# Oil Debris Sensor
## Ferrous Wear Detection

Introduction to Wear Debris Monitoring in the industrial marketplace.

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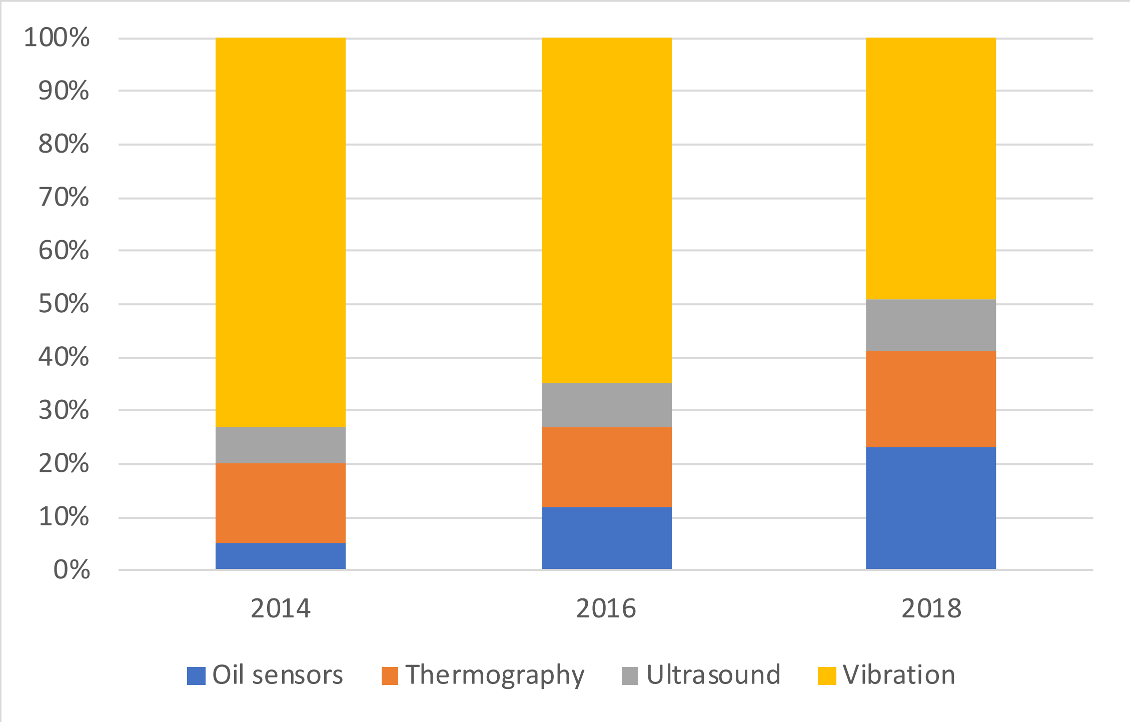
## Modern Marketplace

Today a modern Condition Based Monitoring (CBM) system may consist of many facets. Historically this space has been dominated by vibration monitoring, although this technology is now dropping market share when compared to other technologies. The largest gain in market share is Oil Sensing, which includes Wear Debris Monitoring systems.




Source – Bureau Veritas SMRP 2019

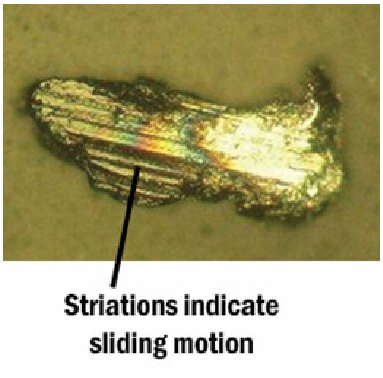
One possible explanation for this is that operators are waking up to the fact that they need more than one point of reference to properly diagnose a fault with a particular piece of equipment. So operators with existing Vibration programs are building their pool of data points through investment in oil sensing techniques. Many oil sensors will integrate seamlessly into existing Vibration online monitoring controllers, maximising previous investments. It is also true that vibration sensing on low speed rotating assets is less effective than high speed assets. So it is also possible that more low speed gearboxes are being monitored, when compared to previous years.

## Technology History

Wear debris monitoring and wear debris analysis was first developed during the 70's and early 80's. The technology came to the fore in the market place in the 1990's and has been solidly established ever since. Modern processing and sensing techniques have allowed the proliferation of new smaller, low power, sensors which industry is adopting as the new standard, at an ever increasing rate.

## Operational Theory

The principle is simple, contacting metal surfaces will start to break down, even at the most microscopic of levels. This is a simple fact of how gearboxes, bearings and engines work. Yes, we can reduce the friction between surfaces; oil and lubricant manufacturers are developing ever better grades and blends of oil to enable this. But what happens when a seal fails, water ingresses or the additives burn out and the lubrication properties are less than optimal?




Credit – Machinery Lubrication

Contacting surfaces start to break down for several different reasons. I'm sure you will have heard of Friction, Fatigue, Fracture, Impact and Corrosion. Though this is not an exhaustive list, each of these causes of debris provides their own unique imprint on the debris when we examine them under a high-power microscope.

Now, in a perfect world, and looking for the absolute best result, we would take all the oil out of the machine leaving behind no residue. We would then examine each and every particle found in the oil and with absolute accuracy, identify what is happening inside the rotating asset.

You don't need me to tell you how impractical this approach would be.

## Offline Analysis

The practical approach is to tap off a small sample of lubricant into a perfectly clean sample bottle, to avoid cross contamination, and send it to a lab for analysis. The drawback is that this sample, usually less than 0.5% of the total system lubricant volume, must contain debris representative of the whole lubrication system and overall condition of the machine. Therefore, the location from which the oil sample is taken from is critical to getting a good result.

Your lab will then examine this sample and provide you with a Parts Per Million (PPM) count of any base metals as well as providing an overall assessment of the total metal content through a Particle Quantifier (PQ, PQI or FW) assessment. If necessary, they will examine the debris for the tell-tale signs of friction, fatigue etc. that we discussed earlier. The lab can then recommend an action based on the combined data from these results.

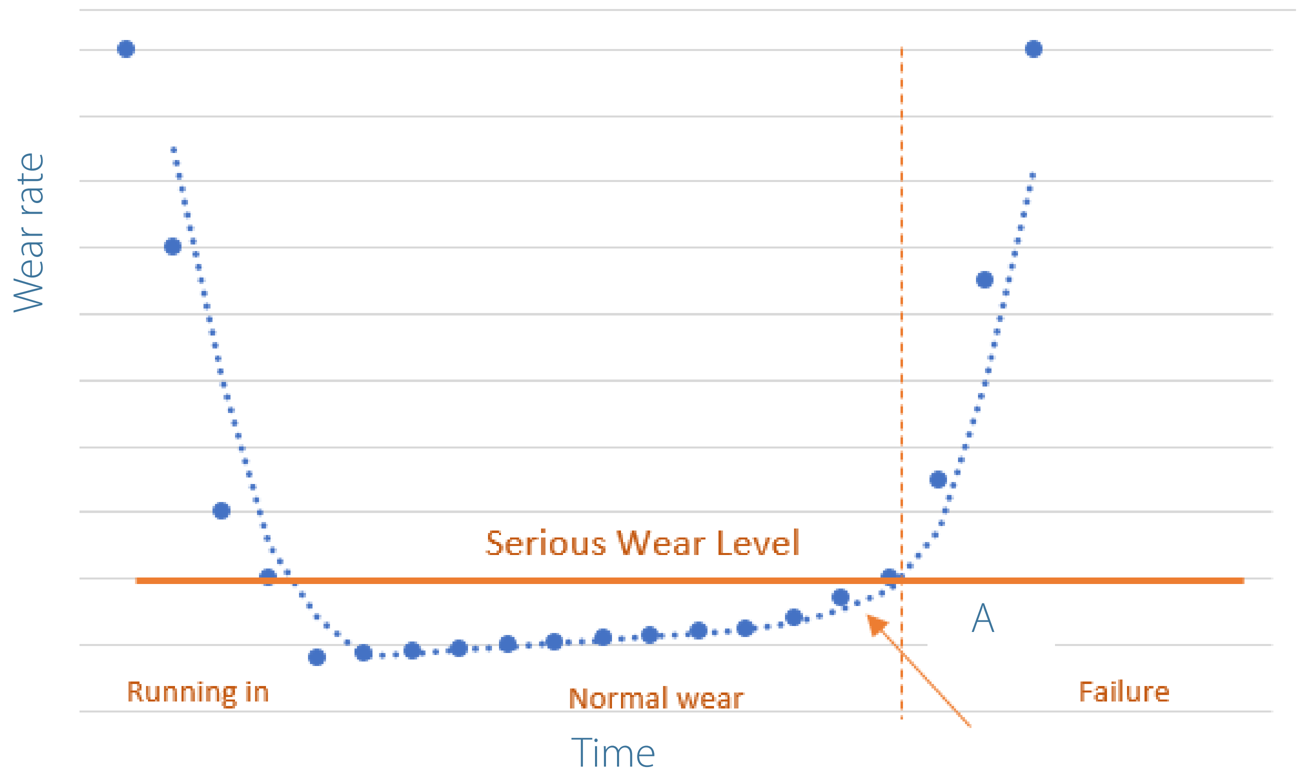
For the most critical business assets some operators pay specialist CBM companies to visit them, as regularly as weekly, to draw off oil samples for full lab analysis and trending. For most of us this level of investment is impractical, from a cash and often accessibility perspective. For example, could you imagine the cost and time implications of scaling multiple offshore wind turbines every week to take an oil sample!

## Online Analysis

There is a growing trend within the world's largest manufacturing companies to augment this lab analysis with real time sensors. Many technologies exist to examine the volume and sometimes count of metal particles present in an oil system.

These real time or online sensors are looking to follow the trend of normal wear and inform operators as soon as the normal operating limits start to trend towards potential failure.

In the image below we see a typical "bath tub" curve as an asset moves from brand new to failure.




There will always be a period of high wear at the start of the life of the asset, or after a major rebuild, as the gear teeth polish against each other. This is known as running in or bedding in. After the initial running in period "normal" wear will occur. The critical point any operator needs to catch is the upward inflection of the line in the graph above, at the point marked A.

Real time sensors are crucial in pinpointing the inflection. Operators might get lucky and take a sample for lab analysis at this point, however the most likely scenario is that this golden window of opportunity will be missed and the machinery wear rate will inadvertently drift up the curve towards failure.

What a good online sensor will do is tell operators that an oil sample and analysis should immediately be scheduled, outside of the normal 6 months to annual sample window, or perhaps just increase the frequency of oil sampling because the duty cycle on a particular machine has increased. At the very minimum, a good hard look at a piece of equipment should be performed during the next planned shutdown. Approaching maintenance in this way can bring huge cost savings on all types of gearboxes where process is critical. For powerful 2 point, real time analysis we can overlay wear debris and vibration data in a complementary manner.

In summary, catch everything, plan actions ahead and hit your uptime targets. Any online/real time sensor is not a whole oil lab packed into a tiny box. If it were, oil labs would long since be a thing of the past. With any compact and affordable solutions there will always be constraints, but what an online sensor will do for us is provide continuous trend data of vital things like ferrous wear or particle count as it happens, giving us live machinery health information and advanced warning that something could potentially start to go wrong.

## Final Summary

Wear debris monitoring should be the backbone of any quality CBM program. Independent market data is showing us that modern companies are investing significantly more in Oil Sensing and Wear Debris monitoring, compared to previous years. This could be related to the proliferation of instrumentation on low speed rotating assets, where vibration monitoring is known to be less effective.

With so many great tools and services available there couldn't be a more relevant time to be investing in online wear debris monitoring.

If you want to find out more about Condition Based Monitoring and the Gill Oil Debris Sensor take a look at our *Condition Monitoring: Reduce Downtime, Keep your Machinery running* video at gillsc.com/condition from **Gill Sensors & Control Limited.**

*References - The Wear Debris Analysis Handbook – B. Royland & T. Hunt*

> View Technical Specifications

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## > Find out how Gill can help improve your Predictive Maintenance Strategy


*Industrial Sensor*

*Inline Sensor*

| Industrial Models |
|---|
| Oil Debris Sensor with Display 4-20mA |
| Oil Debris Sensor with Display 0-10v |
| Oil Debris Sensor with Display CAN |

| Inline Models |
|---|
| Oil Debris Sensor 4-20mA |
| Oil Debris Sensor 0-10v |
| Oil Debris Sensor CAN |

| Sensor Head Fittings |
|---|
| Sensor Head Fitting M22x1.5 6g to BS3643 |
| Sensor Head Fitting M24x2.0 6g to BS3643 |
| Sensor Head Fitting 3/4" x 16UNF class 2a to ASME/ANSI B1.1 |
| Sensor Head Fitting 1/2" BSPP to BS EN ISO 228-1 |
| Sensor Head Fitting M20x1.5 6g to BS3643 |

| Options |
|---|
| Inflow Adaptor for M20 x 1.5 sized sensor |
| Inflow Adaptor kit with Valves for 1" diameter pipe |
| Inflow Adaptor kit with Valves for 1.5" diameter pipe |
| Conduit kit for display models (Sensor to electronics) |
| Demonstration Kit |

*Adaptor kit (sensor not included)*

*Adaptor (sensor not included)*

## Where to buy

Gill sells its products through a worldwide network of trained distributors, so you can count on the very best advice for your application.

**For further information on the condition sensor range, including manuals and datasheets, please click below.**

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