Oil Debris Sensor
Ferrous Wear Detection

Wear Debris Monitoring on Low Speed Drives

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A Modern Solution to an Age Old Problem

The Condition Based Monitoring (CBM) market is awash with new technologies and new ways to monitor problems that are as old as the industrial revolution. I am sure that the French inventors of the first modern automotive transmission had issues with shaft alignment, poor lubrication, excessive vibration and surface pitting. Panhard and Levassor, working over 125 years ago, would have loved to get their hands on some of the technology that today we take for granted.

But faced with so many choices, what sets different technologies apart from one another and how do you choose the right ones for your **critical machines,** especially those running **at less than 600rpm ?**

The Industry Standard

For many years vibration monitoring has been the mainstay of most processing markets. With a hardware cost that makes it affordable for even the tightest of budget holders; the technology has found its way into almost every part of industry.

Defined as the mechanical oscillation about an equilibrium point the layman understands that vibration is the back and forth motion created by a rotating component. What a vibration sensor (and a trained analyst) will tell you is if something has changed within the machine that alters the vibration profile.

What is Vibration?

Vibration is caused by a number of conditions, including imbalance on a rotating device. In a remarkably similar way to how sound is generated (the two are very closely linked, think of a tuning fork) vibration is a series of pressure waves travelling through a structure. A vibration sensor converts these pressure waves into digital electronic signals using piezo crystals; a technique that you will find in many other sensors and applications. By plotting the frequency and amplitude of these waves you can generate a 'normal' vibration profile. Regular or continuous monitoring of the sensor will generate data to overlay the vibration profile captured today with the previously determined 'normal' condition. In this way we can assess if something has changed, which is generally for the worse.

How do these Frequencies and Amplitudes vary?

Now, cast your mind back to physics class at school. You may remember the equation 'force equals mass multiplied by acceleration squared'.

Or $F = M \times A^2$

A great way to think about this in a real-world scenario is the force that you feel when you hit a pothole in the road. There are two variables here that contribute to the jolt that you feel. The speed you are travelling at (A) and the depth of the pothole (M). If you hit a pothole at the same speed every day, on your way to work, as that pothole gradually gets deeper you would notice the bump you feel gets worse.

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Troubles at Low Speed

In our analogy we said that the faster your car is going the bigger the jolt. Conversely slowly driving over a pothole will cause little jolt at all. In the equation you will note that 'A' is squared (A^2) meaning if you travel over the same pothole at ever increasing speeds the jolt you will feel becomes exponentially stronger the fast you travel.

$MxA^2 = F$

$10 \times 1^2 = 10$
$10 \times 2^2 = 40$
$10 \times 3^2 = 180$

What this means for a vibration sensor is that there is a whole load of vibration to pick up at high speed, but it gets exponentially harder to measure reliably at low speeds. If we can't determine a reliable 'normal' how can we compare and be confident when an 'abnormal' condition occurs.

Applying the Pothole Analogy

The pothole analogy is a near perfect fit with what can happen to gear teeth as they start to deteriorate. Pitting and micro pitting are a phenomenon that occurs on the face of the contacting gear teeth. As the name suggests these

are 'potholes' in the gear surface. Vibration sensors will pick up signals when the edge of the pit is sheer. However, over time (and quite quickly in some cases) the sharp edges will flatten off as the pothole gets bigger. With smoothed edges to the pothole the vibration levels will drop off, which could fool you into thinking a problem has gone away.

Other Variables

In our analogy we ignored some key facts. What if you travel at a different speed when you hit the pothole? What if you drive a van or truck and your load changes every day? In an industrial gearbox these factors either mean additional sensors (such as speed, torque or current draw) are required to determine 'normal' vibration profiles. Therefore, you will need to employ the services of an external company or get some of your engineers trained and accredited to CAT standards. This training will allow you to understand what the vibration profiles mean and what action you should take.

Alternatives in Low Vibration Applications

Fortunately, there are methods of detecting machine defects that are independent of speed, load and the severity of the defect. Contacting metal surfaces will always deposit small amounts of metallic debris into the lubricating oil. It's simple physics and obvious when you think about it. The gearbox life cycle starts with higher levels of wear, as teeth polish together and bed in. It also finishes with high wear when the gearbox starts to break down and fail.

Typical gearbox life – Bath tub curve

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Wear Debris Monitoring

Collection of wear debris deposits, either from the oil flow or via an intelligent magnetic drain plug has become common place in many developed industrial markets. For operators running gearboxes rotating below 600rpm it is important; for machines running below 200rpm it is absolutely critical that they have an alternative condition detection device other than vibration

Vibration Sensing

- High rotating speed ✓
- Other sensors already installed ✓
- CAT trained vibration enginneer ✓
- Best for Electric Motors ✓

Wear Debris Sensing

- Low rotating speed ✓
- Variable speed or load ✓
- No training required ✓
- Best for Gearboxes ✓

Summary

For higher speed applications the industry standard vibration monitoring system is often sufficient, especially for electronic motors. However, for operators of low speed drives who have gearboxes absolutely critical to their processes (and bottom-line profits) wear debris monitoring just makes sense (excuse the pun).

Want to find out more?

If you are new to the world of wear debris monitoring check out our FREE eBook on Wear Debris Monitoring in the industrial market place below or if you are ready to jump straight into the technical details, view the datasheets.

Read the ebook

View Datasheets