sediment build up on the bottom of a desalter is important to maintain the most desalter water residence time. Several approaches are implemented to maximise sediment removal (Figure 2). Some include several levels of intermittent mudwashes throughout the day while varying the mudwash rate. Others mudwash continuously at the highest rate tolerable. A mudwash survey can identify the optimal approach for a desalter.

Best practice testing

Testing should be conducted on both crude and water entering and exiting the desalter. Crude oil should be tested for basic sediment and water (BS&W), salt and filterable solids. The wash water should be tested for pH, NH_3 and chlorides, while the effluent water should be tested for pH, chlorides, oil and grease. This should be conducted a minimum of three times per week by the chemical supplier and daily by the refinery laboratory. Refractive light and infrared chromatograph analysers are quickly becoming standards to test for chlorides by chemical suppliers.

Chloride balance

One of the methods used to evaluate unit performance, validate analytical results, and ensure flow meter accuracy is to conduct a chloride balance around the desalters. The amount of salt given up by the crude oil must equal the amount of salt picked up by the wash water. A good data set should show an error of less than 10%.

Wash water optimisation

The wash water injection location, quality and quantity are critical in desalting. Injecting a portion of the wash water upstream of the cold preheat train can help minimise crystalline salt formation in the preheat train. Wash water quality can also impact the desalter operational performance (Figure 3). Wash water relatively low in chlorides, ammonia and other contaminants is recommended. Depending on the gravity of the crude slate, a wash water ratio between 5 – 10% is recommended.

Crude knowledge

Creating inventive, accessible and useful tools to document varying desalter conditions in relation to crude feed and/or crude blends is a critical role of a chemical supplier. Applying lessons learned helps ensure a proactive approach to preventing, rather than reacting to, desalter upsets.

Operator training

As with most positions throughout a refinery, operators move from job-to-job, get promoted or just experience some level of turnover. Therefore, while desalter operations are an important aspect of a refiner's responsibilities, it is not often the top priority. Effective, periodic operator training should be completed at some frequency to help ensure they have a level of desalter operational proficiency as well as the newest desalter methods or techniques. It is essential that chemical suppliers develop a solid working relationship with operators, as their assistance can help avoid an after-hours trip to adjust a chemical pump rate.

The calibrated eye and desalter operations

Currently, the standard for evaluating the desalter trylines involves using a kitchen spatula placed in the fluid stream of each tryline and inspecting the fluid. Most spatulas are the larger stainless steel type used to flip burgers on backyard grills.

The best operators would collect tryline samples in bottles, allow the fluid to separate and report estimated percentages. On the 'other hand', some operators, due to their workload, would report just the visual appearance of the stream leaving the sample point without a spatula.

As a chemical supplier, Athlon can offer training that helps guide operations to improved procedures. Ultimately, desalter operations cannot be monitored, reported and managed 24/7 by the chemical supplier. Operationally, the chemical supplier and refinery operations have to make decisions about desalter management from less than optimal information. For example, if an operator determines the material in the desalter effluent brine is black and, therefore, identifies that material as oil, the communication made to management is that there is a desalter upset and action is required. There are different actions taken among refiners, but those actions often come at a significant indirect cost.

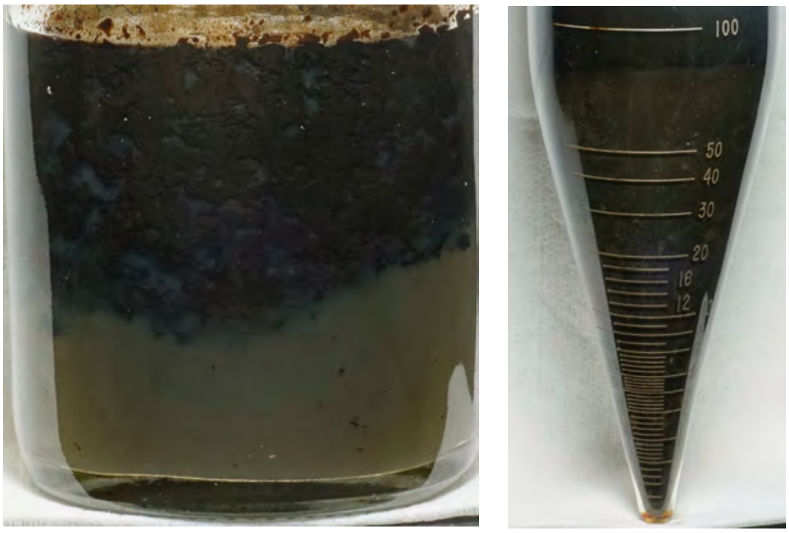

Figure 4. With the spatula, this material, visually, was identified as all oil. After centrifuged, 80 – 90% of this material is water.

Figure 5. Visually and in a sample bottle, this material appears to be all oil. After centrifuge, ~90% of this material is water.

Figure 6. Some operators, without a spatula, identified this water as oily water. The oil and gas result was less than 50 ppm.

Why is it important to delineate oil from dirty and/or black water?

For most, there is an obvious answer to this question, but as the quality of raw crude becomes more complex, the amount and type of contaminants is increasing too. From a chemical supplier and refinery operations perspective, the more contaminants that are removed from the oil, the less problems for the downstream units.

There is one perception and three possible realities at play that affect an improper and a proper response to each scenario. The dark appearance of desalter effluent water can be caused by several factors, including oil, asphaltenes, iron particulates, and microbiological sources. One perception is that all black material is oil. In reality, the black material can be all oil, a combination of oil and water (Figures 4 and 5), or all water with some contaminant darkening the water (Figure 6).

A simple spatula test should delineate oil from water, but not all operators have the time, or, in some cases, the discipline, to run through all the trylines with a spatula. Additionally, the appearance of this material can cause some alarm for a refinery's waste water treatment plant (WWTP). Since asphaltenes have the ability to 'tie up' large amounts of water and other contaminants, they can appear to be a larger volume. Often times, the actual oil content is minimal and a lot of refineries' WWTP impact is minimal over a short period of time. However, for a refinery, 100% oil in the desalter effluent is a condition that needs to be corrected immediately.

Conclusion

A refinery desalter is the first critical step in cleaning crude and removing problematic material from affecting the rest of the refinery. This article outlines several best practice methods that refiners can reference with their chemical supplier.

From a refiner's perspective, the last time the desalters have been audited needs to be reviewed. This includes reviewing findings, setting up operator training, helping to ensure supplier service is 'up to par', and getting back to basics. As a result, real desalter upsets can be avoided and desalter performance can be optimised to remove solids and salts to avoid untimely shutdown in downstream units/equipment. The ultimate goal of chemical suppliers is to be a partner in improving reliability, minimising downtime and maximising throughput. It all starts at the desalter.