



## Oil analysis sensors

By Jack Poley

There is a life-of-its-own movement in oil analysis that says companies should gather as much information available on-site as possible rather than securing and transporting samples to a lab for testing. Some companies have on-site testing facilities that are reducing the time it takes to transport samples to an analytical facility, thus lowering their shipping costs and providing results faster.

Sensors represent a technology that's gained a substantial amount of momentum in oil analysis as a first line of defense, adding a dynamic component heretofore not available to the information-gathering process. Yes, temperature and pressure analysis were always available, but they produce much more general data.

Vibration analysis, which was introduced before modern oil analysis (which includes wear metals inspections), has been a dynamic process from the start. Probes (mostly accelerometers) are mounted to machinery, spewing out continuous information. Vibration analysis followed a development path that was technology-driven. Data gathering first consisted of handwritten readings gathered while walking from machine to machine, followed by portable recorders or readers and remote data gathering on a continuous basis.

In some instances, remote data gathering is wireless. Periodic real-time monitoring has now become continuous real-time monitoring. In addition, oil analysis has been playing catch up with this concept, as oil



**Figure 1.**  
A typical oil condition sensor employing dielectric measurement.

quality sensors continued to improve to the point of viability and acceptance. That time has come.

Why did it take longer for oil sensors to gain parity with vibration sensors in terms of continuous monitoring? The simplest answer is that oil sensors need to be in the oil flow stream, whereas vibration sensors are mounted externally, either permanently in one or more locations or singularly as a temporary, movable (often magnetic) attachment until a reading is secured—the walk-around method. Oil can be very hostile to sensors—first in terms of heat and second in terms of fouling to a point of dysfunction. Machine vibration also might be an issue. So ruggedness and durability were great obstacles.

Oil, particularly dirty oil, presents both physical and chemistry problems that tend to defy the nondestructive analysis sensors attempt to perform. It took years for technology progress of sufficient scope to enable readings that were accurate and repeatable coming from instruments that were

lasting enough to do the job.

Sensors measuring dielectric strength were the first types available. Transformer oil testing, developed and introduced by power companies, filled a need to know that a minimum of insulation protection was being upheld for both safety and performance concerns. The original instruments were bulky and substantial in order to deal with the power required for a meaningful test. In the late 1960s miniaturized, battery-operated versions of dielectric strength-measuring devices came into being, but none really demonstrated a profound ability to detect significant change on a repeatable basis.

Several commercial laboratories, spurred by a desire to not be eclipsed by a little box, compiled data to discredit these toys. However, dielectric-measuring sensors represent a quantum upgrade from the original low-tech products. The good news is that a significant change in dielectric strength does suggest a problem. The bad news is that the problem is not disclosed with specificity. One knows there is a problem, but what can be done? The answer, of course, is to send a sample to a lab and gather supporting data to isolate the indicated problem.

Does the above scenario provide value, given that sensors add extra expense to acquire and install? Yes, but probably to varying degrees. If one has no other oil analysis program, it certainly is better than nothing, hands down. If one already has an oil analysis program, there may be justification to take samples at

greater intervals than previously, thereby paying for the sensors over time. How about abandoning sampling altogether after installing sensors? In most cases, it's not a good idea. Oil analysis in a lab still is and should be a viable and necessary procedure, even in the presence of sensors.

*Sensors fill the 'interval gap' where samples are routinely taken because there are times when a problem may arise shortly after an oil sample is taken.* Without a sensor the problem would go undetected until a month (maybe two or three months) had elapsed. Clearly, there is added value. Sensors are here to stay, and they will only increase in numbers and applications over time because they make

good sense. But sensors will not be wholesale or replace laboratory testing, at least not in the near future. Part of this is due to the cost to develop and implement a program, but the other part is the inherent limitations of sensors with respect to detection and robustness. In addition, there are simply some types of contamination or degradation that are not currently addressed with sufficient precision.

While sensors will surely improve and offer more information, continuing to put pressure on what are called routine laboratory inspections (fuel, coolant, soot, water, acids, oxidation, metals, particles, etc.), there will probably always be a need for more advanced testing. Ferrography,

scanning electron microscopy and other testing yet to be adapted or invented will be increasingly utilized, and one may expect some laboratories to adapt this scenario over time if, perhaps, reluctantly. Time will tell.

In my next column, I'll discuss individual sensor types and how they fit into existing oil analysis programs. **TLT**

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