The Lease Pumper's Handbook

CHAPTER 13

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Section A

TESTING AND TREATING

There are several reasons why the lease pumper chemically treats crude oil systems. The pumper needs to understand chemical-related problems and how treatment can help alleviate the problem. Typical reasons for treatment include:

- Removing water from produced crude oil
- Treating produced water prior to re-injection
- Preserving casing and tubing from corrosion
- Reducing paraffin and asphalt accumulation
- Reducing scale accumulation
- Preventing gas sales lines from freezing

A-1. Treating Oil, Corrosion, and Scale.

The lease pumper stores chemicals on the lease that have been formulated to meet several treating needs. Chemicals are often delivered in 55-gallon drums. Because paper labels deteriorate over time, drums stored on the lease should be marked with a paint marking stick for future reference and identification. Recording procedures are included in Chapter 19, Record-Keeping.

The purposes for these chemicals include:

- Treating crude oil before sales
- Reducing corrosion damage
- Scale deposits and sand stabilization

Treating crude oil before sales. Most chemicals for treating crude oil are used to lower the BS&W content to an acceptable level prior to sale. There are several types of chemicals for treating oil, and chemical companies use different terminology to describe the same compound. The pumper must understand the purpose of each type, know when to use them, and always be as economical as possible when using them. Chemicals may be water-soluble, oil-soluble, or soluble in either.

Oil treating chemicals include:

- Oxygen scavenger
- Corrosion inhibitor
- Surfactant (a soap)
- Paraffin solvent (a thinner)
- Demulsifier
- Other chemicals according to need. Overuse of some chemicals can cause emulsion problems that require very expensive solutions. Some chemicals are used to solve problems created by overtreating. These are much more expensive than basic treating chemicals.

Reducing corrosion damage. Corrosion can be a big problem and can occur downhole by eating holes in either the tubing and casing or in surface facilities. Corrosion inhibitors prevent this.

Scale deposits and sand stabilization. Scale is treated as it enters the production system and in the formation before it can develop. Scale inhibitors must be matched to the conditions of the produced water.

A-2. Testing Crude Oil.

Long before a sellable amount of crude oil in the stock tank has accumulated, an important task is to test the oil to determine if the BS&W level is low enough to be accepted by the pipeline or truck transporting company gauger. The gauger will usually be more careful in analyzing the oil if the pumper witnesses gauging and testing procedures.

Eight inches of emulsion and thiefing the bottom. The BS&W or emulsion level accumulated on the bottom of the stock tank must be no more than what the local purchaser allows, typically 8 inches or less. The content of this heavy BS&W emulsion is usually a mixture of crude oil, salt water, paraffin, possibly a small amount of asphalt, formation sand, and a host of other compounds. This mixture is heavier than free crude oil so it falls to the bottom and may float on the water. Water in oil production is usually as salty as ocean water. The sand can be finer than bath powder and is, therefore, difficult to separate.

Crude oil weighs less than 8 pounds per gallon. Fresh water weighs 8.33 pounds per gallon. Produced salt water usually weighs more than 8.33 pounds per gallon and reaches a natural saturation point at about 9.6 pounds. This mixture is homogenized and blended together and is difficult to treat and separate. Free saltwater will migrate to the bottom. When the tank is thiefed, the stratifying of oil, BS&W, and free water becomes obvious.

This natural separation can occasionally be used to a distinct advantage when treating tank bottoms. If neglected, the bottom emulsion will become so heavy that the pumper will have to *spud* the plumb bob through it to gauge the tank.

Tagging bottom with the thief. When tagging bottom with the thief, the graduated trip rod must be set accurately. As the thief approaches bottom, it must move very slowly to prevent agitation that would result in a false reading. After tagging bottom, the thief should be lifted approximately one inch and then dropped sharply.

If the thief is lifted five or six inches vigorously and then dropped, BS&W will be agitated. The test will indicate a higher bottom than is actually present, as well as a greater BS&W percentage for the bottom shakeout. After excessive stirring of the bottom, an accurate reading may not be possible until sufficient time has been allowed for settling.

Checking the bottom. To check the bottom level, the lease pumper should follow this procedure:

1. Put on plastic gloves.
2. Lower the thief to the bottom of the tank.
3. Secure the sample.
4. Bring it back to the top.
5. Give it a side twitch after the top of the thief has cleared the oil to allow a small amount of oil to spill out.
6. When it stops dripping, lift the thief out of the tank with one hand and place a rag under the bottom of the thief with the other hand to keep the tank clean.
7. Slowly pour the oil out of the top of the thief across the palm of the other gloved hand. With close observation, it can

easily be seen when the oil thickens and turns to emulsion.

8. Hold the thief vertically again and look inside as well as outside. The level of the emulsion remaining in the thief can be easily read. This is the height of the tank bottom. The side of the thief is marked in inches.

As remaining emulsion is poured back into the tank, the point at which free water appears can also be determined.

1% or less BS&W and the centrifuge. BS&W contained in the crude must not exceed the maximum levels specified by the crude purchaser—usually less than 1%. To determine this, the lease pumper should use the following procedure:

1. Take one sample of crude oil from near the top.
2. Take a second sample approximately 10 or 12 inches above the bottom.
3. Place the two samples in a centrifuge and determine the amount of BS&W in each.
4. Add these two values together.
5. Divide by two.

This computation gives the average BS&W throughout the tank. Since the average is computed on a straight line and actual contamination is on a curved line, the oil purchaser has a small "shakeout" advantage.

To make the reading more accurate, another step can be added that involves taking a third sample from the center of the tank and dividing by three. Occasionally a tank will test as sellable by the three-sample method, while it would be rejected under the two-sample method.

There are several popular styles of centrifuge machines and three styles of tubes:

- 12.5 milliliter (ml)
- 100 ml pear-shaped
- 100 ml short cone-shaped.

Centrifuge tubes are expensive, so extreme care should be taken in handling them.

When oil is sold, the 100-ml tube is generally used to analyze the sample. The pear-shaped tube is more accurate when very low percentages of BS&W need to be measured.

The 12.5-ml size hand shakeout machine is commonly used and is satisfactory for estimates. A sturdy bracket should be made and fastened securely to the bed of the pickup to support the unit when in use. It is possible to fasten it to the tank battery steps or on a board, but the bracket is usually more workable. When properly maintained, the machine will last for many years. Repair parts can be ordered from the nearest supply company.

Oil temperature correction. It is more difficult to treat cold oil than warm oil. When slow moving oil is produced from the well, it will be approximately the temperature of the earth that it is coming through. Deep wells are hotter at the bottom than shallow wells, and as oil rises in the well and leaves the production zone, it becomes cooler. As oil cools, it does not flow as easily, and the viscosity becomes thicker, thus supporting more BS&W. A heater/treater may be needed to heat the oil to assist in separation, especially in winter. Flow lines in most sections of the country are left on top of the ground to absorb the heat from the sun in order to treat the BS&W out of the oil. If chemical is injected at the wellhead or at the bottom of the well through the annulus, the treating process may be easier. In winter the oil should be treated as quickly as possible before it becomes colder on the surface.

When the purchase price of crude oil is quoted, it must be at an exact temperature and gravity with no contamination to receive the posted price. The Scoop Master tank thermometer is an accurately computed device that contains a holding pocket to reduce temperature changes while it is being read. It is attached to the gauger's tray by a cord that allows it to be lowered into the middle of the tank of oil to obtain the exact temperature.

When oil is sold, the number of barrels is computed, then the temperature correction factor is applied. If the oil is cold, this factor will increase the number of barrels shown as sold. If the oil temperature is above the temperature at the quoted price, the number of barrels computed as sold will be reduced.

API gravity and the hydrometer. There are two methods for computing gravity. The specific gravity method compares the weight of oil to an identical volume of water at the same temperature. Under this system, pure water at 60° Fahrenheit represents a specific gravity of 1.000. A lighter liquid would have a value less than 1.000, while a liquid heavier than water would have a higher specific gravity.

The API gravity system sets the value of water at 60° Fahrenheit as 10. However, in the API method, a lighter liquid has a higher value. Oil will usually measure more than 15 but less than 50. Condensate will range above 50 into the 70s. As the number gets lower, the oil will be thicker, darker, and more difficult to treat. As the number gets higher, it will be thinner. As it approaches distillate, it may give the appearance of uncolored gasoline or kerosene. The higher the API gravity, the easier it is to treat. 16 gravity oil weighs approximately 8 pounds per gallon and 336 pounds per barrel. 50 gravity oil weighs 6.51 pounds per gallon and 273 pounds per barrel.

The API gravity of all oil sold is determined by the use of a hydrometer. In order to obtain the gravity of the oil, the following procedure is used:

1. Lower the thief to approximately the center of the tank.
2. Trip it closed.
3. Raise it up to where the support lip of the thief can be hung on the side of the hatch.
4. Gently lower the appropriate hydrometer into the oil and allow it to float until the temperature of the hydrometer adjusts to the temperature of the oil.

The hydrometer will have a range of 10-20 points. The hydrometer will float in the oil at the level of the gravity indicated at the top of the liquid.

The transport driver carries a set of 3 to 4 hydrometers in a case that will cover the range of gravity readings for all of the oil produced in the field, from distillate to a heavy gravity. Each gravity level has a value or reduction in the quoted price of the crude. This cost impact is one reason why the pumper must analyze the oil prior to the sale. The pumper must know the reading that the transport driver should indicate on the run ticket.