

Determining Moisture Levels In Oils At A Power Plant

Written by R.C.J. Wilson, CEnv. IEng. MEI, MRSC, Ferrybridge C Power Station
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An advancement over Karl Fischer titration...

Technology has been marching on and on since development of the "gold standard" of oil analysis. Here's how one British power plant has been benefiting from a leader of that parade.

In modern conventional power stations, the overall condition of the fluids that lubricate large, high-value machinery is critical. In particular, moisture in the oil can wash out critical anti-oxidative compounds, contributing to lubricant oxidation and subsequent loss of lubricant performance. Although Karl Fischer (KF) titrations have been used over the years to measure the degree of water in oil, this analytical method does, in fact, have some limitations. Three years ago, the Ferrybridge C Power Station in West Yorkshire, England, began moving from its use of the KF method to use of Fourier transform infrared (FTIR) analysis to measure and control the level of water contamination in lubricating fluids. The result? Accurate data in less time—*and with less complication*—than the "gold-standard" Karl Fischer method.

Lubrication monitoring at Ferrybridge

Ferrybridge C Power Station is a 2000MW coal and biomass co-firing power station. Its four enormous steam turbines and main feed pumps produce enough power for two million homes—*or 4% of the United Kingdom's daily electricity requirements*

. The power from one steam turbine would be sufficient to power six Queen Mary 2 cruise liners traveling at full speed.

Each turbine shaft is over 170' long and exceedingly heavy, with 12 support bearings lubricated by mineral oil. This lubricating oil serves more than one purpose: It is also the control oil for operating the turbine governor valves and steam admission valves. Thus, it is mandatory for the

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oil to be monitored and kept within the required specification. Since the level of moisture in the oil changes over time as a function of environmental and operating conditions, it is also imperative to rapidly obtain accurate analytical information. To do all this, Ferrybridge has turned to the A2 Technologies iPAI FTIR analyzer equipped with the TumbIIR transmission cell system ([see Sidebar](#)).

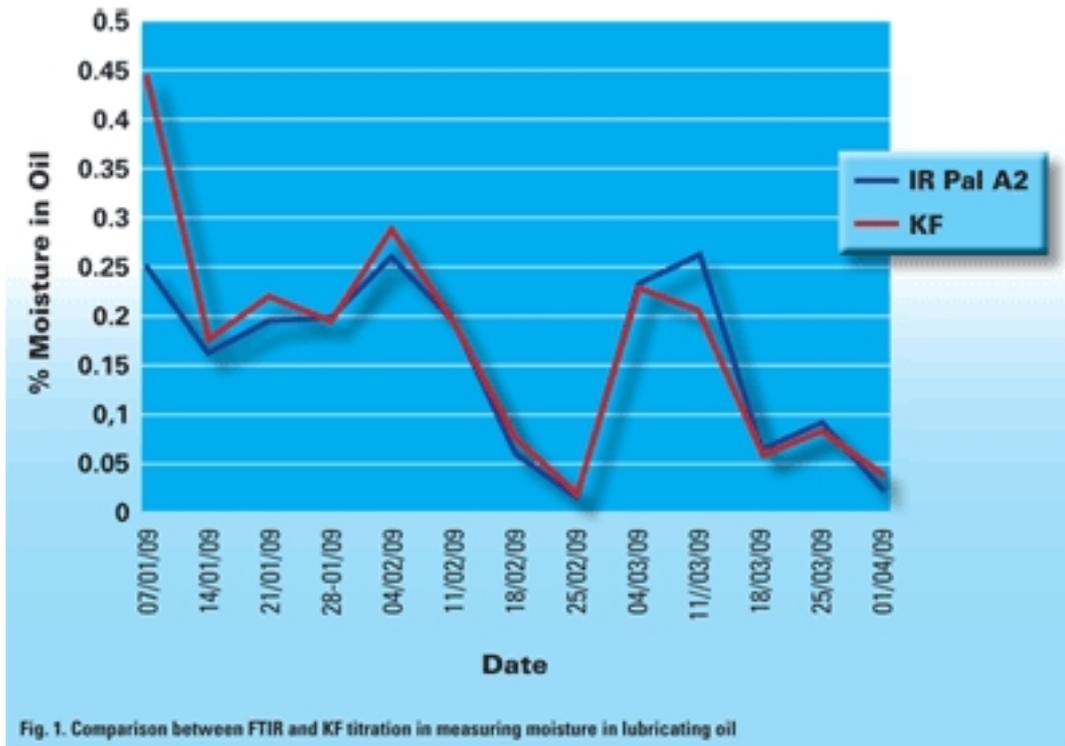


Fig. 1. Comparison between FTIR and KF titration in measuring moisture in lubricating oil

As shown in Fig. 1, testing the FTIR analysis against Ferrybridge's KF titration method showed a good correlation between the two techniques. Since the trend in the amount of water present is monitored, absolute values are not necessary. Even with KF measurements, absolute values are not measured, since results may be biased by the amount of sample used and the inherent immiscibility of oil and water. Therefore, repeat measurements are made with both FTIR and KF (many times with the KF). Because FTIR measurements are so quick, repetitive measurements are faster and easier. The small discrepancies between the two methods are not significantly different from those obtained by carrying out two KF tests on the same sample.

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Having gained confidence in the accuracy and reliability of the FTIR method, Ferrybridge has largely eliminated KF measurements. An example of how the plant uses FTIR can be seen in Fig. 2, where A2's iPAL system tracked the level of moisture in both the turbine oil and the main feed-pump oil.

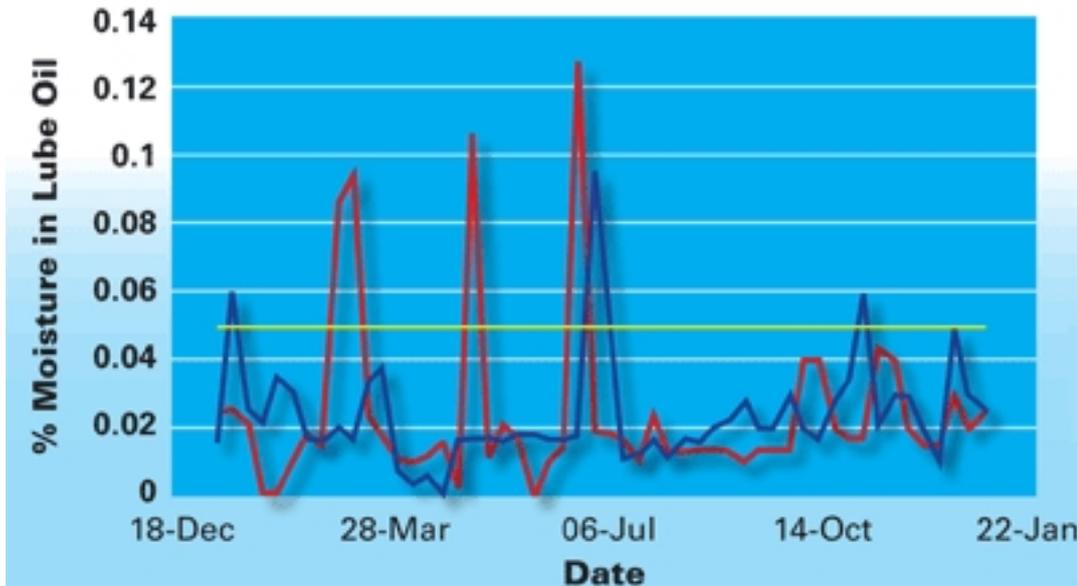


Fig. 2. Measurements of moisture in lubricating oil for Unit 1 main turbine and main boiler feed pump, in 2009

When the moisture in the lubricating fluid is greater than the allowable specification, corrective action is taken to remove the water in the oil. There are two methods to adjust the moisture content of the turbine oil:

1. The turbine gland steam pressure is manually adjusted if the unit is to operate at a lower-than-normal load.
2. A mechanical device that separates water from oil is used to remove moisture from the turbine main oil tank.

In addition to monitoring the level of water in oil and alerting plant personnel to take corrective action when necessary, the iPAL FTIR analyzer is used to track the effectiveness of the methods the site uses to eliminate water and return the oil to acceptable moisture limits.

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The benefits of FTIR analysis

There are numerous reasons why Ferrybridge has turned to FTIR analysis of its lubricating oils—*eliminating much of its KF analyses in the process.*

FTIR is quicker and more straightforward than KF, no toxic reagents are required and it's easy to train personnel on its use. As analytically accurate as KF (and in some cases, more so), the iPAL FTIR system can go beyond determining moisture levels in oil. Using pre-calibrated, on-board methods on the same sample, it can measure other important specifications, including additive depletion, overall condition/oxidation and oil in water for discharge purposes.

One of this FTIR system's greatest benefits, however, is the fact that it affords real-time analysis, on site. This, in turn, lets personnel immediately ascertain the condition of a lubricating fluid. If an oil is found to be out of specification, on-site testing allows corrective action to be taken—*and the effectiveness of such actions to be determined*—virtually in real time. All of this can be accomplished before the initial results from an off-site testing lab could even be reported.

The FTIR system is important for another reason: It increases Ferrybridge's level of confidence in results that it does obtain from off-site testing labs. The plant has found that if lubricants are not sampled, packaged and sealed correctly for shipment, there can be a significant difference in moisture testing reports. In the past, results obtained from outside labs frequently were found to be, at best, suspect and, at worst, completely inaccurate. Carrying out on-site testing with the FTIR analyzer serves as an important cross-check on off-site lab testing.

A2's iPAL FTIR analyzer has become a vital part of the Ferrybridge on-site testing protocol. In fact, the plant has so much faith in this technology that its use is now being extended to more applications at the site. **LMT**

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Using A2's iPAL FTIR System

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To analyze a sample, the operator places a drop of neat used oil on the lower TumbIIR window mounted in the surface of the iPAL FTIR analyzer, then rotates a second, gimbal-mounted window into place, thereby creating a reproducible 100-micron gap that holds the oil. The system comes equipped with a pre-calibrated, automated method for determining the amount of water in oil, and a simple command initiates the transmission IR method. The unit then collects, analyzes and reports the data. Since the system is capable of accurately analyzing water as low as 200 ppm (with no sample preparation), detection limits are not at issue. A2 has developed a surfactant-using method that allows quantitative detection of water in lubricating oil down to 65 ppm. For more info, enter 01 at www.LMTfreinfo.com