Hydrocarbon Testing at Frac Sites

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Introduction

The increase in oil and gas production through hydraulic fracturing and more advanced systems for extending well life has changed the international oil landscape. The US is now an exporter of oil products and the economic benefits are trickling into other industries. At the same time, public concerns arround the potential negative environmental impacts are pushing for more stringent federal and state regulations.

The environmental concerns for hydraulic fracturing seem to focus around water—the amount used and potential contamination of ground water. Indirectly, transporting water, wastes and materials to and from a well site is also an issue. According to Lynn Helms, director of the North Dakota Department of Mineral Resources, the first year of a new well requires over 2000 truck trips[1]. Trucking is highly visible to the general public with the impact of noise, dust, traffic and road degradation. Reducing incoming and outgoing water to a well site would satisfy both the fear of using up public water supplies as well as truck traffic issues, making water recycling and reuse a potential option.On the flip side, most people do not realize that fracturing in the US is about 0.3% of the total water use while our golf courses use 0.5 %.

While drill cutting wastes have not gotten as much public attention they too can have an enviromental impact and are subject to regulations requiring the oil content to be monitored prior to disposal.

Cost vs Regulations

For oil and gas producers, water and wastewater management practices are driven by both cost and regulations. If the cost of fresh water is low, there is little impetuous to reclaim the flowback or produced water for reuse. In most regions of the US, reinjection into disposal wells is the lowest cost option for flowback and produced water.

In arid areas where fresh water costs are high and citizens are protesting the depletion of aquifers, the US is beginning to hear talk of regulations supporting water reuse. A March 26, 2013 news release from the Railroad Commission of Texas titled “Railroad Commission Today Adopts New Recycling Rules to Help Enhance Water Conservation by Oil & Gas Operators” [2] shows the trend to support reuse. This particular ruling is not a requirement but an attempt to foster producers’ recycling efforts by eliminating the need for a recycling permit if the fluids are to be reused on their site or another operators’ site. Legislation for mandatory recycling of flowback and produced water was introduced to the Texas Legislature in April 2013 via House Bill 2992. Regulations may therefore soon drive more recycling and reuse efforts.

Wastewater management options

In addition to reinjection, there are a number of other wastewater management options that include removal to an off-site treatment facility, evaporation ponds, reuse for hydrofracking and treatment for surface discharge. Each option has maximum levels of free or dissolved oil that will be accepted making oil removal the first step in wastewater handling. Along with oil removal is the need to test oil in water levels to ensure required levels has been attained.

Arid states in the US that utilize evaporation ponds for wastewater are regulated by the US EPA to have no oil or oil sheen on the ponds. An oil layer also reduces the ponds’ evaporative efficiency making oil removal a necessary first step. Public treatment plants have limits of oil for incoming wastewater depending on what their treatment systems can handle.

InfraCal TOG/TPH Analyzer

For each disposal option, reducing the oil to an acceptable level is one of the first requirements. Measuring oil and grease levels can be done on-site with portable infrared analyzers. Filter-based infrared oil in water/soil analyzers such as one pictured to the left, have been used in the oil industry for more than 40 years, predominantly on off-shore rigs where equipment needs to be rugged and reliable. A test can be done on-site in less than 15 minutes without having to incur the cost and delay of off-site laboratory analysis. An added benefit is this simplified technology does not require a skilled laboratory technician to do the analysis.

Drill cutting and mud wastes

Solid wastes from drilling are clasified by the U.S. EPA as "special waste" making them exempt from many federal regulations so the disposal laws vary from state to state. Land application, pit burial, off-site treatment center or in the case of cuttings, reuse for road surfaces or filler in concrete are common disposal options. Recycling drill cuttings and muds usually require the removal of oil contaminants. Testing the efficiency of the oil removal system can be done on-site with the same infrared analyzer as listed above for oil in water testing.

While water based muds (WBM) may sound better to the public's ear, oil based muds (OBM) degrade much faster in land applications while WBM tend to be high in salts. For land application WBM is typically sprayed as slurry and OBM is applied as a solid. In a study conducted by Chad Penn of Oklahoma State University, after 1 week land applied OBM had 50% degradation and after 70 days, 98% degradation. A portable infrared analyzer was used for the oil content testing. The study results show that proper land application can be a good disposal option.

Whether drill cuttings from oil based muds (OBM) are sent to a treatment center, prepared for land disposal, or processed for reuse the initial hydrocarbon levels must be determined as well as levels attained after treatment or degradation. Typically, these levels are in the 0.5 – 10% range, well above the typical ppm requirements for oil in water.

Sub-ppm to percent level infrared measurements

Going from ppm levels up to percent levels with the same sampling system can be an analysis challenge. Wilks has developed procedures that allow for a full range of analysis and with the new InfraCal 2 Analyzer, there is now the capability to have multiple calibrations for different concentration ranges, as well as the ability to detect sub-ppm levels.

InfraCal 2 Analyzer TRANS-SP

Water samples typically have hydrocarbon levels in the ppm or mg/L range while drill cuttings are in the percent range. A filter-based infrared analyzer can be configured with different sample stages for different solvents used for extraction or use different solvents with the same sample stage.

For example, a horizontal ATR sample stage using hexane, pentane or cyclohexane as the extraction solvent can be used for oil in water levels from 0.3 to 1000 ppm range. The hydrocarbon solvent is evaporated off and the infrared absorbance due to the residual oil film is measured.

The same ATR sample stage can be used for the higher 1-10% range found in drill cuttings or muds. The sample is diluted by using a solvent that does not have an infrared absorbance at the hydrocarbon wavelength such as tetrachloroethylene (perchloroethylene) or S-316 (dimer/trimer of chlorotrifluorethylene) and therefore does not require evaporation. The same analyzer can but used for TPH in soil if a spill or pond leak occurs to determine the extent of contamination.

For analyses where it is important to detect volatile hydrocarbons, IR transparent solvents such as tetrachloroethylene or dimer/trimer of chlorotrifluoroethylene (S-316) allow for direct measurement in the solvent without an evaportion step. A cuvette holder sample stage is utilized for these solvents.

Conclusion

A quick and simple on-site infrared oil and grease measurement gives operators at a well site a useful tool for optimizing frac water treatment procedures, maximizing evaporation pond efficiency, complying with off-site disposal requirements of wastewater and drill cuttings, or for assessing contamination. This is the same field-proven technology that has been used worldwide for both the off-shore and on-shore oil and gas industry and is a reliable testing method that will help reduce public environmental concerns.

References

[1] Dobb, Edwin; "The New Oil Landscape." National Geographic, March 2013, Vol.223-No. 3.

[2] Railroad Commission of Texas, News Release – March 26, 2013, http://www.rrc.state.tx.us/pressreleases/2013/032613.php