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**Question 41: What are some of your operating practices used to mitigate incursion of water slugs in crude feed from tankage? Are there any early warning devices or procedures currently being used successfully?**

**THEISS** (Marathon Petroleum Corporation)

We all know that water comes in with the crude and can cause upsets to crude system desalters, so really the goal is to try to minimize the unknown amount. I mean, we know it is coming in, and the key thing is trying to identify and prevent it. In tankage, you do have to be careful about slugs of water forming pockets. So, whether you can get it off a tank or not, you may not be fully successful doing that because of the way the water can form in the tank. The first step we have at Marathon is having really good operating procedures around dewatering; so, having a good dewatering program. We can see variability with the effectiveness of dewatering. It will really be dependent upon the crude, the type of tank, whether you blend other crudes in there, and how frequently you have to dewater that tank. The other factor is knowing what you have. We talked a little about sampling crude and about how getting a good BS&W (base sediment and water) reading off a tank could help lead you into knowing how much water content you have in that tank. We typically try to target around 1% or less before charging it to a unit.

What also works, from a tanker's perspective, is slowly changing crude over time. So, if you have a crude diet change and are taking a tank out of service to put on a new one, slowly introducing that tank can help assure that you know the amount of water or that you can actually see the water come through the system. We do have some places where you can actually build controlled ramps into the crude diet changes. The effectiveness of the controlled ramps really depends upon your tankage that you have. Try having no live crude injections. If you are receiving into a tank from a pipeline, try not to introduce that tank directly to the crude system. Allow it to go to isolated tankage, settle out, and draw off the water.

As far as tank operations, a good mixing program involving tank circulation loops is essential to ensuring that you are trying to mix as best as possible and have the water come out. As I talked about earlier, it really depends on the crude type and your historical reference to that crude which will determine how frequently you want to dewater. We have seen success from the installation of floating suctions where the suction line floats on the level of the oil and is really not coming off the bottom of the tank. We have installed those floating suctions at a couple of our facilities, and we have seen some general improvements in minimizing some water slugs to the crude units.

We have had mixed results from some other techniques. Installing water analyzers or densometers to measure the density as the crude comes into the crude unit will really be dependent upon where you have them in your system and whether they allow proper response time for the operator. The closer you get to the crude unit, the less response time you have, the harder it will be to manage that water before it hits your desalting system. Generally, there is good success if you get crude via pipeline. Having analyzers or densometers on the incoming pipeline as it goes into your tankage, you understand how much water is coming in with that crude. You can properly segregate it or allow more time for settling and dewatering at that point in time.

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Lastly, there are obviously a lot of chemical treatments on the market, including demulsifiers. Talk to your chemical treatment vendor who can provide some insight and experience on the best chemical application you could apply to help minimize water intrusion.

**McDANIEL** (KP Engineering, LP)

I really do not have a lot to add to what Jeremy covered, because he touched on almost everything I had to say. He talked about looking for early warning signs. I mean, once it gets to the unit, you will see a pressure spike in the desalter. By that time, it is really too late. You will possibly be looking at a crude reduction rate while trying to get back to a stable operation. I thought it was cool when Jeremy talked about this floating suction, because I have seen where operators have actually just raised the tank suction by physically raising the pipe. However, if you are already struggling with minimal tankage and you are feeding your unit from same tank you are receiving from a pipeline or from a ship, then you are not helping your situation.

**JORDAN SMITH** (NARL Refining LP)

I do not have a question. I will just say that we recently installed an API meter. We actually put it on the spillback from our crude charge pump, and we had great success. It is very accurate and has helped the control technicians a lot. Whenever they are bringing on a new tank, they will watch it like a hawk. It really gives them a good heads-up on what is coming before it hits the unit.

**ROGER METZLER** (Baker Hughes, a GE Company)

I want to add to the end of Jeremy said, with regard to some of the chemical additives that can be used in your crude tankage. You have a variety of different chemicals there not only to help precondition to aid water drop, but also to address some other contaminants and needs for stability in the crude tankage. The conditioning effect can help your desalter operations. Much like if you think of your washing machine at home, you have your soak cycle. You can do some preconditioning of your crudes in tankage and help your overall operations predominantly for the desalter, but it can also potentially help with some fouling issues in both the cold and hot preheat.

**JAY STEINER** (Merrick & Company)

Speaking from previous experience, one of the biggest factors – other than water coming in from crude – is slop oil management. There have been several industry-wide discussions about preferentially feeding slop oil directly to your crude tanks or directly into the crude charge, but water content in the slop oil is frequently missed or forgotten, especially by the operators. They think it is just a free way to get rid of some problems. So, just keep that in mind.

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## **GAMBOA-ARIZPE** (CITGO Refining & Chemicals, L.P.)

Remember, the level of participation increases the likelihood of winning prizes. It works. I mean, Tariq Malik won a backpack yesterday, so there must be a correlation. So, just a reminder to everyone that participation is key.

## **JEREMY THEISS** (Marathon Petroleum Corporation)

Plugs of water are problematic, in terms of causing desalting and crude column upsets. Pockets of water can form in the tank due to the characteristics of the crude. The primary defense is to minimize water in crude oil; but with current upstream practices, we know water will enter in with the crude. Having systems in place to reduce, mitigate, and handle water intrusion is important to maintain stable crude unit operations.

### **Operating Procedures**

Having detailed procedures or guidelines in place is an important step to ensure that water intrusion is minimized. Sampling crude tanks for basic sediment and water (BS&W) prior to charging will provide the information needed to manage water intrusion during the crude change. A typical target is 1% maximum, but this is dependent on the systems you have in place to handle water (desalting operation, chemical additions, etc.). Operators must understand the impacts of the location and type of sampling system. If not truly representative, samples can lead to misrepresented results.

Slowly charging a crude tank over a period of 15 minutes may allow the crude desalters to handle the change in crude diet or water content. Some refineries have built ramp controllers into the DCS system. The control operator can provide a final percentage of the tank, and the controller will gradually open at a rate over a period of time until reaching the desired set point.

Injection of crude, while receiving crude in the same tank, can be problematic and is not recommended. Non-crude injections, such as slop re-run or oil skimmings, should be monitored as they are put on charge to a crude unit. These materials likely contain water and can easily cause upsets. Having sampling and monitoring systems is important to classify the material prior to introduction.

### **Tank Mixing and Dewatering Program**

This mitigation option is more operation-intensive and requires diligence by tank farm operations. Depending on the amount of crude tankage available, allowing tanks to settle after receiving and mixing, proper dewatering can be done before charging a tank to the crude unit. Typical dewatering frequencies will vary based on residence time and crude type. On average, dewatering programs will result in an appreciable amount of water being drawn at least twice a week. Tanks can also be water-cut on some frequency to determine the amount of water in a tank.

### **Floating Suctions**

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Floating suction is an option used to minimize slugs of water on problematic tanks (tanks that tend to form emulsions that are hard to break: slop oil tanks). Floating suction works through an extended suction within the tank that floats on top of the liquid level of the tank (Figure 1). A working floating suction minimizes the amount of material drawn off the bottom of the tank, given the tank has adequate settling time and liquid level is maintained.

### **Analyzer Technology**

Online water or density analyzers can be used to provide warning of water slugs. This piece of equipment is a capital investment that provides operators alarms due to changing compositions. However, use of these analyzers may not be 100% reliable in terms of response time, depending on where they are installed throughout the system. Having multiple tank or line installations will allow the operator to diagnose the source of the water. Crude pipelines may have this technology, and having good communication and coordination with them gives the receiver warning on crude batches containing higher amounts of water. This alert system allows the tank operator to take proper precautions, potentially segregating a portion of the batch.

### **Chemical Treatment Program**

Adding a demulsifying chemical as far upstream as possible to allow mixing and contact time will help separate water and oil in storage tanks. Mixing time and dosage rate is a key component for the effectiveness of the demulsifier. A chemical vendor can evaluate the chemistry and provide a demulsifier recommendation.

### **W. ROSS McDANIEL (KP Engineering)**

After speaking with a couple different Operations folks, I learned that most simply gauge tanks and water-cut them as needed. Gauging and water-cutting tanks become a bigger issue for facilities that do not have enough crude tankage to allow for filling and settling. If your facility is receiving feed from the tank that is receiving pipeline or ship transfer, it is more likely that you will have a hard time simply relying on tank gauge and water cutting.

The bad news is that you only know it after seeing pressure spikes in the desalter. At that point, it is likely too late to adjust the desalter operation accordingly, and you may need to cut back on charge to better handle the expected increase and unstable desalting until control is regained.

Occasionally, the design of the crude pump suction line can be modified to help minimize the incursion of water slugs. However, this may not always be practical because it could result in a reduction in the effective working volume of the crude tank. Another option is considering automated dewatering systems, as well-as instrumentation, to detect the water concentration in oil or oil-to-water interface level control; however, I am not sure many do this.

### **CHRIS CLAESEN (NALCO Champion)**

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This operating practice starts with proper management of crudes at the tank farm. Crudes with high water content are treated separately and may require a tank demulsifier. All crude tanks are allowed to settle and be homogenized. Samples are taken at different tank levels before the tank is allowed in the feed. Early warning systems can be based on density and Agar-type probes.

### **DENNIS HAYNES** (NALCO Champion)

For crude tank systems that have the capability to dewater, emulsion breaker chemistries can be applied to reduce water and salt content prior to charging to the crude unit. Microwave absorption probes have been used in some cases to identify if significant slugs of water are coming from tankage.

### **RAÚL ROMERO** (NALCO Champion)

Some of the good practices observed in refineries to mitigate water slugs in crude feed from tankage include:

- Proper crude tank dehydration, including well maintained mixers, suitable residence time, and also a chemical dehydration program. Setting proper limits on BS&W on crude reception helps to improve general crude dehydration management. Sampling facilities and procedures are key factor to mitigate impacts.
- Slop tank dehydration also contributes to water slugs if not properly operated and water content controlled.
- Crude tank-related piping that is not in active operation for several days, like a “dead leg” piping, can settle and accumulate important volumes of water. When a related crude tank is fed, caution should be taken to slowly increase its throughput.
- Crude tank switch should be done in steps. First, reduce flow from the tank in operation, and then increase it from tank that is to be started up, taking one or two hours to complete the process. This operation is generally manual and requires special operator attention on tank levels so as not to affect CDU operation.
- During the desalter operation, mixing pressure drop and percentage of waterwash can be reduced during the crude tank switch.

### **GLEN SCATTERGOOD** (NALCO Champion)

We have implemented a crude tank dehydration program by injecting an emulsion breaker into the raw

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crude as a tank is being filled. After some period of mixing, the mixers are stopped, and the still tank allows water collection and removal from the bottom of the tank. This practice has reduced the water content of crude charged to the crude unit desalter and has eliminated variable water slugs experienced in the past.

## **ROBERTSON (AFPM)**

These next two questions were originally addressed in 1978. When we looked back through the transcripts, we saw that they have now resurfaced. The person who answered them then – Chris McDowell – is here, so she can let us know if the answer has changed since the one, she gave in 1978.

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