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WHITE PAPER

Solvent Choices for Infrared Testing of Oil and Grease in Water



InfraCal 2 Model TRANS-SP

Water is a very strong absorber in the mid infrared (IR) region where oil is measured. We see the effect of infrared absorbance when a cold bucket of water left in the sun is quite warm by afternoon due to the absorption of infrared energy as heat. When measuring part per million (ppm) oil levels with mid IR, the water absorbs so much of the infrared energy that the signal becomes saturated and low oil levels cannot be detected. The oil in the sample needs to be separated from the water in order to make a measurement. Typically, the oil is extracted into a solvent and then measured either directly in the solvent or the residual oil is measured after solvent evaporation.

There are a number of different solvents which dissolve the oil and are hydrophobic so they form a separate solvent layer that can be conveniently used for the analysis. Some of the solvents are heavier than water which requires a separatory funnel or a syringe and an inverted vial with a septum cap to get to the solvent layer. The solvents lighter than water are easier to access from the top of the container. A summary of the solvents and their properties is in the chart in the next section.

Some of the solvents are IR transparent (ie: perchloroethylene) and do not have hydrocarbon absorptions so the oil can be measured directly in the solvent. Hydrocarbon solvents such as hexane require the solvent to be evaporated prior to the measurement to avoid having the solvent contribute to the reading. For hexane, a measured amount of solvent extract is put on a horizontal ATR (attenuated total reflection) crystal. After the solvent evaporates, the residual oil film is measured. With the solvent evaporation step, volatile hydrocarbons in the sample will be evaporated along with the solvent. For gas condensate wells, the Model TRANS-SP is recommended if the volatile hydrocarbons are to be included in the measurement.

The IR transparent solvent extract is put into a quartz cuvette (InfraCal 2 Model TRANS-SP). The IR light passes directly through the fluid and the amount of light absorbed by the oil in the solvent is measured by transmission. Because the volume of sample that the infrared light passes through is larger than the layer of oil on the ATR crystal, the detection limit is lower. For a 10:1 sample to solvent extraction ratio, the InfraCal 2 Analyzer, Model TRANS-SP, with a cuvette can measure down to 0.1 ppm and the InfraCal 2 Analyzer, Model ATR-SP, with a horizontal ATR crystal measures down to 0.3 ppm.

Six considerations that will affect solvent choice:

1. Measurement range

   As noted, transmission analyzers have a different minimum detection limit (MDL) than analyzers with ATR sampling. If a sub ppm measurement is required, an IR transparent solvent and the InfraCal Analyzer 2 Model TRANS-SP would be necessary.

2. Availability

   Some solvents such as the S-316 or infrared compatible Tetrachloroethylene from Mallinckrodt Baker can be difficult to obtain in some parts of the world. Knowing what solvents are available may influence which InfraCal 2 Analyzer Model to purchase.

3. Cost

   Solvents range in price so if cost per test is an issue, you may want to check the solvent prices in your region.

4. Solvent toxicity

   The NFPA toxicity rating is in the chart below.

5. Disposal requirements

   Every country has different chemical disposal requirements. If a collection system is not already in place, you may want to check how to dispose of your solvent. Customers that have an oil treatment system may have the option of putting the sample and hydrocarbon solvent back into the treatment system.

6. Flammability

   While most petroleum facilities have far more volatile hydrocarbons in the air than the 50 microliters that has evaporated from the sample plate, some are concerned with flammability of solvents such as hexane. The flammability rating is in the chart below.

SOLVENT	MDL*	INFRACAL MODEL	LIGHTER THAN WATER	NFPA RATING TOXICITY	FLAMMABILITY	RECOMMEND PURITY
Hexane	0.3	ATR-SP	yes	1	3	95+%
Pentane	0.3	ATR-SP	yes	1	3	95+%
Cyclohexane	0.3	ATR-SP	yes	1	3	95+%
Vertrel MCA	0.3	ATR-SP	yes	1	0	MCA
Petroleum Ether	0.3	ATR-SP	yes	2	4	**
Perchlororethylene Tetrachloroethylene	0.1	TRANS-SP	no	2	0	Mallinckrodt Baker-Ultra Resi-Analyzed
S-316***	0.1	TRANS-SP	no	2	0	N/A
Freon 113	0.1	TRANS-SP	no		0	99+%
Carbon Tetrachloride	0.1	TRANS-SP	no	3	0	99.9%

* Minimum Detection Limit for a 10:1 sample to solvent extraction ratio
** Residue on evaporation 0.0003% (or equivalent to Aldrich Anhydrous 300314)
***Dimer/Trimer of chlorothrifluoroethylene

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