On-Site Analytical Technology for Proactive Equipment Maintenance in the Petrochemical Industry

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Petroleum refining and petrochemical manufacturing operations are increasingly incorporating methodology and technology to enable proactive maintenance of high value machinery. To prevent equipment breakdown, it is critical that key parts are properly lubricated in order to minimize metal-to-metal contact and subsequent wear. A new at-site analytical technology, Fourier Transform Infrared (FTIR) spectroscopy, is now able to monitor the condition of lubricants used in petroleum refining and petrochemical manufacturing operations and is an important new addition to proactive maintenance protocol for this industry.

Introduction

To reduce repair costs and minimize losses in productivity, more petroleum refining and petrochemical manufacturing operations are turning from preventive maintenance (maintenance based on a fixed schedule) to proactive maintenance (maintenance based on objectively determined need) in order to protect their high value assets. Condition monitoring of crankcase, hydraulic and gear lubricants plays an important role in the maintenance of equipment used in petroleum refining and petrochemical manufacturing. Currently, lubrication condition monitoring is typically accomplished by taking samples in a prescribed manner and sending the samples to a lab for analysis by an array of analytical technologies.

The recent availability of field-portable, rugged and easy-to-use analytical instruments for use directly at the site of petroleum refining and petrochemical manufacturing operations changes how the condition of in-service lubricants can be monitored. These field-ready analytical tools provide users with near real-time information and allow for rapid, actionable decisions to be made, enhancing proactive maintenance programs. One of the most widely used and powerful analytical tools for lubrication condition monitoring is Fourier Transform Infrared spectroscopy (FTIR). This technology has now been engineered for use in the harsh operating conditions found in petroleum refining and petrochemical manufacturing operations.

Infrared Spectroscopy and Lubrication Condition Monitoring

Infrared spectroscopy is an analysis technology that has been used for over 50 years in the study of chemistry and chemicals in virtually every field and industry. When infrared radiation passes through a chemical substance, the infrared light interacts with the molecules of the sample and is absorbed in a highly specific manner. This produces a spectrum of the sample, often called a chemical fingerprint, which is directly related to the specific components in the sample as well as their concentration.

When applied to lubrication monitoring, infrared spectroscopy measures many of the key parameters critical to understanding the condition of in-service lubricants. These include the degree of oxidation of the lubricant, the presence of water and/or glycol, the levels of nitration, sulfation, soot and the amount of anti-wear and anti-oxidants agents present in the lubricant.

Advantages of Real-Time, At-Site Infrared Analysis

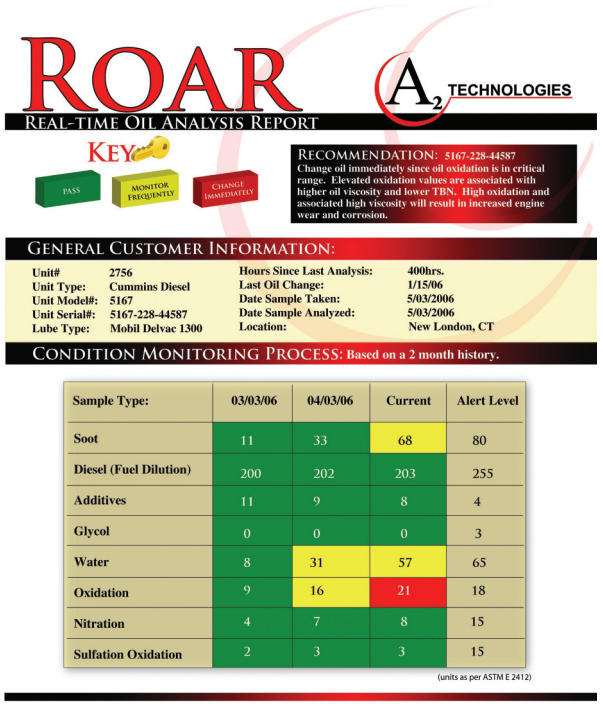
Currently, lubrication samples are sent for analysis to an off-site laboratory on a prescribed time schedule. However, the ability of infrared spectroscopy to measure these parameters in real-time and at site has important implications for proactive maintenance. Changes in the performance of lubricants are not linear as a function of time, therefore the time period between analytical tests should be chosen to reflect the current condition of the lubricant. At-site FTIR analyzers enable lubricants to be analyzed more frequently, which is especially important when previous tests indicate that the lubricant has increasing levels of deleterious by-products or loss of additives.

At-site FTIR analysis can also help to reduce machinery wear caused by rapid oil breakdown and detect problems that could cause catastrophic failures. For example, an anti-freeze leak will cause excessive levels of water and glycol to be present in engine oil and these can be readily detected by FTIR. By more frequent monitoring of engine oil by FTIR, there is an increased chance that these contaminants will be detected before they have a chance to cause catastrophic damage to the machinery.

At-site FTIR analysis can rapidly ascertain the condition of lubricants in manufacturing and refining equipment located in remote and offshore locations, far away from traditional lubrication analysis laboratories. Real-time analysis minimizes the need to send lubrication samples to off-site labs for condition-based monitoring, which in some cases may be difficult, very costly or result in unacceptable delays in obtaining the results. Equipment in these remote locations may face particularly challenging ambient conditions and the ability to monitor the in-service lubricants more frequently via at-site FTIR can help reduce the likelihood of equipment failure.

At-site FTIR analysis enables personnel to obtain clues and insights into the working condition of a piece of

Lubrication sample is drawn for at site analysis by A2 Technologies Mobility FTIR Spectrometer



ROAR

A2 TECHNOLOGIES

REAL-TIME OIL ANALYSIS REPORT

KEY: PASS | MONITOR FREQUENTLY | CHANGE IMMEDIATELY

RECOMMENDATION: 5167-228-44587
Change oil immediately since oil oxidation is in critical range. Elevated oxidation values are associated with higher oil viscosity and lower TBN. High oxidation and associated high viscosity will result in increased engine wear and corrosion.

GENERAL CUSTOMER INFORMATION:

Unit#	2756	Hours Since Last Analysis:	400hrs.
Unit Type:	Cummins Diesel	Last Oil Change:	1/15/06
Unit Model#:	5167	Date Sample Taken:	5/03/2006
Unit Serial#:	5167-228-44587	Date Sample Analyzed:	5/03/2006
Lube Type:	Mobil Delvac 1300	Location:	New London, CT

CONDITION MONITORING PROCESS: Based on a 2 month history.

Sample Type:	03/03/06	04/03/06	Current	Alert Level
Soot	11	33	68	80
Diesel (Fuel Dilution)	200	202	203	255
Additives	11	9	8	4
Glycol	0	0	0	3
Water	8	31	57	65
Oxidation	9	16	21	18
Nitration	4	7	8	15
Sulfation Oxidation	2	3	3	15

(units as per ASTM E 2412)

Figure 1: Real-time crankcase oil report generated by Mobility FTIR spectrometer (ROAR report)

equipment. For example, high levels of soot may indicate that an engine has incorrect fuel-air ratio. Unusual levels of oxidation may indicate that an engine is overheating. The presence of excessive nitration by-products can be indicative of piston ring blow-by, while the presence of glycol and water may indicate a head gasket problem. *Figure 1* shows a real-time oil analysis report (ROAR) which details the unit being sampled, the results and any trends in the analyses. This ROAR report also recommends next steps to take to maintain the machinery in working order.

In addition, at-site FTIR analysis can assist users in determining whether incoming lubricants are properly formulated, not contaminated in shipping or mislabeled, and that the correct lubrication fluid is charged into the machinery. It is critically important to use lubricants that meet the equipment manufacturer's specifications. At-site FTIR spectroscopy can ensure total quality control of lubricants and other incoming materials.

Conclusion

At-site infrared analysis supports proactive maintenance programs in petroleum refining and petrochemical manufacturing operations, providing immediate insight to the overall condition of lubricating fluids and the equipment that these lubricants protect.

At-site analysis also ensures personnel at remote and offshore sites can make rapid, actionable decisions based on objective analytical data in support of proactive maintenance programs to ensure equipment reliability.