Rapid Analysis is Key to Successful Management of FOG

In some parts of the UK, the majority of sewerage blockages occur due to a build up of Fats Oil and Grease (FOG) from food-related activities, domestic homes and industry. Quantitech Managing Director, Keith Golding, believes that successful management of the problem, through best practices and effective grease interception, can only be achieved when rapid analysis tools are employed.

Drawing on experience in the United States, Keith explains how monitoring can help to ensure that FOG related problems can be minimised, from both point and non-point sources.

> ***"Infrared analysis of oil and grease has been used in the petroleum industry on highly regulated offshore platforms for over 30 years"***

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(please note that a high proportion of the material was provided by Sandy Rintoul, President of Wilks Enterprise, Inc.)

Point sources have been the focus of much attention recently; however, combined sewer overflows (CSOs) are a major contributor to non-point source pollution. A recent study in the United Sates showed that FOG blockages account for 50 to 75% of all CSOs [1].

In response to this problem the US EPA, along with city and state agencies, initiated the Capacity, Management, Operation, and Maintenance (CMOM) programme in 2001 to encourage operators of sewer systems to improve maintenance. As an aid to the CMOM program, Water Environment Research Foundation (WERF) funded a report titled 'Assessment of Grease Interceptor Performance' [1].

The study evaluated different grease interceptor designs and tested the effluent for FOG levels with a portable infrared oil and grease monitor, the InfraCal TOG/TPH Analyser (see *Photo 1*) because this enabled rapid onsite analysis.

InfraCal CVH

For both industrial and sewage treatment operators, waiting for remote laboratory results can take several days or even weeks, which may result in high levels of FOG entering the wastewater stream. As a consequence, accurate onsite analysis is generally preferable.

FOG ANALYSIS METHODS

FOG analysis is slightly more complicated than normal chemical analysis because the definition of FOG is dependent on the procedure and solvent used. Different test methods assess different physical properties of FOG, so there can be differences in the result.

In essence, infrared analysis counts CH2 groups, so infrared absorbance rises with the length of hydrocarbon chain which correlates with the weight of the hydrocarbon. Therefore, the EPA 1664 hexane/gravimetric method and infrared analysis typically correlate well with each other. Table 1 shows two sets of data comparing the hexane/infrared method to the hexane/gravimetric method. One data set is from a meat packing plant and the other from tests conducted on a grease trap at a restaurant.

Table 1: Comparison of the Hexane/infrared Method to the Hexane/gravimetric Method

	Meat Packing Plant	
	Infrared	**Gravimetric**
Sample 1	67 ppm	70 ppm
Sample 2	1990	2020
	After Grease Trap at a Restaurant	
Sample 1	423	415
Sample 2	332	300
Sample 3	103	130
Sample 4	157	170
Sample 5	67	74

Differences begin with sample collection because it is difficult to obtain two identical grab samples from a waste stream. Another consideration is recognition of the inherent error in the EPA 1664 Method itself. As stated in the method in section 17.0 'Acceptance Criteria for Performance Tests' for ongoing precision and recovery, the accepted range hexane for extractable material is 78-132%. This means that for a 100ppm sample, an acceptable result from a laboratory using the EPA 1664 method would be 78ppm to 114ppm, or +/- 18ppm. For hexane extractable material that is treated with silica gel to remove the polar organics for a total petroleum hydrocarbon (TPH) measurement, the acceptable result range is 64ppm to 132ppm, or +/- 34ppm for a 100ppm sample.

INFRARED ANALYSIS OF FOG

Hydrocarbons such as fats, oil and grease can be extracted from water through the use of an appropriate solvent. The extracted hydrocarbons absorb infrared energy at a common infrared wavelength and the amount of energy absorbed is proportional to the concentration of the oil/grease in the solvent. The infrared absorption can be directly calibrated to the amount of oil in the original sample.

Infrared analysis of oil and grease has been used in the petroleum industry on highly regulated offshore platforms for over 30 years. EPA Methods 413.2 and 418.1 were infrared methods for oil and grease measurement that called for (now banned) Freon to extract hydrocarbons from the effluent.

EPA Method 1664 using hexane as the extraction solvent and gravimetric analysis is now the standard method replacing Freon methods. This gravimetric procedure requires a skilled laboratory technician, a considerable amount of time and specialist equipment. So, to accommodate those that need fast, simple analysis, the ASTM passed a new method using a Freon replacement solvent, and simplified infrared analysis. There is also a simplified infrared method using hexane extraction and evaporation.

MEASUREMENT OF FOG USING INFRARED ABSORPTION AND A HYDROCARBON FREE SOLVENT

For an infrared measurement, FOG is measured at the C-H absorption band at 2930 cm- [1]. S-316 solvent (called for in the new ASTM method D 7066-04) and hydrocarbon-free perchloroethylene are good infrared solvents as they totally lack a C-H absorption band. The solvent extract is placed directly in a quartz cuvette and a beam of infrared light goes through the cuvette with the extract for an infrared transmission measurement (*Figure 1*). A detector

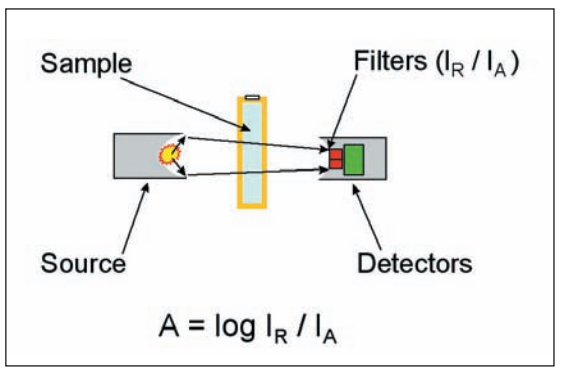

Figure 1: The measurement of IR absorption of an oil sample with a cuvette

with a 3.4µm filter for C-H absorbance measures the hydrocarbon content in the extract. The minimum detection for this method using a portable fixed filter infrared analyser is 2ppm.

MEASUREMENT OF FOG USING INFRARED ABSORPTION AND HEXANE EXTRACTION

Hexane is a desirable solvent because disposal is simple and it is the solvent used in EPA Method 1664. Hexane must be evaporated off so that it does not interfere with the measurement of oil and grease. This poses a problem for the traditional infrared method of using a quartz cuvette and transmission as described above. To overcome this limitation, an ATR (attenuated total reflection) sample plate (*Figure 2*) is used as an alternate sample holder to the quartz cuvette. For this analysis, a measured amount of the hexane extract is deposited directly on the ATR crystal. The hexane evaporates and leaves a film of oil and grease on the surface of the crystal. The infrared beam is internally reflected down the ATR crystal and the output is focused directly on the detector situated at the opposite end of the infrared source. Since there is an evanescent wave that penetrates into the film of oil and grease at each internal reflection point, energy is absorbed at the C-H absorption band without the hydrocarbon interference from the hexane. The minimum detection for the hexane extraction is 8ppm.

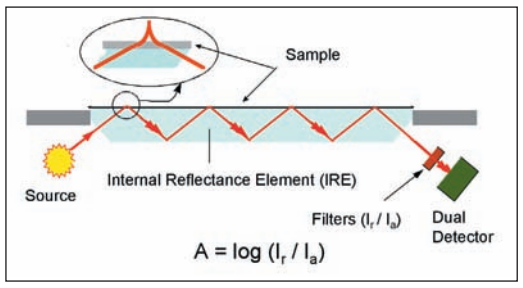

Figure 2: The measurement of IR absorption of an oil sample with an ATR sample plate

FOG MEASUREMENT PROCEDURE

The advantages of infrared analysis over the gravimetric method are simplicity and speed. Portable, relatively inexpensive fixed-filter infrared analysers, such as the Wilks InfraCal TOG/TPH Analyser (*Photo 1*), are currently employed by regulators and industrial pre-treatment personnel for on-site testing. The extraction and measurement procedure involves several simple steps, which means that an operator with minimal training can perform the analysis.

On Site FOG Measurement

The sample is collected in a container. The solvent, hexane, perchloroethylene or S-316, is added at a ratio of one part solvent to 10 parts sample. After shaking for two minutes, the hexane, which is lighter than water, will rise to the top carrying dissolved oil and grease with it. The S-316 and perchloroethylene are heavier than water and require an inverted container such as a separatory funnel or a jar with a septum to remove the solvent.

For the hexane method the extract is placed on the ATR crystal and after evaporation (about three minutes) the result is displayed. For the ASTM method D 7066-04, the cuvette is filled with the S-316 or perchloroethylene extract and placed in the analyser. After 30 seconds, the result is displayed. Typically, an analysis from sample collection to final result takes less than 10 minutes.

SUMMARY

The management of a process is greatly enhanced by the availability of accurate, 'live' data, so portable infrared analysers enable operators of pre-treatment systems to easily assess efficiency. In addition, regulators and water companies can immediately determine who their 'FOG clog' offenders are.

Plant operators are able to take samples both before and after treatment in order to study the process under differing load conditions, so that system parameters can be changed quickly without having to wait for laboratory results.

Most importantly, effluent containing fats, oil and grease above the regulatory limits can be diverted before a blockage is caused.

References

1. Assessment of Grease Interceptor Performance(Supplemental Report to 03-CTS-16T) Joel J. Ducoste, North Carolina State University; Kevin M. Keener, Purdue University; John W. Groninger, Southern Illinois University; Leon M. Holt, Town of Cary; Copyright 2008 by the Water Environment Research Foundation

2. EPA Method 1664, RevisionA: N-Hexane Extractable Material (HEM;Oil and Grease) and Silica Gel Trated N-Hexane Extractable Material (SGT-HEM; Non-polar Materia) by extraction and Gravimetry, United States Environmental Protection Agency, Office of Water, EPA-821-R-98-002, February 1999.

Yorlab Reports 20 Percent Sales Rise

Kirstin Davis, Financial Director, Yorlab

Yorlab has increased sales by more than 20 per cent over the last 12 months.

Financial Director Kirstin Davis says "Although the reported revenues were flattered by the Euro to sterling exchange rates for European and African sales, these figures represent significant volume increases in all of our major markets which include the UK , Africa and the Indian Sub continent".

She adds that "the takeover of Chester Scientific last year has also been a significant boost, adding a couple of major blue chip companies in the northwest of England to our customer base, this has helped push sales beyond our expectations.

We are determined to keep the growth going without compromising our levels of service to our customers. As a small business it is essential that we have a constant eye on the satisfaction of our customers. Direct contact with customers is an essential element of our business philosophy. We work in partnership with our customers from conception to the finished article; we have recently developed a variation on the traditional essential oil still (pictured), working closely with a customer who was interested in some of the harder to separate volatile compounds. Working in partnership enables us to get it exactly right resulting in customer satisfaction.

We also seek and welcome feedback, it's important to us to know what we are doing right and where we are going wrong."

Ray Smith, Glassblowing Manager, with a essential oil still made in collaboration with the customer

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