Treating Oil With A Wrist Watch

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Saleable oil with a minimum operating cost is a prime objective of oil producers. Accordingly, a sudden rash of unsaleable tanks of oil or a seemingly unaccountable increase in chemical treating cost must be avoided. Either of these undesirables has to be the result of a significant change within the producing system. One might suspect the change to be in the characteristics of the crude oil emulsion itself. However, rarely do the characteristics of an emulsion alter so rapidly that efficient oil treating one day is no longer efficient the next. What, then, does generally cause these problems and how can they best be solved?

Oil treating is common phraseology for demulsification, or the resolution of an apparently homogeneous system into two separate liquid phases. Chemical, agitation, heat and settling time are the elements essential for complete chemical demulsification.

In the common water-in-oil emulsion, an emulsifying agent prevents the very small water droplets from coalescing or uniting into larger droplets which would more readily settle. A chemical demulsifier counteracts this emulsifying agent so coalescence is possible. Thorough mixing is important because the average droplet size in some emulsions may be only a few microns; a micron being about 4/25,000 in. The degree of mixing depends on the location of the chemical injection point. The demulsifier is frequently injected at or near the treating plant; but injection at the well head, or even down-hole, is especially effective on tight, stable emulsions.

Once the correct amount of demulsifier is being injected, the corresponding operating speed of the chemical injector should be recorded for reference. For example, most gas-driven injectors periodically emit an audible "click". The frequency of the clicks depends on the operating speed. A wrist watch or clock can be used to determine the number of clicks per minute which corresponds to the desired injection volume. Only 2 or 3 minutes each day thereafter are required to determine if the operating speed has remained constant. This aid to economic treating is so fast and simple that its importance is generally shrugged off as insignificant.

A more accurate device for quick regulation of a chemical pump is the Flow Calibrator. One model consists of a 1 pint reservoir, a graduated calibration tube and a three-way plug cock. This Flow Calibrator is used as follows:

(1) Connect its outlet to the suction of the chemical pump.
(2) Fill the reservoir with chemical. Position the plug cock so the fluid levels equalize in the reservoir and calibration tube.
(3) Put the chemical pump in operation. Position the plug cock so chemical is removed only from the reservoir. Operate several minutes until the pump piston chamber and lines are filled.
(4) Position the plug cock so chemical is removed only from the calibration tube. Use a stop watch or a watch with a second hand to determine the output volume in accordance with the following: The flow calibration tube is graduated in equal divisions. When the fluid level travels 1 division in 1 minute, the chemical pump is injecting at a rate of 1 qt in 24 hr. Based on this, numerous combinations can be used. For example, 1 division in 2 minutes is equivalent to 1/2 qt in 24 hr.

Flow calibrators of this type are convenient, accurate and time saving. Once a pump is properly regulated, the device can be disconnected for use elsewhere.

Heat and settling time, the other two essentials for demulsification, are provided by mechanical devices which are auxillary to the demulsifier. Demulsification may be incomplete if there is insufficient settling time, too much or too little heat, or improper travel of emulsion through the treating equipment. These general troubles may, in turn, be caused by such specific things as scale, corrosion, improper fluid levels in the treating equipment, exceeding the designed capacity of the equipment, or others.

Centrifuging a sample of the treated oil each day is good preventive maintenance. If, for some reason, the oil does contain an excess of water and/or emulsion, the problem might be corrected before all storage space is filled. The easily found sources of trouble should be investigated first. Sight glasses on treaters or gun barrels should be drained and allowed to refill before fluid levels are checked. Dump valves should be functioning. The temperature gauge should be indicating correctly. A sample from the clean-oil line can be observed; if, after additional settling time, the sample separates into water and clean oil, the demulsifier is obviously effective and has "broken" the emulsion. Further study should then be given to the interval mechanics of the treating equipment.

The Dye Marker Method is a visual indicator of any internal malfunction such as a channelled hay section, holes due to corrosion, or any other malfunction which results in too little settling time or the short circuiting of fluid travel.

A dye marker is a concentrated solution of water and water-soluble dye. It is used to determine the period of time which oil remains in a heater-treater, gun barrel, or other type treating vessel.

The dye marker is injected into the emulsion inlet line (flow line) immediately ahead of the oil treating equipment. If the so-called "clean oil" contains some water as it goes to stock, that water will be colored by the dye after the marker has had sufficient time to travel through the treating equipment.

Other factors being constant, the time required for the dye marker to travel through the treater depends on the path it follows. If the equipment is without internal defect and is functioning properly, the dyed water cannot appear in the oil going to stock in less than the normal residence time of the oil. If the treater does have an internal defect such as channelled hay or a crack or a hole, some of the dyed water will short circuit. As a result, it will appear in the oil going to stock in less time than if the equipment were not defective.

It is not possible to always predict the type defect which causes the dye marker to travel through the treater in less than normal time. For example, dye markers were used to trouble shoot two different heater-treaters. In each case, dyed water appeared in the oil-to-stock just 20 minutes after injection, rather than the estimated 3 hr. In one treater the hay section was found channelled. In the other, the inlet line to the gas separator section was cracked in such a way that emulsion squirted to the dome and dripped down through the gas equalizing line and into the clean oil section.

If large holes have corroded through the heat exchanger tubes of a treater, almost all of the dye marker may short circuit into the oil-to-stock in a matter of seconds. With most other defects, it will take between 5 and 40 minutes for the marker to appear.

In summary, a dye marker is a method for visually verifying that an oil treating problem of water or emulsion carry-over is the result of internal mechanics.

If the conventional gun barrel is used in the treating plant, attention should be given to the solids content of the emulsion. Water washing the produced fluids is important if silica, salt, iron sulfide or certain other materials are present in large quantities. Water, of course, is also essential if the emulsion requires heat. However, the volume of water maintained in a gun barrel should, in most cases, not exceed 50% of the volume of the gun barrel.

Water washing is less important if the produced fluids are low in solids content providing; also, the emulsion does not require heat. In such cases, the water level can be lower and will result in more settling time. Conversely, many gun barrels are 90% filled with water and settling time is too limited for good treating.

Attention should be given the oil-water interface in a gun barrel. A layer consisting largely of paraffin and/or iron sulfide may accumulate at the interface. This layer occupies space and thereby reduces settling time. To this problem research has provided one approach with multi-purpose chemical compounds incorporating both a demulsifier and dispersant. Other compounds are often effective against dul problems involving scale, corrosion, emulsion, or paraffin.

In electric dehydration, the petroleum emulsion is brought into a high voltage field which coalesces the water droplets. The big water drops then settle under the influence of gravity. A modern innovation combines the effectiveness of chemical demulsification, electric precipitation and heat, with the vapor conservation of a closed vessel. The combined chemical-electrical treating efficiencies reduce the need for heat to a minimum or nil. As a result, the low heat demand saves fuel; light ends are conserved; and true A.P.I. gravity is maintained; and volume losses from vaporization are avoided. Minimum heat requirements may also reduce scale and corrosion problems.

CONCLUSION

A periodic review of oil treating fundamentals and the use of a few simple trouble shooting aids will result in a more efficient and profitable demulsification procedure.