Mario on maintenance

From 'predictive protection' to predictive maintenance

Martec's Mario Kuisis looks at continuous improvement in the maintenance field and presents an example of how vibration analysis that was being used to predict premature failure led to a change in maintenance practices that extended bearing life – via the use of ultrasonic detection to optimise lubrication levels.

Continuous improvement is a never-ending journey and is now an entrenched concept. It has also become increasingly important as competition escalates in today's business environment. The best forms of improvement arise from frustration and dissatisfaction with the status quo, which in itself is an improvement over what came before, and with things before that, and so on. Complacency is the enemy of improvement, so if you are feeling satisfied with where you are right now, then beware.

Like other disciplines, much has been done by way of continuous improvement in asset management over the past number of years. Proactive maintenance is one of these. But late entrants into proactive maintenance can take advantage of these improvements by leap-frogging early adopters who have not kept pace, whether they be in people, technology, business processes or simply management concepts. Sounds like a race or competition? Well, that's a good way to think of it.

Vibration analysis, using a modern instruments such as SKF's Microlog analyser, can be used to collect route-based data about the condition of bearings. Vibration analysis can be seen as a 'predictive-protection' technique that gives and early warning of imminent failure.

By coupling vibration analysis with an actively managed lubrication programme involving measuring friction during the greasing process and periodically in service using an ultrasonic detection system, blind greasing with fixed quantities at fixed intervals could be replaced with the application of an optimum quantity of grease at the times when needed.

To illustrate the principle and how it can be used to advantage, let's take a simple example in the most well-known field of condition monitoring, viz. vibration analysis.

As an aside, to many, condition monitoring is synonymous with vibration analysis. As we have learnt in this series it is only one of several dozen condition-monitoring techniques, but it is best known. Wikipedia does nothing to dispel the impression with words like "VA… is often referred to as Predictive Maintenance (PdM)". As we have learnt, there are problems enough in getting findings from the condition monitoring team not only communicated, but also constructively taken up and acted upon by the maintenance team. But let's assume you have this buttoned up and are now looking for the next improvement in the big picture of maintenance.

Before vibration analysis and in the absence of other condition monitoring options, susceptible plant would fail without warning, often catastrophically. It was therefore a big step forward to be able to detect incipient failure and proactively take steps to either prevent it, or plan for the eventuality of the failure – this applies in many situations when the asset cannot be taken out of service and run to failure is a preferred option. This can now be accomplished with a high degree of success in multiple ways. So what more can be done?

This question came up recently as a result of repeated incidents of premature failure of several identical units of critical plant on an industrial site. Impact on business operations was severe. Vibration analysis did what it was intended to do. Deterioration was detected and pre-emptive action taken to prevent catastrophic failure. However, the asset owner was dissatisfied as, in his view, this amounted to no more than 'predictive protection'. It addressed a symptom and not the cause of his pain.

Great care had been taken to operate and maintain the asset in accordance with the requirements of the OEM. Indeed, with their participation in the maintenance programme. Yet still the failures occurred, with no assurance that they would not continue. The financial impact in direct and consequential costs was simply intolerable. What more could be done?

In this particular case, the failing component was a rotating element bearing that required manual greasing. Root cause analysis attributed the failures to operation at or beyond the design limits of the bearing combined with lubrication issues, swinging from times of over-lubrication to starvation. The construction, space constraints and commercial considerations did not permit a design change, a sealed bearing or automated greasing. There was no room for error in maintenance. Operational conditions had to be maintained at their optimum.

One may argue that this is not a good design, but these things happen more often than we would like and the maintenance or reliability engineer is obliged to find a workable solution

What better driver for finding improvement?

One of the many potential benefits of proactive maintenance is life extension. This became the focus and single most important requirement for the asset owner. Having identified the root cause in lubrication, the logical next step was to examine why and how this happened. After all, the lubrication regime specified by the OEM was adhered to. From the findings, improvements could then be devised to overcome the problem. Investigation showed that the correct grease was applied, in the correct quantities, at the correct time-based intervals.

However, visual inspection revealed large quantities of excess grease expelled from the bearing relief valves of some units. The expelled grease that did not show evidence of functional time in the bearing, but with oil separation indicating short term exposure to excess temperature. From an examination of operational records, it was found that the duty cycle between units varied significantly, yet all received the same amount of grease at the same interval.

Evidently, the bearings were being subject to periods of over lubrication with consequent overheating and lubricant breakdown, followed by periods of starvation. The worst of both worlds. With the bearings also operating at high stress, service life was severely compromised.

Clearly this was a case that called for actively managed lubrication and presented a great opportunity for improvement. By measuring friction during the greasing process and periodically in service, blind greasing with fixed quantities at fixed intervals could be replaced with the application of an optimum quantity of grease at the times when needed.

The end result for the asset owner is not only asset life extension, but also a reduction in grease consumption. Once implemented on the subject critical assets, the same technique and benefits can be spread across the remainder of the asset base.

From another perspective, this is one instance that shows the importance of using complementary condition monitoring technologies. Vibration for big picture rotating machine health assessment and diagnostics, ultrasound detection for active lubrication management using real time friction measurement and thermography for correlation by temperature measurement. This is what predictive maintenance is all about – making use of the insights obtained from a variety of condition monitoring technologies to make a useful contribution to the overall aims of the organisation.

The bottom line is we all need motivators to cause us to step beyond our day-to-day issues and while finding solutions to thorny issues. This is a sure way to bring about those lasting improvements. ❑