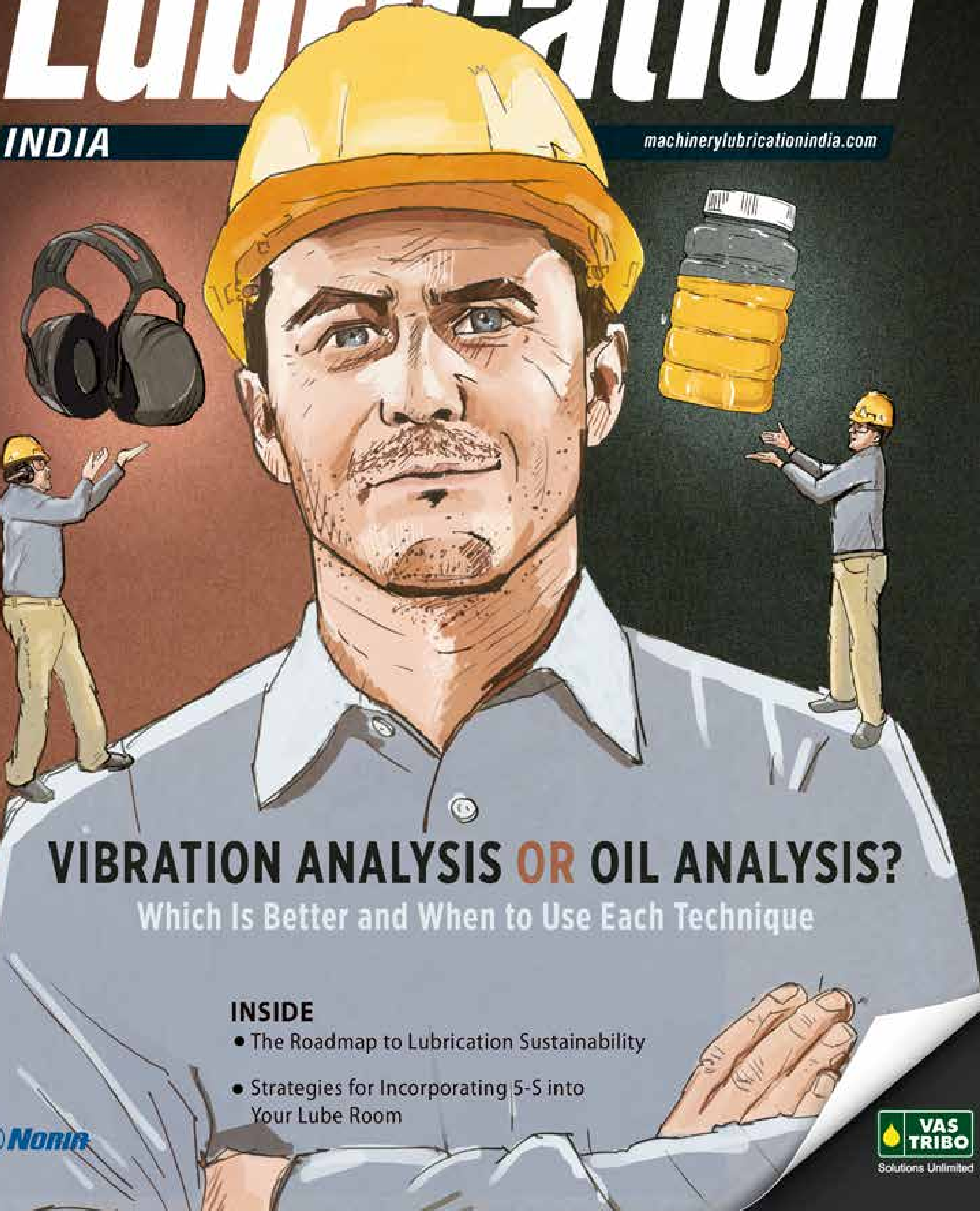
September-October 2020

Machinery Lubrication

INDIA

machinerylubricationindia.com



VIBRATION ANALYSIS OR OIL ANALYSIS?

Which Is Better and When to Use Each Technique

INSIDE

- The Roadmap to Lubrication Sustainability
- Strategies for Incorporating 5-S into Your Lube Room

TATA STEEL
#WeAlsoMakeTomorrow

TATA

International Conference on Condition Monitoring

on

AGILE AND SUSTAINABLE ADVANCES

in Equipment Reliability Through

CONDITION MONITORING

VIRTUAL - January 21 - 22, 2021

M/s Tata Steel Limited and Condition Monitoring Society of India, Visakhapatnam are jointly organising an "International Conference on Condition Monitoring (ICCM- 2021)" on January 21-22, 2021.

Call for Papers

- Cutting Edge Technology in Rotating Equipment
- Breakthrough Innovation in Power system
- Next Generation Plants & Assets
- Futuristic Hydraulic & Lubrication Systems
- Smart Technologies in Water Systems
- Smart Sensor and Edge Computing
- Data Analytics, Artificial intelligence and Machine learning in condition monitoring

For any further details contact: Event Coordinator– *Manjunath S*, Tata Steel Ltd, 7632987377 & *Hemanth Bari*, DGM, Adani Group, Dahanu, Mobile: 9321925402 | convener.iccm2021@gmail.com for sending abstract | Call for papers & case studies presentation

Dates to Remember

Abstract submission (max 250 words)	– Oct 15, 2020
Acceptance of abstract	– Oct 30, 2020
Early registration	– Oct 20, 2020
Submission of full paper	– Nov 15, 2020
Acceptance of full paper	– Nov 30, 2020

Registration Fee*

Sponsored delegates	– ₹ 2,000/-
Other delegates	– ₹ 1,500/-
Students/ Research scholars	– ₹ 500/-

E-Certificate will be issued to all the participants.

Awards

3 Best papers | 3 Best Stalls

NEFT payment is preferred. However, Registration fee can be paid by DD/Cheque as per above details. DD/ Cheque drawn in favor of *'Condition Monitoring Society of India - Jamshedpur Chapter', Current A/c No: 31601489872,* State Bank of India, Jamshedpur – Jharkhand - 831001. *IFS Code: SBIN000009.*

CSI

Advertisement Rates for Souvenir

Outside back cover (1)	– ₹ 25,000/-
Inside cover pages (2)	– ₹ 20,000/-
Full page advertisement	– ₹ 15,000/-
Half page advertisement	– ₹ 10,000/-
Virtual stall	**– ₹ 50000/-**

Call for Sponsorship*

Category Charges (in ₹)	Free Delegates	Souvenir Advertisement
Platinum: 1,00,000	5	Full page colour
Gold: 50,000	4	Full page colour
Silver: 40,000	3	Full page colour

MLI September-October 2020

TABLE OF CONTENTS

Machinery Lubrication INDIA

Publisher's Note

The global economy has been badly hit, but normalcy is coming back and being seen in different parts of the world. Most industries have been affected during these trying times, and the lubricant industry has not been spared. The demand for automotive lubricants has significantly reduced due to total and partial lockdowns. Likewise, industrial lubricants have been dealt a hefty blow because of a low demand of manufactured goods during these times.

The current global COVID-19 pandemic has forced companies to operate uniquely and smartly while noting various health and safety regulations. The current situation has changed the maintenance and operational landscape and ultimately boosted the indulgence of industry 4.0 technologies. The fourth industrial revolution aims to transform the traditional industrial processes and enhance the value creation chain. Some of the vital applications in lubricant condition monitoring include interconnectivity or integration of lubrication systems and the introduction of automation that will reduce the complexity of manual testing. Advanced online lubrication sensors in addition to offline analysis for data collection and fusion, will ensure real-time interferences hence improve overall equipment efficiency. One of the cornerstones of Industry 4.0 is data analysis and knowledge discovery tools like data analytics and simulation. In the case of lubricants, data may be employed separately or integrated with other condition monitoring data like vibration and operational data to provide robust insights on the health of the lubricant and the machines. Lubricant condition monitoring and other maintenance programs can employ these technologies that ensure industrial operations like maintenance are efficient, productive and less wasteful.

Apart from building long-term competitiveness on the global stage, India stands to gain significantly by implementing Industry 4.0. Adopting this industrial revolution will allow manufacturers to improve productivity, efficiency, safety and performance. Second, Small and Medium enterprises (SMEs), which form the backbone of Indian manufacturing can leverage Industry 4.0 technologies to become more responsive, increase productivity, streamline costs and reduce risks. Third, employers will be able to increase the skills of their workforce. Training in safety-related skills will also come into play with an increased level of human-machine cooperation.

We would like to thank our readers for the heartening response to our previous edition's cover story – "Fire-resistant Hydraulic Fluids".

Our current issue's cover story is "Oil Analysis or Vibration Analysis? Which Is Better and When to Use Each Technique" which will help our readers to determine the most appropriate maintenance actions by analyzing each asset and considering various perspectives.

Despite the challenging times, we have been relentless in keeping you up to date with the industry news & informative articles and we will continue to do so. Enjoy the Read.

As always, we welcome your feedback & suggestions.

Stay Safe & Be Healthy.

Warm regards

Udey Dhir

Detection Zone Coding for **More Efficient Condition Monitoring**

"Condition monitoring is like a treasure hunt. The greater fun is in the search."

These days, reliability professionals are faced with diverse options related to technologies and methods to detect, troubleshoot and remediate problems. Figure 1 is a simple example of the available options to collect data and arrive at decisions regarding the health of machinery and machine components. The logical starting point is always to carefully rank failure modes by both criticality and probability of occurrence. For more information on this topic, see my previous column titled "A New Look at Criticality Analysis for Machinery Lubrication." This method is known as failure modes and effects analysis (FMEA), and has been extensively documented.

The failure mode ranking sets into motion the critical-path process in reaching optimized decisions related to condition monitoring followed by the prescribed response or remedy. This response should not simply be corrective but also incorporate proactive measures to prevent or restrict recurrence. The emphasis is on optimized decisions and actions. It's easy to go cheap (penny wise, pound foolish), but there also can be temptation at the other extreme (a state of reliability excess), often driven by fear of the unknown. The optimum reference state is an activity of seeking balanced decisions. After all, you are not trying to maximize reliability. There is no greater source to find this balance than knowledge and education.

Detection Zone Table (DZT)

Figure 2 shows a relational table with colors designating condition monitoring detection zones. These zones will be described in more detail later. However, in the simplest terms, they are intended to help focus skills and resources where there is the greatest need. This weighs the benefits of condition monitoring against the inherent costs of the skillful and frequent execution of its application.

In the table, the three columns going from left to right relate to the skills, tools and methods used to perform condition monitoring tasks. The first column is mastery-level condition monitoring and therefore is conducted with precision and expert skill. The middle column is condition monitoring at a more ordinary or basic skill level. The right column is condition monitoring performed with reckless abandon by untrained and unqualified individuals. At this level, condition monitoring is more wild guesses and dartboard science.

The three columns not only relate to the degree or depth of training and experience but also depend heavily on other factors such as reliability culture, access to technology and tools, and the availability of sufficient condition monitoring staff. Of these, more than anything else, reliability culture dominates what condition monitoring technicians and analysts do and how they do it. Fix your reliability culture and many other things get fixed concurrently.

The Power of Frequency

The detection zone table also shows three rows that designate the location and timing of the condition monitoring tasks, which are equally important to the outcome. Condition monitoring timing could be continuous (e.g., an online sensor) with little human interaction or periodic using inspection tasks and data collection, such as with portable devices. The frequency of these tasks has everything to do with the results achieved. Of course, certain machines can do just fine with no condition monitoring at all (run to failure).

Consider the following analogy: Regardless of the fisherman's expertise, no fish will be caught if his hook is not in the water. The same is true with detecting root causes and active machine faults. Technicians can only detect if they are performing condition monitoring tasks that effectively target known failure modes.

This periodicity is where inspection by a well-trained operator or technician has an advantage over technology-based condition monitoring. For instance, sight-glass oil analysis can be performed daily, unlike laboratory oil analysis, vibration analysis and ultrasound, which often are scheduled at monthly or quarterly intervals. Condition monitoring done in near real time by imbedded sensors, a la the industrial internet of things (IIoT), can deliver an equal or superior advantage.

As you might expect, location has to do with the optimum inspection or data collection point. For example, in oil analysis, where is the optimum location to pull a sample? Likewise, what are the critical examination points when performing inspections? What about location as it relates to the use of heat guns and infrared thermography?

A long P-F interval is obviously desired, which depends heavily on frequency. This helps close the gap between the point of detection relative to the failure inception point. Using condition monitoring to detect and eradicate failure root causes produces a negative P-F interval. What could be more ideal? Hence, condition monitoring performed at a high frequency will be more effective and far more proactive (root-cause oriented). This is the strategic foundation of proactive maintenance.

Detection Zone Definitions

The four zones in the DZT are color coded as follows:

Green Zone (Proactive): Early root cause detection in this zone is related to frequent inspection in the right places using the right tools and methods as well as expert skills.

Machinery» Lubrication India

Publisher
Udey Dhir - udeydhir@tribologysolutions.com

Creative Director
smassociates@gmail.com

Advertisement Sales (US/Canada)
Brett O'Kelley - bokelley@noria.com

Advertisement Sales
(India/all other countries)
admin@machinerylubricationindia.com

CORRESPONDENCE
You may address articles, case studies, special requests and other correspondence to our

Operation office :

Editor
213, Ashiana Centre, Adityapur,
Jamshedpur-831013, India
email : editor@machinerylubricationindia.com
Tel: +91-657-2383238
Tel:(USA): +1-918-960-9738

Marketing Office
Rider House, 136,
Sector 44, Gurgaon-122003, Haryana
National Capital Region, India

Machinery Lubrication India Volume 49 - Issue 5, September-Ocotber 2020 is published bi-monthly by VAS Tribology Solutions Pvt. Ltd. Operation Office:213, Ashiana Centre, Adityapur, Jamshedpur-831013, India.

SUBSCRIBER SERVICES: The publisher reserves the right to accept or reject any subscription. Send subscription orders, change of address and all related correspondence to: VAS Tribology Solutions Pvt. Ltd. Operation Office:213, Ashiana Centre, Adityapur, Jamshedpur-831013, India.

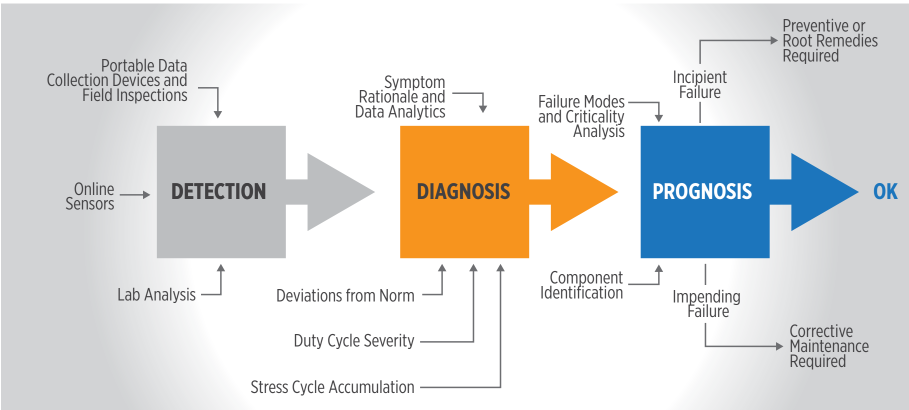


Figure 1. An example of the available options for collecting data and arriving at decisions relating to the health of equipment

Yellow Zone (Predictive): This zone may miss some root causes, but when well-executed, it can detect faults and incipient failure issues early (near to the time of inception). It will depend on frequent inspection coupled with skillful techniques and effective tools.

Amber Zone (Protective): Condition monitoring in this zone catches faults before catastrophic failure and collateral damage can occur. Some may call this just-in-time condition monitoring, but for many reasons, it is a slippery slope at best. Although a pre-failure detection may be possible, in other cases the failure development period may be too narrow for a practical forewarning to be achieved. Of course, there are also those pesky sudden-death failures.

Red Zone (Breakdown): This is the complete operational failure.

Detection Zone Coding

Next, assign failure modes to the optimum, best-fit detection zones. Start by working down the failure mode ranking, beginning with process-critical machines. Place each failure mode in one or two zones within the DZT. Highly ranked failure modes should be assigned to the green zone. Others may fit within the yellow zone. Lesser-ranked failure modes can be placed in the yellow or amber zones.

Let's apply this to a hypothetical example. A high-speed centrifugal compressor has had chronic problems with bearing failures. An FMEA exercise ranked varnish and sludge to be the apparent root cause in most cases. The primary root cause was impaired lubricant air-release issues, which was made worse by entrained air sources. Adiabatic compressive heat from the entrained air was the cause of varnish.

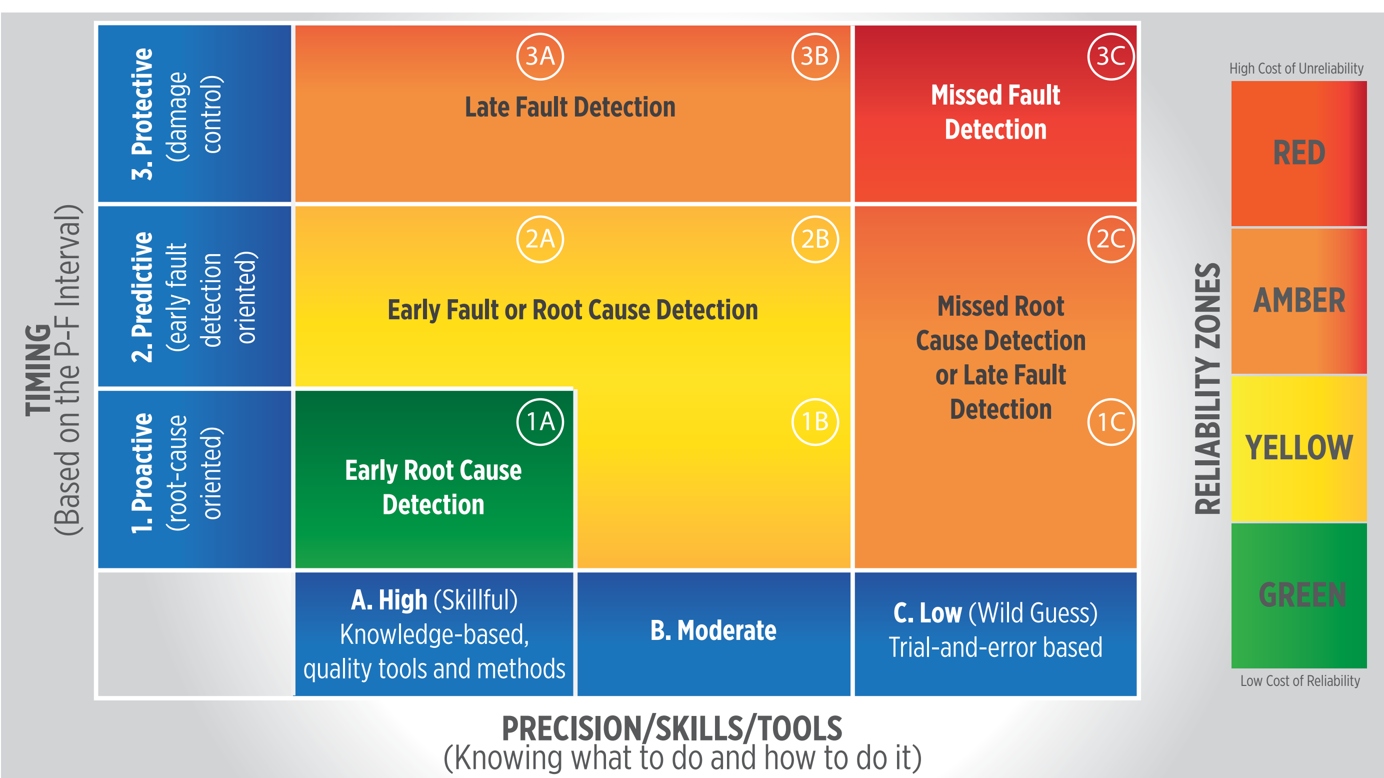


Figure 2. An example of a detection zone table

Figure 3 recasts the DZT to illustrate how condition monitoring can detect and respond to this type of failure in different ways. The varnish example was used because I've seen the actions and results listed within the table's cells in many real-world cases. Following is a brief description of each of the cells.

Cell 1A: Skillful and frequent inspection and oil analysis detect and recognize the aeration problem. The root causes (air induction and cross-contaminated oil) were eradicated.

Cells 2A and 3A: The main difference here is the delayed detection and response to aeration and the need to address the varnish problem that ensued. Early detection prevents varnish. Late detection requires de-varnishing of the oil and machine. This leads to extra costs and extra risk.

Cell 1B: Here, a lack of training on varnish and aeration resulted in treating the symptom (degas) and not the root cause (the source of air-release and entrainment problems).

Cells 2B and 3B: With the aeration problem undetected and unfixed, the aeration issue quickly escalates into a varnish and sludge problem. Removing the varnish and sludge followed by changing the oil is nothing but a short-term remedy. The root cause remains unchecked, so aeration and varnish will soon return.

Cell 1C: While aeration was detected, the haphazard solution of changing the oil and filter did nothing to provide a real solution. How many times do you need to change an oil to fix an air-entrainment problem?

Cell 2C: The time delay and poor condition monitoring skills lead to advanced varnish being detected but not the root cause. Once heavy varnish potential is present, the compressor's days are numbered.

Cell 3C: A bearing failure and teardown revealed oil-way sludge and restricted oil flow to the bearing (starvation). The maintenance staff immediately declare the oil was defective and the cause of the bearing failure. The oil supplier was fired, and a new oil was put into service. Will the second oil supplier be fired soon, too?

The Critical Five

Is it necessary for a person to use the DZT for optimized condition monitoring? Absolutely not. However, the table helps you understand the consequences of shoddy condition monitoring. As I've seen for years, just any oil analysis program is not good enough. The same is true with inspection and the many other condition monitoring technologies and methods. Doing versus

TIMING (Based on the P-F Interval)

3. Protective (damage control)	3A • Inspection finds sludge and heavy surface varnish • Aeration problem detected and corrected • Oil analysis performed • De-varnishing measures performed	3B • Inspection finds sludge and surface varnish • Oil and filter changed • Precision flush applied	3C • Bearing failure occurred due to lubricant starvation from oil-way sludge • Gross sludge on oil filter found. Filter was in bypass • Defective oil believed to be the cause. Oil type and supplier changed. No machine flush was performed
2. Predictive (early fault detection oriented)	2A • Varnish potential (VP) detected by routine inspection and oil analysis • Troubleshooting finds and corrects aeration problem	2B • High VP detected • De-varnish technology used to restore health of oil • Cause of varnish was not found	2C • High VP detected • Repeated oil and filter changes attempted to solve the problem. • Surface varnish and oil-way sludge accumulate
1. Proactive (root-cause oriented)	1A • Aerated oil quickly detected & recognized • Air ingression source found and corrected	1B • Aeration problem detected • Root cause not resolved • Degas technology applied to remove entrained air	1C • Aeration problem detected • Oil and filter changed with hope of remedying problem
	A. High (Skillful) Knowledge-based, quality tools and methods	**B. Moderate**	**C. Low** (Wild Guess) Trial-and-error based

PRECISION/SKILLS/TOOLS (Knowing what to do and how to do it)

RELIABILITY ZONES: High Cost of Unreliability — RED — AMBER — YELLOW — GREEN — Low Cost of Reliability

Figure 3. A detection zone table used to illustrate how condition monitoring can detect and respond to failure in different ways

doing well can produce sharply different results.

Think of the critical five as a simple way to define what is meant by "doing condition monitoring well." They are as follows:

The What — Know what you are trying to detect or analyze. Is it a symptom or a root cause? Is it measurable or verifiable? Is it controllable?

The Why — Know why it is important. How does it affect reliability and asset availability? How does detecting and controlling it reduce the life-cycle costs, energy consumption and environmental impact? How does it increase safety?

The Where — Where is the most effective location to find what you are trying to detect? How can this location be improved and made more convenient (installing inspection windows, for instance)?

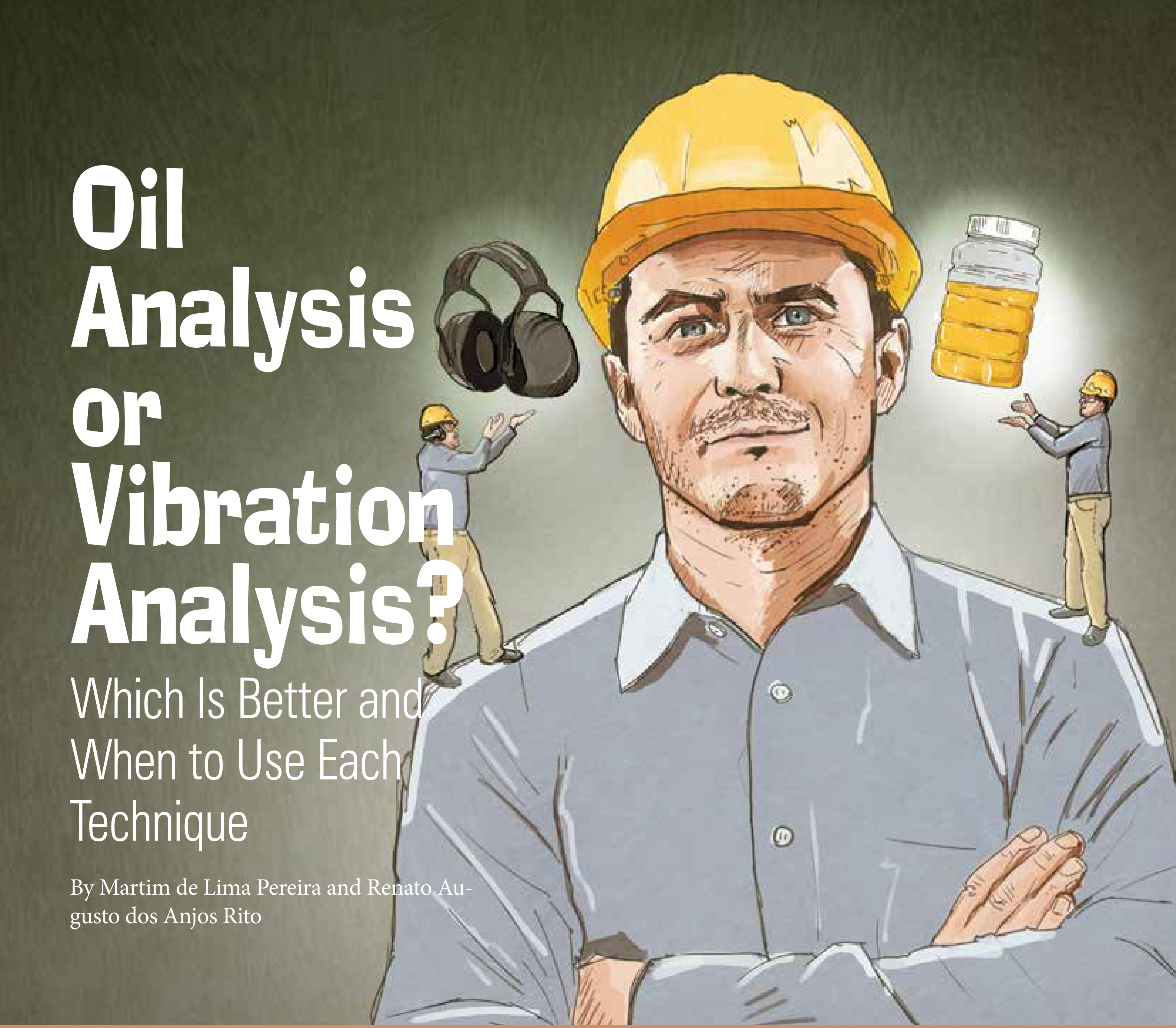
The How — What skills, methods and tools will be needed for optimized detection and control? How can root causes be detected before the onset of failure? How can failure symptoms be detected early to extend the P-F interval and make remediation convenient without significant loss of the remaining useful life (RUL)?

The When — When must condition monitoring tasks be performed to achieve the reliability objectives? How can daily inspections and online monitoring play an effective role?

Condition monitoring is like a treasure hunt. The greater fun is in the search. And yes, there is a treasure at the end. **MLI**

About the Author

Jim Fitch has a wealth of "in the trenches" experience in lubrication, oil analysis, tribology and machinery failure investigations. Over the past two decades, he has presented hundreds of courses on these subjects. Jim has also published more than 200 technical articles, papers and publications. He serves as a U.S. delegate to the ISO tribology and oil analysis working group. Since 2002, he has been the director and a board member of the International Council for Machinery Lubrication. He is the CEO and a co-founder of Noria Corporation.
Contact Jim at jfitch@noria.com.



Oil Analysis or Vibration Analysis?

Which Is Better and When to Use Each Technique

By Martim de Lima Pereira and Renato Augusto dos Anjos Rito

Vibration and oil analysis are two highly effective predictive maintenance techniques that have been used for decades. Other techniques such as thermography and sensory inspections can be applied to maintenance as well. However, to determine the most appropriate maintenance actions, it is necessary to analyze each asset and consider various perspectives.

Vibration Analysis

Vibration analysis has been described by many as the best way to detect machine failure, including the degree of severity. It also is used as a tool to validate the acceptance of a machine after it has undergone some intervention.

Vibration analysis can be applied to various types of rotating assets, such as electric motors, pumps, reducers, fans, power generators, compressors, turbines, etc. It is an excellent tool to identify misalignment, unbalance, mechanical clearances, belt defects, warped shafts, defective bearings and gears, cavitation, lubrication defects, etc. In more advanced applications, it is possible to identify resonance in static structures.

Vibration analysis offers many benefits, as the non-destructive or non-invasive techniques cover nearly 80 percent of a plant's machinery. With the results, maintenance teams can drive a variety of improvements, such as better foundation conditions, proper alignment, improved balance quality, and reduced or even eliminated chronic machine problems.

Several vibration analysis tools can be used based on the characteristics of the machines, such as kurtosis, fast Fourier transform (FFT), envelope analysis, spectrum analysis, etc. These tools can be applied according to the fault modes you wish to monitor. Each failure mode is identified in the spectrum by the displayed symptoms. For example, unbalance is characterized by one times (1x) the rotation, while misalignment is classically identified by one and two times (1x and 2x) the rotation.

A very common symptom is the presence of a high-spectrum carpet value, which always denotes lubricant failure, either due to an absence of lubrication, excess lubricant or contamination. When the lubrication team is integrated with the vibration analysis team, these cases can be well-controlled.

Other symptoms include an oil vortex or dry vortex. Symptoms of these defects are characterized in the frequency spectrum by 0.42 to 0.48 times the revolutions per minute (rpm). They usually are found in sliding bearings with oil that operates under pressure at high speeds. When this occurs, the oil pushes the shaft into the bearing, accelerating its wear. This can be minimized or eliminated by changing the oil speed.

Oil instability is very severe and can lead to bearing play. This instability sometimes happens when the oil whirl frequency coincides with the critical machine speed. This special condition of shaft resonance with the oil's turning frequency results in a more serious form of whirlwind, called oil whip. In this case, the vortex speed will keep up with the critical rotor speed and will not disappear even if the machine operates at higher speeds. This event is highly destructive.

Rolling vibrations can also be caused by improper lubrication. This is easily noticeable in the spectrum, as the friction of the bearing with the shaft raises the carpet. This frictional force can excite other machine frequencies as well. Figures 1-2 illustrate this symptom, which is called carpet.

Figure 3 shows an example of slight oil instability, which in this case is still within the acceptable values. This frequency is from a bearing within a power generator. It can serve as a monitoring target, as it indicates the health of the machine.

Oil Analysis

Oil analysis is also widely used to diagnose the condition of equipment. This technique has produced considerable information and contributed greatly to asset reliability.

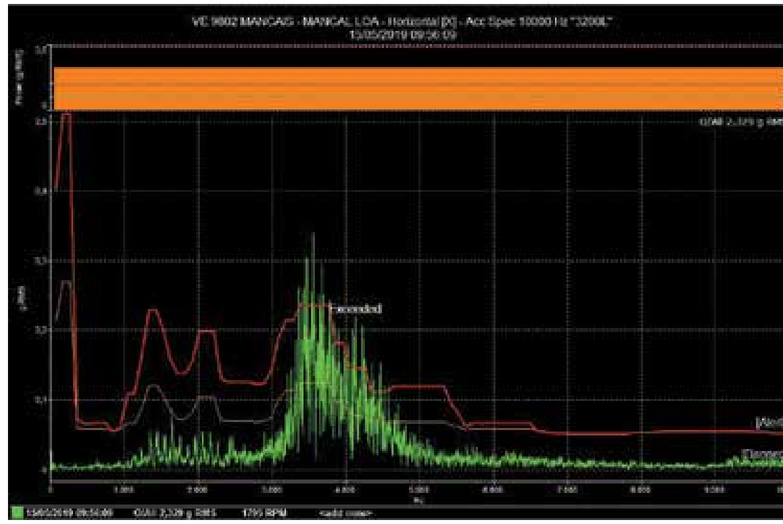


Figure 1. A bearing vibration spectrum before lubrication

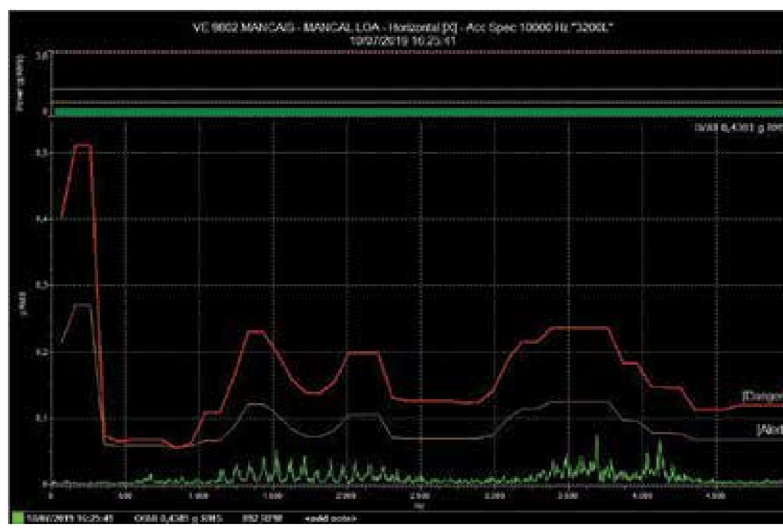


Figure 2. A bearing vibration spectrum after lubrication

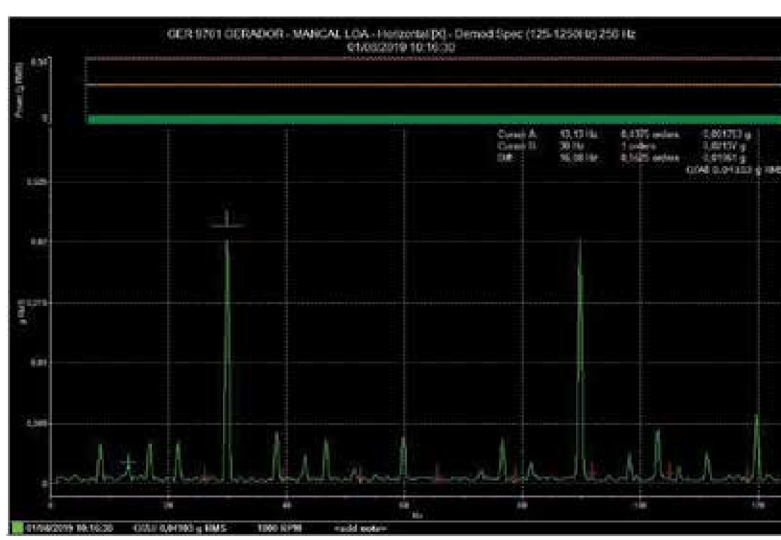
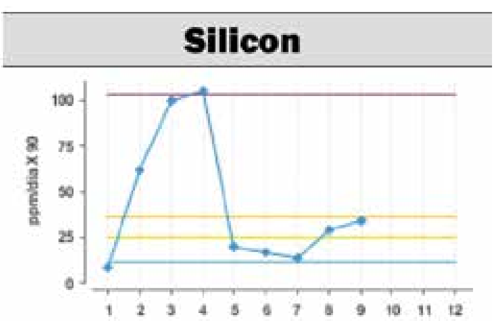


Figure 3. Oil instability frequency

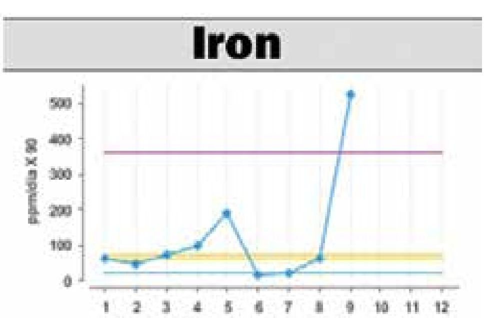
Figure 5. The quality of sample collection determines the quality of the analysis.

Figure 6. An exposed gearbox with a desiccant breather installed



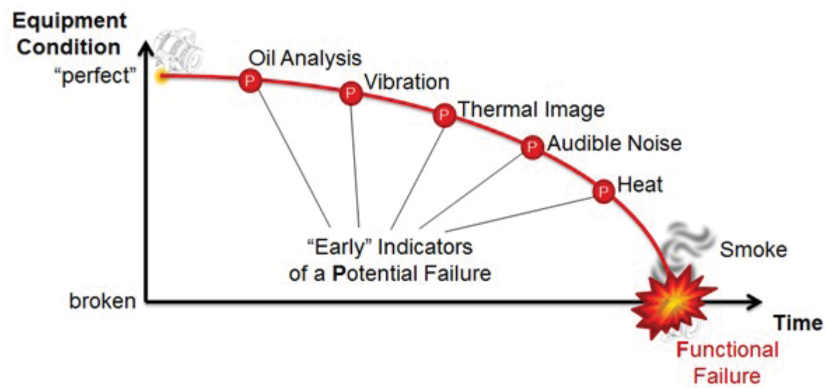
1	2	3	4	5	6	7	8	9	10	11	12
8.86	61.96	99.88	105.7	20.19	17.14	13.76	29.5	34.03			

Figure 7. High silicon content was identified in two oil samples.



1	2	3	4	5	6	7	8	9	10	11	12
64.56	45.3	72.19	99.44	190.4	18.18	23.86	64.59	527.3			

Figure 8. Iron content trend for the soybean elevator reducer



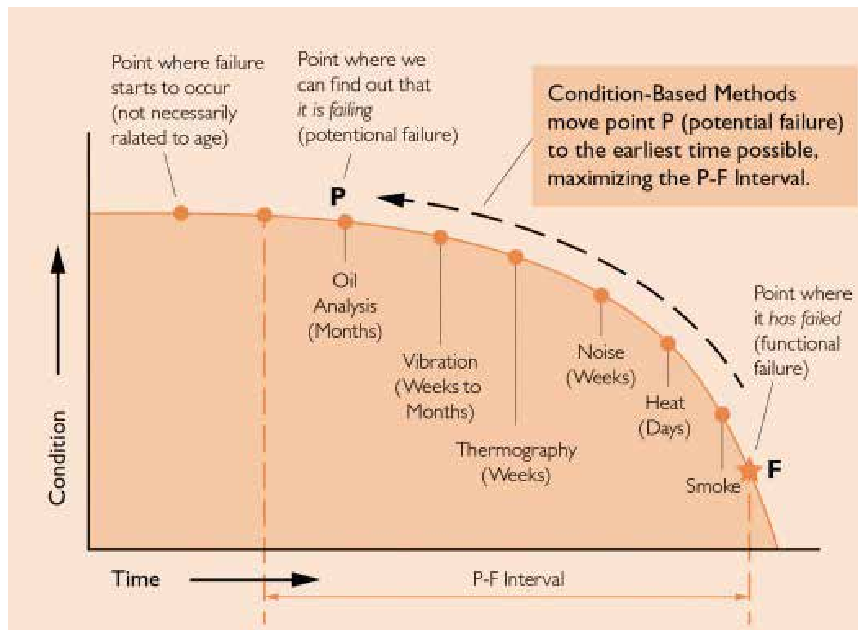


Figure 4. Potential failure curve

It is very useful in monitoring the condition of reducers, compressors, turbines, pumps, transformers and hydraulic systems.

When a machine is in operation, there is continual friction of its components due to particle generation. The particles generated by this friction typically are charged by the lubricant, which can be easily identified through oil analysis.

Just as vibration analysis has several tools that can be used according to the failure mode to be monitored, oil analysis has parameters that must be selected based on the machine's characteristics. It is critical to choose the appropriate analysis tests for identifying abnormal oil wear particles, customizing each test according to the different types of equipment.

In addition to the use of particle counting, which is one of the techniques that best characterizes lubricant severity and condition, trend analysis of this condition is also very important. This trend will alert you to how quickly you must intervene. Global values quantify the severity of the problem. However, it is not enough to simply characterize the problem. With this technique, the frequency spectrum is used.

In oil analysis, when a certain amount of iron is detected in the oil sample, no conclusion can be reached if you do not observe the morphology of the particles. Large particles describe the onset of wear, in which case changes in vibration analysis may already be seen. Thus, the shape and size of the particles are essential to indicate the source of the problem.

The most common types of oil analysis provided by laboratories are viscosity, particle count, water content, acid number, base number and particle size. Keep in mind that water in oil has been shown to greatly accelerate equipment wear-and-tear and requires urgent intervention. This contaminant is very aggressive to machine components, increasing both the oil oxidation process as well as the friction between metals.

A good lubrication plan will clearly describe the entire sampling process, including how to collect, store and transport oil samples to ensure the reliability of the analysis results. This is why lubrication technicians should be trained for these tasks. Care and guidance on how to perform sample identification and submission for analysis will be of no less importance.

Figure 4 shows how oil analysis often manifests ahead of vibration analysis in the cases of bearing failure detection in low-speed gearboxes.

Oil analysis also comes to the forefront with mineral impurities and increased amounts of metal particles (iron, steel, copper, etc.). The elevation of these values can be perceived early with oil analysis before being identified by vibration analysis.

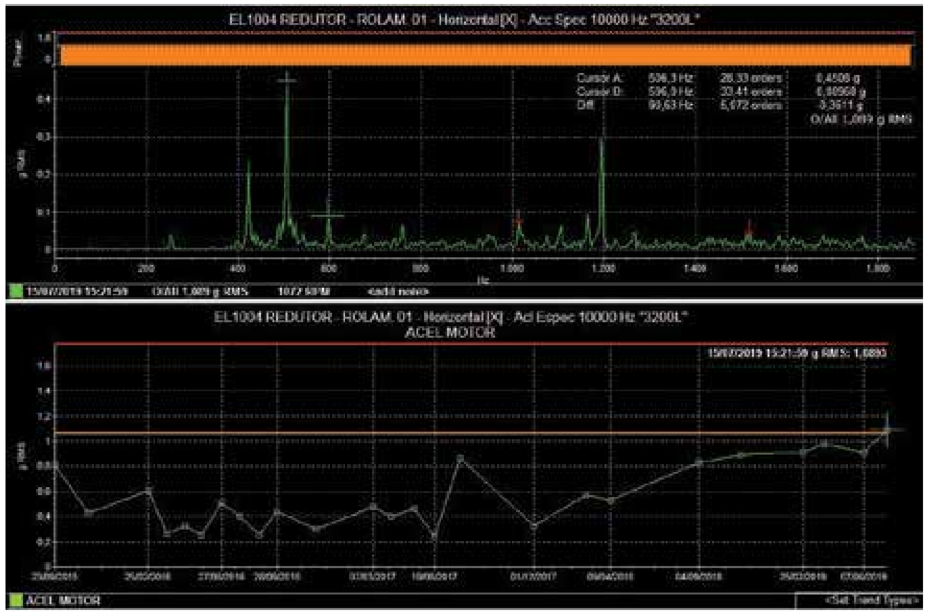
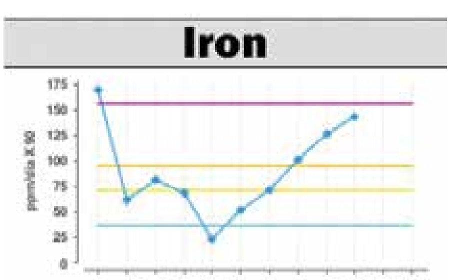


Figure 9. Vibration trend for the reducer

Figure 10. An example of a lift gearbox



1	2	3	4	5	6	7	8	9	10	11	12
170.2	62.64	81.09	69.1	23.38	52.2	72.09	100.8	127.3	142.8		

Figure 11. Trend of increasing iron levels in the lift gearbox

Figure 12. The vibration spectrum for the lift gearbox

Vibration Analysis vs. Oil Analysis

There are many examples of vibration analysis and oil analysis working well and complementing each other, such as for a bearing lubrication failure or pinion tooth wear detection. However, there are also cases, such as with unbalance and misalignment, when only vibration analysis can be applied. On the other hand, identifying water in oil will only be possible through oil analysis. Used together, both techniques are valuable tools for root cause analysis and can help ensure the reliability of an asset's condition. Therefore, vibration analysis and oil analysis are indispensable to any maintenance program.

Case Study: Low-Speed Gearbox Analysis

At the primary plant of a South American manufacturer of vegetable proteins, many of the machines are exposed to the outdoors. In this location, there are two well-defined seasons: a rainy summer and a dry winter. Thus, the assets are vulnerable to external contamination if their seals are inadequate. Early oil analysis results illustrated these conditions well. This helped the maintenance team deploy and improve a protection system by installing devices to inhibit contamination. The results were quite noticeable.

The plant soon discovered that oil analysis had the ability to reveal issues before other predictive maintenance techniques, as alarms would appear in oil analysis reports that did not manifest in the other techniques.

For example, in the oil analysis results for a soybean elevator reducer, the iron content increased from 65 to 527 parts per million (ppm), while the chromium value increased from 0.10 ppm to 0.83 ppm. This was a strong indication of bearing wear.

By analyzing the vibration data for the same month, plant personnel found that the values were still within acceptable limits. However, vibration analysis was able to more accurately identify which element was being worn.

Although the vibration results were not alarmed, the trend curve revealed the values were rising. Figure 9 shows that these values sounded the first alarm on July 15, 2019, but were still acceptable compared to the oil analysis results, which already indicated high severity. Note also that the chromium value increased from 0.10 ppm in previous samples to 0.83 ppm. This suggested some bearing deterioration. In the same report, other important signs could also be seen, such as a reduction in phosphorus as a result of the increase in iron.

A similar situation occurred with one of the plant's lift gearboxes. In this case, the issue also was detected first through oil analysis and only later through vibration analysis. Figure 11 shows the trend of increasing iron levels from the oil analysis results.

Meanwhile, the gearbox's vibration analysis results for the same month were normal. It wasn't until more than a month later that an increase in the vibration values indicated an input shaft bearing failure.

With this information in mind, plant personnel decided to intervene in the machine and replace the damaged oil and bearing. The rolling elements of the changed bearing attest that both techniques were successful. After the oil and bearing replacement, the vibration analysis showed no defects.

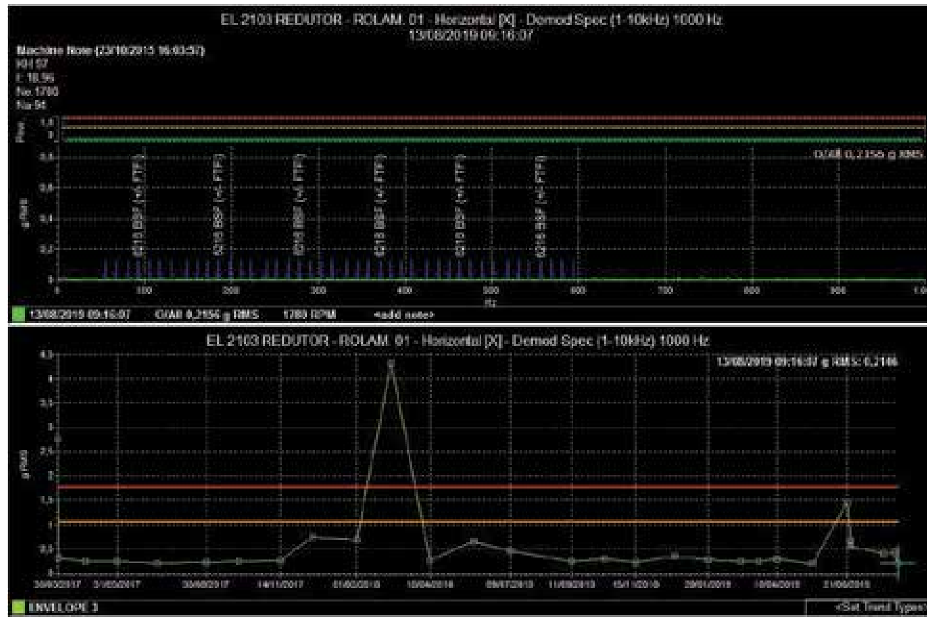


Figure 13. Vibration spectrum on the gearbox after intervention

The plant has seen encouraging results from combining oil analysis and vibration analysis. There have been fewer breakdowns and an increase in productivity. Faults are managed and interventions aligned with production planning to reduce downtime. Machine components and the lubricating oil are changed only when necessary to maximize their lifespan. The plant's balanced equipment vibrates less and consumes less energy. Components like bearings and seals are even lasting longer.

Oil analysis and vibration analysis have proven to be effective techniques for monitoring the condition of assets. While many studies have shown that oil analysis can provide an earlier warning of potential failures, the best results occur when there is an integration of these two techniques, making them both indispensable in today's maintenance programs. ***MLI***

Jaywant Yelsattiwar | Kluber Lubrication India

CASE STUDY

Sustainability through **Transparent Girth Gear Lubricants**

The Ecological Footprint and Handprint

Emerging measurements of human impacts on the planet are gaining mainstream credibility. The Ecological Footprint has been developed by an international coalition called the Global Footprint Network as a measure of our use of the planet's biocapacity. The Ecological Handprint measure seeks to build upon the Footprint measure and reframe the concept of sustainability by looking not just at ecological impacts but also ensuring sustenance for those in need.

The 'ecological footprint' of humanity is gaining attention as way of measuring the amount of resources we consume and the waste we produce against the planet's ability to produce those resources and 'digest' our waste. Currently, every year we are exceeding the planet's 'biocapacity' to perform these functions by about 50%. The ecological footprint calls this an 'overshoot'. In 2014, overshoot day – that is the day we used up 100% of the planet's biocapacity – fell on August 19th. But in 2016 we will have reached overshoot day even earlier, on August 8. We use more ecological resources and services than nature can regenerate through overfishing, overharvesting forests and emitting more carbon dioxide into the atmosphere than forests can sequester.

Ecological Handprints bring a social dimension to the issue of measuring our Footprint and recognize the need for people's needs to be met as part of the sustainability agenda. This concept suggests that we can achieve a high level of human development without compromising the ecological systems upon which all life depends.

Cement Plants

Cement plants have cement mill for raw material grinding and further clinker formation, the Kiln girth gear drive for clinker formation. Typically these drives are rotated with the help of pinion and girth gear. Maintaining pinion and girth gear in good condition is must for uninterrupted running of the plant. But maintenance and monitoring does not only help sustain these pinion and girth gear. Here lubrication plays a vital role in enhancing the life of girth gear drives.

Problem

Primarily, girth gear drives were running with graphite as a main constituent in the grease, In the longer run, with use of graphite based open gear lubricants, pitting, scuffing, root step, side fins observed on gear and pinion tooth flank because the gear is mostly in mixed friction zone. In this condition gear requires additional work like root step removal, side fins removal, polishing of the teeth etc.

To carry out these jobs, the stoppage of Mill or Kiln is required and production hours are also lost. Lot of safety guidelines and formalities need to be furnished while carrying out these jobs, this adds on the work to already occupied Safety Officers. Carrying out these jobs need lots of cleaning activity to remove the grease manually, manpower, skilled manpower, grinding tools are required.

Solution

Now with new synthetic transparent lubricants the wear is almost negligible because of the higher lambda values and the rotating parts being in Elasto Hydrodynamic Lubrication (EHL).

You can see the tooth flank clearly, amount of lubricant required for running the equipment is almost half of the graphite base lubricants. Less wastage and substantial increase in the life of Girth Gear.

Sustainability

This helps us in minimizing foot print and maximizing hand print.

Case Study on Cement Mill Girth Gear Lubrication

Abstract

The report emphasises on the condition of Cement Mill open gear drive after putting Synthetic Lubricant . In comparison with our Graphite based product. Here we will try to present the condition of the open gear drive in terms of temperature difference, tooth flank condition and optimization of grease consumption from day one.

Equipment Details

Gear OEM : Fuller
No. of Pinion : 2
Toooth Flank Width : 750 mm
Lubrication System : Spray (2 X 5 Nozzles)
Lubrication System OEM : Lincoln Helios (Pneumatic operated)

Objective

Enhancing the Girth gear life with Introduction of transparent Open Gear Lubricant

- Enhance the life of Pinion and Girth Gear.
- Tooth flank condition is clearly visible.
- With the higher viscosity, it was possible to Optimize Consumption from existing 14.39 Kg per day to 6.5 Kg per day with stable parameters.
- Vis a vis it is observed that with synthetic lubricant, measurable parameters Temperature, Vibration, Tooth flank temperature wrt Shell temperature ambient temperature observed stable.
- No further propagation observed on the tooth flank and tooth flank condition is clearly visible, which helps the customer in monitoring the condition of the tooth flank.

Efforts / Major Activities to achieve the objective

To fulfil our objectives as mentioned above we have taken these steps:

- Consumption optimization (Grease) without change in condition of the drive
- Condition monitoring at regular intervals & optimization
- Stable parameters even half of the lubricant consumption
- Saves money
- Easy inspection
- Less disposal helping in minimizing foot print and maximizing hand print
- Help reduce CO_2 emission.

Typical tooth flank temperature recordings for Running Out Pinion (ROP)/ Running in Pinion & Gear

Date	DE to NDE 1	DE to NDE 2	DE to NDE 3	DE to NDE 4	DE to NDE 5	Δ T
06.05.2019	55.2	55.1	55.9	56.4	56.5	1.4
07.05.2019	51.2	51	51.5	52.1	52.2	1.2
07.05.2019	53.1	52.8	53.6	54.1	54.2	1.4
08.05.2019	52.8	52.6	53.2	53	52.4	0.8
25.05.2019	52.3	52	52.6	52.7	52.2	0.7
25.05.2019	56.1	56.4	56	55.4	55.8	1
26.05.2019	52.1	53.6	54.1	53.5	53.3	2
25.06.2019	53.9	53.6	53.5	53.4	52.5	1.4
26.06.2019	53	52.9	52.6	52.5	51.6	1.4
18.07.2019	52.7	53.6	54.2	53.7	53.8	1.5
19.07.2019	52	53.2	53.3	52.8	52.3	1.3
20.07.2019	53.1	53.5	53.6	52.6	52.1	1.5

Spray Patten with Graphite base lubricant

Spray pattern with synthetic lubricant

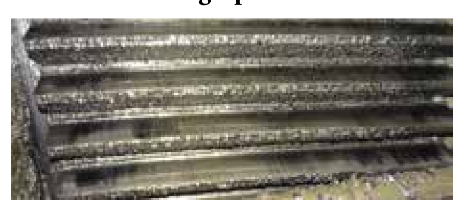
Pinion with graphite lubricant

Pinion with synthetic lubricant

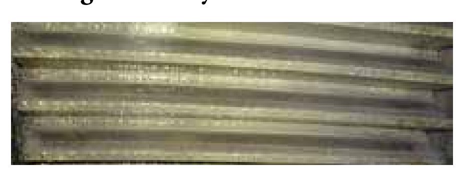
Pressing Pinion with graphite base lubricant

Pressing Pinion with synthetic lubricant

Girth Gear with graphite lubricant



Girth gear with synthetic lubricant



Date	DE to NDE 1	DE to NDE 2	DE to NDE 3	DE to NDE 4	DE to NDE 5	Δ T
06.05.2019	53.8	54.7	56.2	57.5	57.9	4.1
07.05.2019	49.5	50.2	51.2	52.3	52.7	3.2
07.05.2019	49.6	50.7	52.6	54.2	54.9	5.3
08.05.2019	50	51.1	53.6	54.4	54.6	4.6
25.05.2019	52.5	51.8	51.8	51.2	50.1	2.4
25.05.2019	55.5	54.9	55.8	54.5	53.3	2.5
26.05.2019	53.9	53.6	54.1	53.1	53	1.1
25.06.2019	51.3	50.6	50	49.6	48.9	2.4
18.07.2019	53.3	52	53.2	51.8	50	3.3
19.07.2019	52.3	50.7	49.3	49.8	48	4.3
20.07.2019	52.7	52.3	52.4	51.1	49.5	3.2

Date	DE to NDE	DE to NDE	DE to NDE	DE to NDE	DE to NDE	Δ T
06.05.2019	51.6	52	52.3	52.6	53.3	1.7
07.05.2019	48.8	49.8	49.8	48.8	49.9	1.1
07.05.2019	48.2	48.5	48.8	48.8	49.5	1.3
08.05.2019	48.1	48.5	48.5	48.5	48.6	0.5
25.05.2019	49.6	49.3	49.2	49.3	49	0.6
25.05.2019	52	52.1	52.5	52	51	1.5
26.05.2019	49.8	50.1	50.5	50	49.7	0.8
25.06.2019	50.1	50.0	49.7	49.4	48.5	1.6
26.06.2019	50.0	49.9	50.0	49.3	49.0	1.0
18.07.2019	50.5	50.5	49.9	49.8	49.1	1.4
19.07.2019	49.3	49.1	49.0	48.5	47.8	1.5
20.07.2019	50.6	50.2	50.6	50.1	49.2	1.4

About the Author

Jaywant Yelsattiwar is a Mechanical Engineer having an experience of about 10 years in the field of Open Gear Inspection, Analysis and Documentation in Cement Plants. Instrumental in achieving Equipment Reliability of Critical Equipment (Girth Gear) and minimize TCO (Total Cost of Operation) through sustainable lubrication solution. He is currently working as a Senior Area Manager with Kluber Lubrication India. Contact him at jaywant.my@in.klueber.com

Shell Lubricants, the global leader in finished lubricants is one of the most diversified international energy company in India. It has the entire Lubricants end-to-end value chain in India, from conceptualization and development, to production and distribution. In an interview with Jhumpa Mukherjee of Machinery Lubrication India, Mr Praveen Nagpal, Chief Technology Officer, Shell India, talks about tackling the COVID-19 situation and what it takes to operate in the region.

Mr Praveen Nagpal is responsible for establishing Shell's Technology Leadership through strong collaboration with OEMs, Customers and Industrial bodies working towards continually lowering the Total Cost of Ownership for customers while maintaining environmental sustainability. He has over 24 years' experience working with heavy industry OEMs, Marine, Industrial and Automotive lubricants in various local and global roles like operation and maintenance, field services, technical services, research and development and special projects. In addition to product development, he has led development of innovative customer-centric services like real time oil condition monitoring through sensors and telematics, door-step industrial services.

1. What do you have to say about Lube Market in India?

India accounts for nearly 7% of global lubricant demand. While the overall lubricant demand growth in the country has slowed in the last couple of years, it remains one of the fastest-growing finished lubricant markets in the world. Before the COVID-19 pandemic, the Indian lubricant market grew due to the presence of large industrial manufacturing sector comprising automotive and auto component manufacturing, chemicals, pharmaceuticals, tire and rubber, power generation, and mining, among others; a large and growing population; growing commercial and consumer vehicle population; and mounting transport infrastructure. The pace of growth in the Indian lubricant market before COVID-19 was moderate at around 2% to 2.5%. With the reduction in demand due to the pandemic, we anticipate that even in 2021, it may not attain the same levels as we saw last year in 2019. In the long run, the market should return to its normal growth rates, as the fundamental demand drivers are still in place. However, 2020 will see a contraction in demand.

2. According to you, how has COVID-19 impacted the lubricant industry? How Shell India is tackling the situation?

COVID-19 situation resulted in a severe reduction in industrial activities towards the end of March and April. At the same time, we had to ensure non-disruption of supplies to essential industry customers, as our products support them in keeping their machines running. Over the last few months, I am happy to share that we have been able to fulfill supply promises to our customers. We were one of the first international oil companies to have our blending plant up and running even during this crisis. We managed to do so by ensuring absolute care of our staff.

- Care being one of the key pillars for us, we have reached out to more than 126,000 people with PPE kits, relief kits and meals.
- In the lubricants business in particular, we worked with our distributors and a not-for-profit partner Vision Springs to help distribute relief kits to truckers and ambulance drivers, people who are stepping out on a daily basis so that we can stay safe at home and have access to essential services and healthcare.

Right at the beginning of the lockdown, we ensured that we used our mechanic engagement app to share all the relevant healthcare tips on the pandemic, to ensure everyone was familiar with the concept of social distancing, identifying the symptoms of the disease and the precautions to take, the helpline numbers to reach out to, among other things. In these extraordinary times, customer centricity continues to drive all our efforts. We have partnered with start-ups like Pitstop and Hoopy to deliver contactless doorstep services to car and bike owners across India; this will also generate huge employment opportunities for our mechanic community. Shell has innovated and delivered many solutions through a lot of different platforms, like Shell remote sense - a technology for real time oil condition monitoring, real wear headsets for virtual diagnostics, Shell LubeCoach Academy – an online training platform, Shell LubeOptimizer – doorstep fluid reliability services for industrial customers etc.

3. Tell about Shell's business in India and segments that you cater to.

Shell is an energy giant multinational and has been associated with India for more than seven decades. Royal Dutch Shell, the parent company of Shell India, is ranked third on the Fortune Global 500 list for 2019. Shell is one of the most diversified international energy companies in India with over 9,500 employees and presence across upstream, integrated gas, downstream, renewable energy with a retail presence across six states –Karnataka, Tamil Nadu, Telangana, Maharashtra, Gujarat and Assam. It has the entire Lubricants end-to-end value chain in India, from conceptualization and development, to production and distribution; serving 50000 consumers through a robust network of 200+ distributors across B2C and B2B lines of Sales. This includes a world class lubricant oil blending plant that manages a large supply chain through a network of 4 Regional Distribution Centers and 8 warehouses. With customers at centre of our offering, Shell research and product development teams have developed a wide range of mineral and synthetic categories basis application demand and value for customers. We offer a range of mineral and synthetic categories of lubricants catering to needs of varied automotive initial fills & aftermarket requirements and industrial applications including auto component and general manufacturing, power, metals, construction, mining, sugar, oil and gas.

4. Research & development plays an important role in any sector, more particularly in lubricants. Would you like to tell us about the R&D efforts taken up at Shell?

Typically in a crisis, people look for technology or product innovation, but I think the needs of a consumer are very different at the moment. We have been utilizing this time to connect virtually with all our customers to understand their business needs and priorities at this point of time and accordingly adjust our R&D programs to help all of us come out stronger after the lockdown. We are using the customer inputs to create solutions around fuel efficiency, lower emissions and cost optimization. Currently, with our staff unable to travel to customer locations, we wanted to ensure that we are able to provide maximum possible services remotely. After all, with the digital platforms available today, a lot of things are possible without people being physically present at a particular place. With this in mind, we rolled out Realwear headset technology, to enable virtual inspections by our experts, helping our customers optimize operations and prevent equipment breakdown. We have also made available the application of sensors for seamless monitoring of equipment to ensure that operating conditions are normal and to monitor equipment conditions and idle time among other parameters to provide useful insights to customers to optimize the cost of operations.

5. Most of the manufacturing companies are trying to incorporate Industry 4.0, what are your views on this front?

We are amidst the 4th Industrial Revolution, and technology is evolving faster than ever. There is no sector that will not benefit from adopting elements of Industry 4.0. Covid-19 itself has fast-tracked the technology adoption across industries. Machine breakdowns and downtimes can cost millions to industries and a lack of access to consumers. Making a decision related to lubricants can be both challenging and cumbersome for a manufacturer. What if a manufacturer can leave everything related to lubricants to someone else and focus only on core operations? Shell Lubricants has enabled just this for manufacturers.

I see the future of lubricants management with integrated sensors applicable with multiple machine systems and enabled with machine learning algorithms which give the advantage of real-time monitoring resulting into optimizing machinery processes. It helps manufacturers prevent unplanned breakdown thereby improving the reliability of the machinery. Besides increasing reliability of the machine, customers can also ensure maximum utilization of lubricant's residual life, thereby, reducing the overall total cost of ownership. To share one such example, Shell also offers a unique platform called 'LubeAnalyst – an oil condition monitoring service' to its customers helping to ensure that the equipment and lubricants are in optimum working order by identifying potential oil or equipment failures before they become critical. We have a strong database of ~25 million data points which help to understand the behaviour of machinery in a specific environmental condition and whether they need to optimize the machinery processes or the lubricant development processes. This service is designed to help save money and time on maintenance. To help customers with faster decision making, Shell has recently established two more labs one in Bangalore and another in Udaipur in addition to an existing one in Mumbai. The regional labs make the reports available within 24 Hrs. once sample reaches the machine.

Besides this, Shell identified a problem of manual tracking of a rainbow of mining and construction equipment fleets which was resulting into huge loss of operating hours translating into high Opex, fuel consumption, higher CO2 footprint and unable to maximize the capital. To solve this problem, Shell introduced an innovative "wireless telematics solution – MachineMax" which helps to track machine's operational hours and location 24/7.

Also, Shell in partnership with IBM has recently launched a "mining industry specific technology platform – OREN" which will provide solutions helping miners as well as their suppliers and customers. OREN is a go to mining and industrials innovation platform for digital transformation at scale. It'll offer choice and ease of access to software, services, and digital solutions from the globe's most innovative companies – a true digital solutions marketplace.

6. India is a market with strong growth opportunities. Increasing demand for lubricants is also forcing global majors to shift to local manufacturing instead of imports. Keeping in line with this trend how does Shell look at "Make in India" campaign?

Indeed, India market has strong avenues for growth and it is a focus market for Shell. We have capabilities with the entire lubricants end-to-end value chain. We have our blending plant in Mumbai and State-of-the-art Technology Center in Bangalore. The lab is involved in R&D for the global requirement of lubricants and greases. In addition, we are working on many innovative projects to support our customers. Shell also has an active program Shell E4, for startups focused on cleaner and sustainable energy solutions. The company is also working on solutions for energy storage systems and infrastructure for electric vehicles.

7. Our government is pushing for the growth of electric vehicles in the country. How is Shell preparing for this shift? And what will be the impact on the sales volume.

We are taking a broad-based approach to energy. We are one of the pioneers in gas-to-liquid (GTL) fuel as well as nature-based solutions. The advent of EVs will bring its own set of lubrication needs and at Shell we have a deep technical understanding of the various points of friction that will require to be addressed.

Thermal fluids will be needed to cool electric motors, inverters, and motor windings, and to support battery thermal management. Specialized process oils will be needed to protect battery membranes, too. There will be greases to lubricate electric motor, wheel and steering bearings, and the transmission lubes for reduction gears and differentials. Plug-in hybrid vehicles will also require specific solutions when it comes to transmissions and engine oil. Electric vehicles require lower oil volumes, but also introduce higher power outputs, more compact designs, higher complexity, different operating conditions, higher thermal stresses, and need to protect against wear at lower temperatures. There are also conductivity issues to consider when copper wires and fluids mix. Not everything is going to be coated, and transmissions in electric vehicles will turn at higher rates, requiring improved controls against foam.

8. What are the major product / service differentiators (technically / technologically) that Shell can be proud of as compared to other major players?

Specific to Shell lubricant solutions, we have innovative products like Shell Tellus S4 VE, a new gas-to-liquid based energy efficient hydraulic oil which offers up to 6 per cent productivity improvement, up to 5 per cent hydraulic energy efficiency and 27 per cent faster air release. Shell Omala S5 Wind – giving an oil life of 10 years for wind turbines. Shell Rimula R5 LE enabling low emissions and fuel economy up to 1.6 per cent and Shell Helix HX8 0W range, a fully synthetic oil formulated with Pure Plus Technology, a revolutionary process that delivers crystal clear base oil made from natural gas with virtually no impurities – making it 99.5 per cent pure. It boosts performance by minimizing friction among moving parts, offers engine protection, fuel economy with reduction in emissions. We are proud to be setting benchmarks for quality and technological innovation and are committed to providing bespoke solutions to our consumers.

9. How was the previous year for Shell and what are the goals for the next year? What are the new initiatives and developments?

We are in midst of a very dynamic situation. As consumer behavior and needs are changing, our goals are also evolving with consumer centricity in center. We'll continue to focus on three key pillars – 1. Care for our people, customers, stakeholders, and communities we operate in, 2. Ensuring business continuity for our customers and 3. Managing cash and liquidity for sustainable business on ongoing basis. In addition, we'll continue to focus on providing technologically sound products and services catering to customers varied needs.

Understanding Logic Valves in Hydraulic Systems

Logic valves are becoming increasingly popular, so it's important to understand them as hydraulic systems evolve.

Logic valves can be difficult to understand. We even seem to have trouble agreeing on what to call them. Many people describe them as "cartridge" valves. This is not incorrect, as they are in fact cartridge-type valves. Even the manufacturers typically call them this. I have also heard them referred to as "poppet" valves. Again, this is not incorrect. They do make a full-beveled seat that allows no bypassing, so they definitely can be classified in this manner. However, I prefer "logic" valves, because "cartridge" does not distinguish them from other cartridge-type valves, such as a relief valve or flow control mounted in a manifold. Likewise, "poppet" does not differentiate them from other types of poppet valves. Whatever you prefer to call them, they are becoming increasingly popular, so it's important to understand them as hydraulic systems evolve.

Advantages of Logic Valves

Logic valves have distinct advantages, primarily because they are mounted in a manifold. This enables them to cope with high pressures better than conventional hydraulic plumbing. Over time, hydraulic systems are being operated at higher and higher pressures. This allows the use of smaller actuators, making the systems much more efficient. Now, more of the energy that goes into the system can be directed to the product, and less is wasted on the mechanical machine operation. This might explain why so many European machines have used these valves for decades, as historically energy costs have been higher in Europe than in the United States. As U.S. plants begin to be more conscious of energy costs, more American-made machines are using logic valves.

Figure 1. A schematic symbol for a logic valve alongside the valve it represents

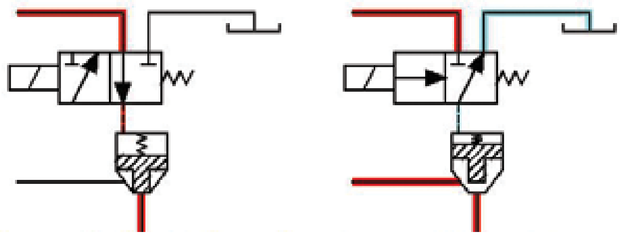


Figure 2. A three-way directional valve can be utilized to determine whether a logic valve is opened or closed.

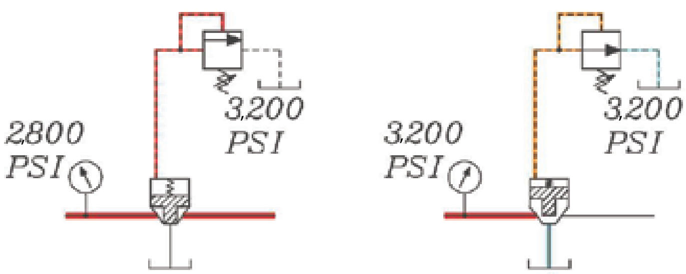


Figure 3. A small pilot relief valve can be used to limit the pressure from a large amount of flow through a logic valve.

Figure 4. A logic valve can also be used as a check valve.

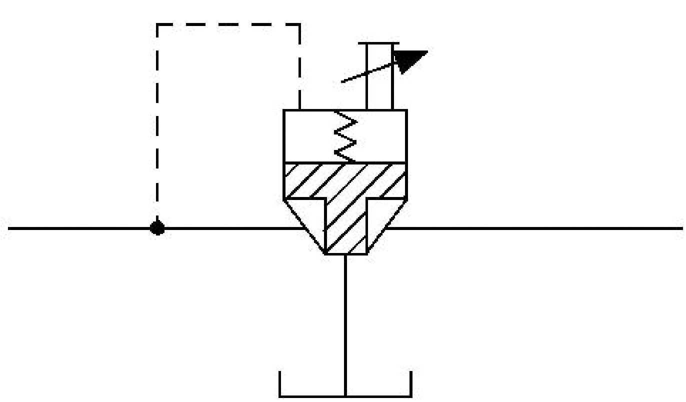


Figure 5. A logic valve with a mechanical variable actuator symbol

Because the valves are mounted in a manifold, less plumbing is required, so the installation costs are lower. Manifolds can be assembled before a unit is shipped. Installation then becomes more a matter of plumbing large manifolds together than installing individual valves. Less real estate is required inside a plant, and fewer leaks are observed. Obviously, if a hydraulic line no longer exists, it can't leak.

Of course, there is a downside to having valves mounted in a manifold. Troubleshooting a system with valves that you cannot see can be confusing. Therefore, it's more important than ever to understand how to read and use a hydraulic schematic as a troubleshooting tool. Unless you have X-ray eyes like Superman, you must rely on a schematic to understand the hydraulic flow.

Directional, Pressure and Flow Control

Logic valves are very versatile. They can emulate almost any type of hydraulic valve and can be used as directional controls, pressure controls, check valves and flow controls. The valves can also handle large amounts of flow with accuracy. Their design may be simple or complex, although generally they are quite simple. While their schematic symbols may take some getting used to, they represent their function very well.

Note the three surface areas in Figure 1 – one on top, one on bottom and a third on the side. As you can see, the side surface area is accessed by holes in the side of the cartridge. There is also a hole on the top, and another hole on the bottom. The dotted line to the top surface area indicates a pilot line. At 3 square inches, the pilot surface is the largest of the surface areas. This ensures the pilot side always generates the most force whenever the same pressure is applied to either the bottom or side as is applied to the top. This is a pilot-to-close logic valve. A pilot-to-open logic valve is also available, but it is not used as often.

The most important thing to understand about pilot-to-close logic valves is that if pilot pressure is applied, the valve will stay closed. When no pilot pressure is applied, the valve can be opened with only the pressure required to compress the spring. This will be a very low pressure. The purpose of the spring is to hold the valve closed whenever there is no pressure in the system. Typically, this pressure will be very low (1-5 bar or 15-75 pounds per square inch), depending on which surface area is used to open the valve. Usually, either a small directional valve or pressure control is employed to pilot the logic valve.

A logic valve is often used as a pressure control when it is

Figure 6. Most logic valves are mounted beneath a cover that's secured by four bolts.

necessary to control pressure while handling a large amount of flow. This makes sense, as it is easier and less expensive to manufacture a small precision spring than a large one. In Figure 3, a small pilot relief valve is utilized to limit the pressure from a large amount of flow through a logic valve.

When it is desired that fluid only travel in one direction, a logic valve can be used as a check valve, as shown in Figure 4. If the flow is moving to the right, the logic valve opens once the spring tension is overcome, but any flow to the left will be blocked as pressure is applied to the pilot surface area.

In Figure 5, a logic valve is shown with a mechanical variable actuator symbol. This symbol means there is a screw that can be adjusted to limit how far the logic valve can be opened, thus causing the valve to behave not only as a directional control but also as a flow control.

The variations that can be applied are infinite, allowing logic valves to emulate almost any type of directional, pressure or flow control. The important thing to understand is that the operation of the logic valve is solely dependent on its surface areas. Remember the following formula: force = pressure x area. When tracing the flow on a schematic, consider the size of each surface area and the pressure applied. With this in mind, it is very simple to determine in which direction flow will travel.

Installation

Logic valves are built to exacting tolerances. The internal clearances are rarely more than a few ten-thousandths of an inch. It generally is recommended that any type of valve be installed with a torque wrench, but for a logic valve, torque settings are critical. Most of these valves are mounted beneath a cover that is secured by four Allen bolts, as shown in Figure 6. If the bolts are not evenly torqued, the logic valve may not work from the time it is installed.

Failure Modes

By far the most common failure of a logic valve is due to contamination, either by particles being introduced to the manifold or generated by component wear and overheating of the fluid. When several of these valves are mounted in a manifold, they tend to contaminate each other. While the system fluid may be changed and the system flushed, usually the pilot fluid is the same as that which was added at startup. It often never leaves the manifold.

To avoid chasing contaminants through a large manifold, you should flush the manifold when a logic valve is replaced. Many companies have suffered from contaminants moving throughout their manifolds, causing one logic valve failure after another. Common sense tells us that all the valves in a manifold are under similar stress at similar pressures, have the same fluid traveling between them and are not mounted very far apart. Therefore, if one valve becomes contaminated, the rest of them cannot be far behind. ***MLI***

About the Author

Jack Weeks is a hydraulic instructor and consultant for GPM Hydraulic Consulting. Since 1997 he has trained thousands of electricians and mechanics in hydraulic troubleshooting methods. Jack has also taught radio-wave propagation for the U.S. Air Force and telecommunications equipment operation and repair for the Central Intelligence Agency at American embassies overseas.

Bennett Fitch and Daniel Rader

The Roadmap to **Lubrication Sustainability**

> "You create sustainability with your lubrication program when you can include the expectation of change as part of the status quo."

Do you remember the last time you planned for a long trip? You likely used a mapping program or a road atlas. You may have chosen to take the backroads or decided that driving such a long distance wasn't for you and paid an airline to do most of the travel work for you. Regardless, when planning a long trip, you always start by considering your current location and then where you want to go. Without a feel for the journey, it's impossible to make good decisions about the trip. The same is true when it comes to improving your lubrication program. Without first assessing where you are and understanding where you are headed, you cannot decide how best to proceed.

Machine longevity is largely driven by the state of the lubricants used and thus the state of your lubrication program. What is the state of your lubrication program? How sustainable is it? Anyone can add grease to a bearing to keep it running for a little while longer, but what can be done to provide sustainability to your lubrication practices?

Set Your Starting Point

What is your current location? Assess the current state of your lubrication program, either with an internal audit or an outside group. Where does your program stand in comparison to lubrication excellence standards? How does it compare to others in your industry, not just with how lubricants are selected but in every way that lubrication can impact uptime and overall equipment effectiveness?

This type of assessment can be performed in many ways. Normally, an objective, standardized assessment is preferred with comparisons to lubrication trends and industry best practices. These trends and practices are always evolving, so the recommendations from yesteryear may not be valid today.

For a thorough evaluation, consider how lubrication is handled throughout the lubricant's life cycle. This would include lubricant selection, storage, handling, contamination control, lubricant analysis and disposal. These six elements, which are part of the assessment in Noria's Lubrication Program Development process, are outlined below:

Lubricant Selection

What are the guidelines for the lubricants being selected? Who makes the final call on these decisions? Are they trained in lubricant selection best practices? Along with cost, are the operational, environmental and equipment factors considered in this decision? Are plant-wide optimizations, such as lubricant consolidation, taken into account?

Lubricant Storage

What are the guidelines for lubricant storage practices? Do you have a designated lube room to help ensure lubricant quality is maintained? Who is responsible for these practices? Are they trained in lubricant storage best practices? A proper lubrication room is not sustainable by itself. There must be policies and accountability for the practices in these storage areas. A good lube room is not cheap. The return on investment will be based primarily on the care given to the lubricated equipment over time.

MEASURABLE CAUSE	MEASURABLE EFFECT
Time on machines with functioning desiccant/ particle breathers installed	Time on machines within the targets for solid contaminants and dryness
Time on machines with functioning desiccant/ particle breathers installed	Time required to filter the oil to within the ISO contamination code targets
Percentage of filters changed before exceeding the differential pressure limits	Time required to filter the oil to within the ISO contamination code targets
Time on machines with functioning desiccant/ particle breathers	Percentage of oil analysis reports with critical contamination alarms

Examples of contamination control leading indicators when correlating both the measurable cause and effect

Lubricant Handling

What are the guidelines for transporting lubricants to machines? Since these activities often are handled by a variety of personnel, training should be a basic requirement with routine refresher courses on the best practices. The machinery's sustainable reliability will be contingent on the quality of the lubricant. Machine failure is expedited when the wrong or degraded lubricant is applied, if a combination of two types of oils or greases is used, or even if lubricant is not added due to a lack of awareness. Inspections or other condition monitoring methods will be critical in this process.

Contamination Control

What are the standards for controlling contaminant ingression and removing contamination from the oil in your equipment? Not all machines require the same practices and configurations, which will depend on factors such as criticality, contaminant likelihood, component sensitivity and cost. Who is responsible for these decisions and are they properly trained?

Lubricant Analysis

Are you taking oil samples and sending them out for analysis? Who is collecting these samples? Who is reviewing the results? Are they trained in the correct methods for sampling and interpreting data? Many oil analysis programs are ineffective because of the misunderstanding for what it takes to gather representative information about your oil and machinery. At the very least, you should know how to perform oil analysis at no cost with detailed inspections directly at the machine.

Lubricant Disposal and the Environment

Do you have regulations outlining how to dispose of lubricants? What are the risks associated with lubricant spills and leaks in your environmental surroundings? Are there precautions to mitigate these risks? Who is responsible for these activities and have they received proper training?

Once you know your starting point, you can gauge how far you want to go and how long it might take. Obstacles will be encountered every step of the way. These may be major, minor, expected or unexpected. Working with people and resetting their daily patterns aren't easy. Overcoming this sense of complacency will help you gain the momentum to keep the program sustainable over the long haul. Critical needs with production will always pop up, but even unexpected shutdowns can be an opportunity to achieve lubrication excellence by completing a short list of work items while the equipment is down. Knowing these methods and being ready is all part of the journey to lubrication sustainability.

MEASURABLE CAUSE	MEASURABLE EFFECT
Time on machines with known ISO contamination codes or moisture levels over the target	Mean time to lubricant degradation (such as oxidation) or machine components with wear
Desiccant breather installation cycle time	Mean time to lubricant degradation (such as oxidation) or machine components with wear
Number of machines with wear debris critical alarms	Number of machines with subsequent wear modes reported by other condition monitoring technologies or machine failure
Number of machines with other condition monitoring technologies reporting wear modes	Number of machines with detection of misalignment, bearing failure or other wear-related failure

Examples of contamination control lagging indicators when correlating both the measurable cause and effect

Set Your Destination

Where do you want to go? Unlike the starting point, your destination may be more of a moving target. It is best to have an idea of your lubrication program goals and begin moving in that direction. To support sustainability of these goals, be sure they are attainable and measurable. Attainable requires having a plan to achieve your goals with the necessary tools, training and time. Measurable means each goal is quantifiable, both in the actions performed and the benefits received. Without both parts of these key metrics, the connection between what created the benefit and which effects resulted from the cause is often misunderstood. This might be the most important prerequisite for lubrication sustainability.

Leading Indicators

Leading indicators help anticipate the onset of potential failure modes and alert you when action should be taken to prevent damage. Most of these indicators seem rather mundane, and few work like an alarm. They are comparable to a low fuel light, indicating a failure mode may soon occur if the condition is not rectified. Above are examples of contamination control leading indicators when correlating both the measurable cause and effect.

Lagging Indicators

Lagging indicators monitor events that are the result of a wear mode already in progress. Through early detection, these indicators can help prevent catastrophic failures, even though the failure mode has already begun. They can be compared to a check engine light when driving on the road. Using indicators like these can aid in scheduling maintenance for a corrective action to avoid longer downtime periods. Above are examples of contamination control lagging indicators when correlating both the measurable cause and effect.

Getting Started

Knowing how far the journey is can be scary and overwhelming. Often, it's better to make headway and get some quick wins before you lay out the entire plan for your lubrication program. With most programs, there will be many opportunities for these quick wins or action items that are easy to accomplish immediately with little or no approval required. Acting on these types of work items can also provide early evidence and justification for a potentially larger investment later.

Training

Start your route guidance with team training. Good training always offers a sustainable return on investment. Whether it's in-house training by an outside vendor, online training, public training courses or simply sharing articles and videos on lubrication best practices, proper instruction can help start the conversation about what is currently being done, right or wrong. Some facilities require formal training for everyone involved in lubrication. Training multiple people together can have a powerful effect and is a must for major initiatives.

Lube Room

Make your lube room a positive example for the entire lubrication program. This room is the heart of your program. Take measures to ensure the right things are being done, such as implementing 5-S practices. This not only will enhance the room's functionality but also make people proud of their work. Best of all, many improvements in a lube room can be done for little or no cost.

Labeling

Employ effective lubricant labeling. Cross-contamination is a real problem. It frequently occurs when the wrong lubricant is used for regreasing or oil top-ups, resulting in a mixture of lubricants. This type of human error often goes unnoticed and unassociated with the root cause of an eventual failure down the road. The savings from preventing just one failure due to cross-contamination might very well justify the investments for larger initiatives.

Oil Filtration

Filter or dehydrate your lubricants instead of changing them out or consider reconditioning discarded oil. The default corrective action for machines with dirty lubricants is usually to change the oil. Depending on the oil's condition, there may just be contaminants that can be removed without significantly affecting the oil's chemistry. When done correctly, decontaminating your oil can be a real cost-saving measure.

Avoid Overlubrication

Perform calculations or use smart tools to avoid overgreasing and undergreasing. Many bearings are very sensitive to the amount of grease lubrication. When unchecked, improper grease volumes can lead to premature bearing failures and downtime. A simple calculation or using ultrasonic greasing devices can help you determine the proper grease amount.

Accountability

Specify who will perform the lubrication tasks and what actually will be done to the machines. Will it be the operator or janitor? Is there a different person for each shift? Stipulating who should complete these tasks can help answer several important questions. For example, what lubricant is currently in the machine? When was it last changed or lubricated? Can these questions even be answered? Much of a lubrication initiative relies on first understanding what is currently occurring. Sometimes it's easier and more sustainable to get these answers by identifying which lubricants are entering and exiting your lube room and by whom.

Track Lubricant Consumption

Analyze where your lubricant is going. If you can pinpoint which machine is consuming the most lubricant on a regular basis, you may be able to discover a bad-actor machine or poor practice being performed. If a specific machine is being topped off more than it should, where is that missing lubricant going? Is there an undocumented leak or is unnecessary lubricant being added? Sustainable lubrication depends on tracking simple things like lubricant consumption. This is the pulse of a lubrication program. Is yours beating abnormally?

Lubricant Consolidation

Find obvious and easy consolidation opportunities. Create a list of all lubricants being used in the plant along with how much and where they are employed. Once this list is compiled, work with your lubricant supplier to identify where there are similar or identical types of lubricants. Consolidating down to a smaller number of lubricants not only can provide cost savings when purchasing lubricants but can also help prevent cross-contamination later.

Unexpected Detours and Staying on Track

Incorporate changes into your lubrication program cautiously but confidently. Once the path from where you are now to where you want to be is mapped out, consider what might change along the way. Let's say you have a list of 10 things you want to accomplish over the next few years to improve lubricant selection, condition monitoring, analysis techniques, etc. Each of these goals may have different challenges, such as high costs, personnel buy-in or implementation difficulties.

For example, an obstacle that could arise during lubricant consolidation is the unwillingness by some to change the lubricant in certain equipment even if the proposed lubricant is equivalent. This is understandable since there's an element of risk when changing something and breaking the "if it ain't broke, don't fix it" mentality.

One way to overcome this mentality is to leverage the success of other plants using the proposed lubricant on the same or similar equipment. You should also offer lubrication training for those uneasy about the change. Of course, it will be more difficult to create alignment on best practices when those involved have a different knowledge base and experience level.

Creating sustainable lubrication practices takes time. Initiatives to improve a lube program should not be tackled all at once. When pushback occurs, it sometimes is a good idea to wait on a certain project and focus instead on another change that might be better received by the team members involved. Be sure to have alternatives when one route doesn't work. No significant journey is completed without its fair share of route recalculations.

The Sustainable Journey

As the saying goes, life is about the journey, not the destination. A journey is a collection of experiences filled with obstacles and course corrections that continually challenge you to live life better. A journey is also where you experience satisfaction and a sense of success. Attaining success and sustainability with your lubrication program is about learning how to make those course corrections and knowing when the status quo is ready for an upgrade. You create sustainability with your lubrication program when you can include the expectation of change as part of that status quo.

The methods you used to achieve success in the past may not be the same ones needed in the years to come. There must be a continuous thirst for new perspectives and new answers, even if it requires a detour or brief pitstop. However, always be sure to get back on course and be moving in the right direction. Finally, remember what it took to get there. Tracking your progress will be the fuel and motivation to keep things going. ***MLI***

About the Authors

Bennett Fitch is the director of product development and Lubrication Program Development (LPD) services for Noria Corporation. He is a mechanical engineer who holds a Level III Machine Lubricant Analyst (MLA III) certification, a Level II Machine Lubrication Technician (MLT II) certification and a Machinery Lubrication Engineer (MLE) certification through the International Council for Machinery Lubrication (ICML). Daniel Rader is a Reliability Engineer at L3Harris Technologies, USA. A Certified Maintenance and Reliability Professional (CMRP) through the Society for Maintenance and Reliability Professionals (SMRP), he holds Level I Machine Lubrication Technician (MLT I) and Machine Lubricant Analyst (MLA I) certifications through the International Council for Machinery Lubrication (ICML).

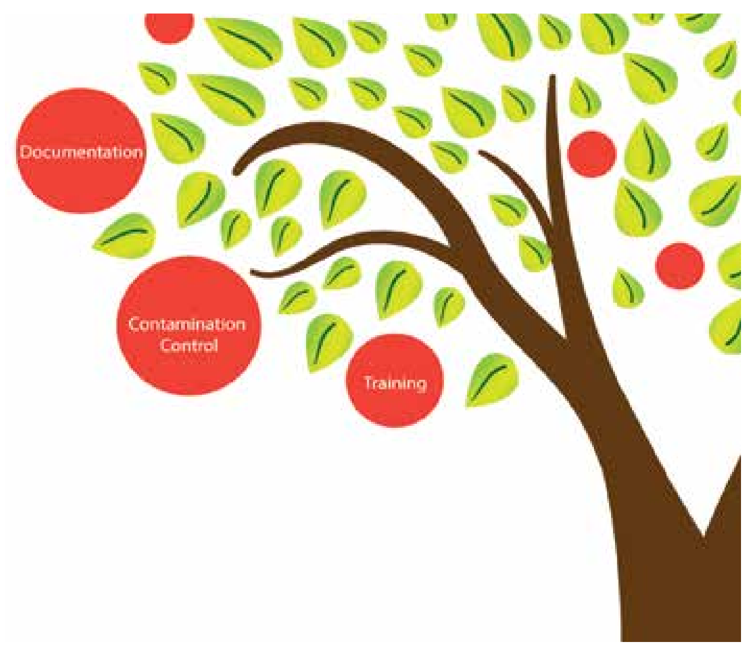
Matthew Adams | Noria Corporation

Identifying the Low-Hanging Fruit **in Your Lubrication Program**

"While fixing these issues alone will not establish a world-class program, it will address the majority of items that early-stage programs habitually fail to resolve."

After assessing and developing multiple lubrication programs across numerous industries over the years, Noria has been able to identify common "low-hanging fruit" or gaps which, if corrected, can significantly improve the program's development and often with minimal cost, time and effort. While fixing these issues alone will not establish a world-class program, it will address the majority of items that early-stage programs habitually fail to resolve.

To the untrained eye, some of these elements may not typically be considered imperative for a lubrication program. However, in truth, they are the simple, yet effective low-hanging fruit that must be harvested to ensure long-term success and sustainability. These elements include inventory management, labeling and tagging, documentation, contamination control, lubricant handling and training.



Inventory Management

Your reception area is the starting point in the lubricant's journey. In this area, inventory management will be one of the key components. Having correct practices on the front end will help set the tone for lubricant handling practices across the site. When it comes to inventory management of lubricants, several things must be considered, such as shelf life, minimum and maximum levels, first-in/first-out (FIFO) practices, reception dating, quality assurance and control, and filtration.

Shelf Life

Using a lubricant after its noted shelf life can decrease its performance. Therefore, it is important to know each lubricant's shelf life, as not all are the same. Contact your lubricant supplier if you are unsure of the timeframe.

Another consideration is auditing your supplier to uncover any issues before the lubricants arrive onsite. If an oil drum is found with a shelf life that has already expired, a sample should be pulled from the drum and compared to the new oil baseline.

Minimum/Maximum Levels

Minimum and maximum storage levels should be established in the reception area. These will be crucial to mitigate shelf-life issues and unnecessary spare-part overhead. Storeroom usage should also be reviewed annually to determine if these values need to be adjusted.

FIFO

First-in/first-out (FIFO) practices can help to reduce shelf-life concerns. You not only need to understand this philosophy of utilizing the oldest lubricant first but also implement a storage strategy to make it convenient. If individuals on the lubrication team must move and rearrange oil drums whenever a new drum is needed in order to get the oldest drum in stock, this practice likely will not last.

Reception Dating

Again, refer to the shelf life but note two specific dates: the batch date and the date the lubricant arrived onsite. This process can be as simple as highlighting the noted batch date and using a paint pen to write the arrival date on the side of the drum. This will help minimize additive depletion issues and allow the reception department to move closer to a just-in-time delivery system. If your facility is receiving drums that are several years older than the batch date, you may want to have a talk with your supplier.

Quality Assurance/Control

Quality control is another essential element of inventory management. For a world-class lubrication program, emphasis should be placed on verifying that the correct lubricant has been received. Establishing testing, quarantine and ready-for-use areas will enable the site to ensure that it at least has the right lubricant and that the viscosity falls within the 10 percent range of the ISO code. Obtaining quality certificates from your lubricant suppliers can also provide assurance that your lubricants have been tested and approved.

Filtration

If your lubrication program is small, the lubricant reception area may be inside your lube room. If this is the case, you have a great opportunity to integrate filtration into your program's inventory management. By minimizing particle and moisture ingression, you will maximize asset life.

	Reliability and PdM Professionals	Lubrication Management Professionals	Lubrication Technicians	Machinery Lubricant Analysts	Mechanics & Craftsmen	Operators	General Managers & Supervisors
Machinery Lubrication I (Cert. MLT I)	Required	Required	Required	Required	Required	Optional But Recommended	Optional But Recommended
Machinery Lubrication II (Cert. MLT II)	Optional Personal Development Only	Required	Required For Program Managers	Optional But Recommended	Optional Personal Development Only	Optional Personal Development Only	Optional Personal Development Only
Oil Analysis I & II (Cert. MLA I & II)	Required	Required	Optional But Recommended	Required	Optional But Recommended	Optional But Recommended	Optional But Recommended
Oil Analysis III (Cert. MLA III)	Required For Program Managers	Required	Optional Personal Development Only	Optional But Recommended	Optional Personal Development Only	Optional Personal Development Only	Optional Personal Development Only

An example of a training matrix for individuals involved in a lubrication program

Labeling and Tagging

A lubricant identification system with a specific shape, color and naming nomenclature for each lubricant is imperative for a world-class program. This system not only should be utilized in the lube room but also for lubricant reception, satellite cabinets, lubricant handling, transfer and sampling equipment, assets, and components.

Lubricant Reception

Just as reception is the starting point in the lubricant-handling process, it should also be the first place to consider labeling. All lubricants should be labeled and tagged upon reception before they are staged or released for use.

Lube Room and Satellite Cabinets

As many lubrication champions have stated, the lube room is the heart of your program. As such, labeling and tagging will be paramount in this area. All lubricants, bulk storage containers and transfer pumps should be properly identified to prevent cross-contamination.

Lubricant Handling, Transfer and Sampling Equipment

Lubricant handling, transfer and sampling equipment are often overlooked when it comes to labeling and tagging. While some facilities have upgraded to dedicated, sealable and refillable containers with labels, it is still fairly common to see transfer pumps, filter carts and vacuum sampling pumps used for multiple lubricants.

Assets and Components

Assets on the plant floor should also be labeled with the correct lubricant identification. Since relubrication tasks are frequently delegated to operations, this is imperative to prevent confusion as to which lubricant goes where. The idea is to create a tagging system that is so clear that anyone can walk in and understand which lubricant should be used throughout the handling process.

Documentation

Documentation is another area where gaps are often identified in underdeveloped programs. Although there may be some resemblance of work instructions, it is rare to find programs that have comprehensive procedures for tasks and line-by-line steps that verify work is being performed the same way by different people. These procedures for lubrication tasks should be carefully considered so as not to hinder workflow in the field while also providing enough detail to standardize the work being completed. Procedures should be created for the majority, if not all, lubrication-related tasks, from reception to used oil sampling.

Reception

Standardized procedures should be established for incoming lubricants, testing and handling. Incoming lubricants should have documentation indicating any damage or concerns with the packaging, along with the reception date and batch date. Testing procedures should detail how and where to pull a sample, as well as which oil analysis tests the laboratory should perform. Handling procedures should specify the correct labeling and tagging process and ensure first-in/first-out practices are carried out.

Lubrication Room

In the lubrication room, the procedures and documentation generally fall under the umbrella of confirming proper maintenance and upkeep of transfer equipment. These procedures typically consist of inspecting and cleaning bulk storage containers, satellite cabinets, transfer containers and filter carts. These simple work instructions can help your team be more proactive. The tasks can be measured by creating 5-S audits to confirm effective follow-through.

Routine Inspections

Route-based documentation often involves visual inspections utilizing both instrumentation and the human senses. Ensuring maintenance personnel "observe" and not just "see" will be key for good inspections. Recognizing specific sounds, normal gauge readings and how equipment usually operates can offer insight for addressing unheeded maintenance and reliability issues. Through effective training, communication and documentation, a quick operator round or flashlight inspection can provide critical asset information.

Routine Lubrication Replenishment

Routine replenishment is another aspect of frequency-based lubrication tasks. Documentation of these procedures should identify how regreasing, oil draining, flushing and refilling practices should be performed. Inconsistent greasing volumes, cross-contamination and improper flushing techniques will lead to lubrication-related problems, so documentation of these tasks is essential.

On-Condition Routes

An on-condition route refers to a consistent, triggered response based on an inspection. These procedures should describe how to top up oil, replace a desiccant breather or change a plugged filter. While these may seem like simple tasks, there are certain details that may require follow-up.

Sampling

It is important to have sequential steps for the sampling process, from confirming proper field techniques to verifying the appropriate tests. Missing information and analyzing poorly collected samples will jeopardize the opportunity to catch potential failures before they occur. With sampling, the goal should be to maximize data density and minimize data disturbance.

Contamination Control

Contamination control is one element within a lubrication program that many sites have begun to address. However, there usually is still low-hanging fruit to be picked. The lubrication team must understand all the possible contaminants in their facility, how and when they are likely to enter a system, and the most effective strategies for excluding and removing them.

Exclusion vs. Removal Strategies

More emphasis should be placed on exclusion strategies, since it is much easier and more cost effective to prevent contaminants from entering a lubricant than it is to remove them once they have made their way into the system. Minimizing exposure during the handling process greatly lowers the opportunity for contamination. Among the methods used to limit exposure include utilizing quick disconnects, reducing the number of times a lubricant is handled, optimizing transfer container openings, and outfitting assets with suitable headspace management hardware and seals. Removal strategies should not be ignored either, as they will be quite helpful in the continuing process of ensuring your lubricants remain clean, cool and dry.

Hardware

Determining the right contamination control hardware to add to a piece of equipment primarily comes down to understanding the asset's criticality, cost of replacement, related downtime costs and replacement-part lead time. The higher the asset ranks on the criticality list, the more time, money and effort should be spent on it. In regard to oil reservoirs, the key locations where you should consider adding hardware will be the headspace, oil level and bottom drain. Using the appropriate hardware in these locations will help keep the reservoir dry, decrease foam and enable you to visually inspect the bottom for contaminants that have settled out.

Filtration

Even if efforts have been made to prevent contaminant ingression, filtration is still needed for those contaminants that make it through or are already in the system. For larger, more critical equipment, online and offline kidney-loop filtration should be considered. Smaller, less critical reservoirs often can be drained and flushed based on oil analysis results. Portable filter carts, which can be moved from asset to asset, are another option.

Lubricant Handling

Although some organizations have made advances in lubricant handling, many lubrication programs are still lacking in this area. Common gaps include improper use of transfer containers, sharing resources among lubricant types and failing to deploy grease guns correctly.

Transfer Containers

With transfer containers, typically an initiative is launched to purchase sealable and refillable (S&R) versions, but no one ever follows up to ensure they are utilized to their fullest extent. Most facilities struggle with leaving spout tops open, staging them next to an asset outdoors, or cleaning the inside and outside of the containers.

Lubricant-Dedicated Handling

Another common issue is not dedicating items for specific lubricant types. Flushing methods can be used to limit the number of handling resources, such as filter carts, pumps and transfer containers, but this generally is not recommended, as there is always a risk of cross-contamination.

Calibrated Grease Guns

It is rare to visit a site where the correct grease, volume and frequency have been verified for the assets. Inconsistencies are often seen in the amount of grease delivered by different styles and types of grease guns. Proactive measures, such as grease gun calibration, metering and other predictive maintenance technologies, can help to avoid these issues.

Training

Reliability engineers and lubrication champions usually receive some type of training, but the training component should be extended to include all individuals involved in the program. A training matrix also should be developed. The type and depth of training should vary according to each individual's involvement. Basic awareness training for the team is frequently enough to identify initial improvement actions.

Formal Training

Personnel involved in lubrication on a daily basis should consider formal certification-based and non-certification-based training. These training sessions may vary from a few hours to a couple of days and should provide both classroom and field exercises. Topics generally include lubrication concepts and fundamentals, lubricant selection, oil analysis, contamination control, lubricant disposal practices and program development.

Informal Training

While formal training frequently receives most of the attention, informal training is often overlooked. Brief 15-minute conversations with maintenance or operations personnel who may perform lubrication tasks on a monthly or quarterly basis can help to ensure engagement of craftspeople and enable new improvements, metrics and concerns to be discussed.

Computer-based Training

Computer-based training (CBT) is becoming more and more popular. This type of training can help address attrition gaps in a lubrication program by introducing or re-emphasizing lubrication basics and best practices. Standardizing a training method for new or transferred employees will set the standard for lubrication expectations at the facility. Although documentation will be the foundation upon which habits and behaviors at the site are built, computer-based training can assist in this process.

Recognizing the Gaps

If your organization currently falls short in any of these program elements, you are not alone. By understanding and recognizing where the gaps are in your inventory management, labeling, documentation, contamination control, lubricant handling and training, you should be able to identify low-hanging fruit to help develop your program and achieve long-term success. ***MLI***

About the Author

Matthew Adams is a technical consultant for Noria Corporation, concentrating in the field of predictive maintenance. He has experience in multiple condition-based maintenance technologies and focuses the majority of his attention on lubrication program development, training and general consulting. Matthew holds a Machine Lubricant Analyst (MLA) Level III certification and a Machinery Lubrication Technician (MLT) Level I certification through the International Council for Machinery Lubrication (ICML).Contact Matthew at madams@noria.com to find out how Noria can help you identify the low-hanging fruit in your lubrication program.

TEST YOUR KNOWLEDGE

This month, *Machinery Lubrication* continues its "Test Your Knowledge" section in which we focus on a group of questions from Noria's Practice Exam for Level I Machine Lubrication Technician and Machine Lubricant Analyst. The answers are located at the bottom of this page. The complete 126-question practice test with expanded answers is available at store.noria.com.

1. Which of the following is the single most important property of a lubricant?

A) Viscosity
B) Dropping point
C) Worked separation
D) Base oil type
E) Acid number

2. Which statement is incorrect regarding filter patch tests for solid contaminants?

A) Patch tests use very fine micron filters
B) The patch test is a form of automatic particle counting
C) Patch tests can be done in-house or in a lab
D) Patch discoloration can estimate overall particle concentration
E) The resulting patch can be viewed or weighed to assess the contaminant concentration

3. Drop-tube vacuum sampling of reservoirs and tanks is best done:

A) Off the bottom of the tank
B) Where the oil return line dumps back into the tank
C) Where the oil suction line pulls oil from the tank
D) From the top layer of the oil in the tank where water and dirt have settled out
E) From the middle of the tank

ANSWERS

1. A
Viscosity is the most important property of a lubricant. While other properties are significant, the wrong viscosity selection may lead to serious problems in a short amount of time, including metal-to-metal contact if the viscosity is too low or high temperature and its associated problems if the viscosity is too high.

2. B
The filter patch test is a simple test used to evaluate solid particles where the oil passed through a fine filter. All listed choices are correct except "B," as there is no automatic particle counting involved in this simple test.

3. B
This will help detect wear metals generated from system frictional zones before the oil becomes diluted in the tank.

LUBE-TIPS

The "Lube-Tips" section of *Machinery Lubrication* magazine features innovative ideas submitted by our readers.

Oil Sampling Strategies

When sampling new oil deliveries for testing, one strategy is to pull the sample from just above the drum or tanker compartment bottom — where contamination is most concentrated. Dispensing lines from bulk transports may also be a good choice (the first and last fluid out).

Avoid Additive Leaching

Particle contamination in a lubricating or hydraulic system is widely known as one of the most devastating contaminants. One effect of particle contamination that is rarely discussed is additive leaching. Many additives attach to particles and are removed along with the particle by filtration.

Oil Reclaiming vs. Oil Re-refining

Although definitions vary, the general difference between oil reclaiming and oil re-refining is that reclaiming removes solids, water, gas and other impurities extractable by vacuum dehydration and filtration, while re-refining removes both soluble and insoluble impurities and most additives, effectively bringing the used oil back to a pure base stock. It then would need to be readditized.

Did You Know?

Additional tips can be found in our Lube-Tips email newsletter. To receive the Lube-Tips newsletter, subscribe now at machinerylubricationindia.com

Have Some Tips?

If you have a tip to share, email it to admin@machinerylubricationindia.com

David Dise | Noria Corporation

Strategies for Incorporating 5-S into Your Lube Room

> "By giving your machines clean, cool and dry lubricants, **you can increase uptime and revenue.**"

A lube room is often a dark, dirty, forgotten area inside a plant. However, it shouldn't be this way, especially considering how important it is in keeping machines moving. After all, without proper lubrication, equipment would not rotate.

By giving your machines clean, cool and dry lubricants, you can increase uptime and revenue. Keeping your lube room clean and organized also will help with lubricant management. When everything has its place and is clearly marked, you can identify what you have and what you need.

One way to achieve this is by incorporating 5-S into your lubricant storage and handling. The 5-S system is a Japanese-based set of principles designed to eliminate waste and foster a workplace culture of efficiency. The five S's stand for sort, straighten, shine, standardize and sustain.

Sort

The first step in incorporating 5-S into your lube room is to remove all unnecessary items. Determine what is deadweight in each area and stack it in one location. This would include things like spent filters, used oil buckets, oily rags, expired lubricants, old funnels, empty drums, broken or worn-out transfer containers, etc. All items in this area should be tagged for later discussion. The team then can decide whether to discard, store or keep these items. If in doubt, throw it out.

Straighten

After removing everything from the lube room, it's time to set it all in order. Create and label a place for everything. Arrange lubricants in a manner that minimizes travel and waste while also providing optimal ergonomics. Bulk lubricant storage areas should be clearly labeled, easy to access and positioned to allow for the first-in/first-out (FIFO) methodology. Organize each work area and cabinet, making it visually obvious when something is out of place. You should be able to see everything needed for an area or cabinet with a quick look. Be patient and persistent. This process can take some time before you feel comfortable with how it looks and operates.

Shine

This step is all about cleaning the lube room and making it like new again. Now that the room has only what's needed and everything is in the right spot, you can clean intensely. This involves wiping down surfaces and transfer equipment, sweeping and vacuuming the floor, degreasing, cleaning the inside and outside of cabinets, and mopping the floor. Go above and beyond the normal cleaning. Clean out oil-containment drains, repair sections of the floor, paint, improve the lighting, replace worn cabinets and parts, remove or update outdated postings, fix any leaks, etc. I like to say, "Clean it like you own it." Take pride in your cleaning so the result makes you feel good, like you accomplished something. Brag about it and show your team how good it looks. By keeping the lube room and the things stored inside it clean, you will help prevent the lubricants from becoming contaminated before they enter the machinery.

Standardize

Once the lube room is clean and organized, take pictures and laminate them for display. This will remind others of the cleanliness level expected in each area. Anything less than what's shown in the picture is

unacceptable. By keeping a benchmark picture on each cabinet or workstation, you also will know exactly what and where things are inside the cabinet. When labeling, use color codes for stored lubricants, transfer equipment and machines to reduce the possibility of cross-contamination.

Sustain

To sustain your lube room in its optimal condition, it will be essential to conduct periodic audits. By creating and posting a cleaning schedule, you can hold workers accountable using a simple completion sign-off sheet. With the benchmark picture on the wall, there is no excuse for error.

45%

of lubrication professionals say their plant has not made any improvements to its lube room in the past five years, based on a recent survey at MachineryLubrication.com

These pictures also help when conducting audits and explaining the results to the team. The audit results and improvement opportunities should be displayed in the area as well. Hold meetings to show pictures of your progress and celebrate as a team to build your culture.

Finally, before implementing this 5-S process into your lube room, your organization or team should designate a lube champion. This individual should have Six Sigma training and know the end goal. He or she will be responsible for managing the team throughout the process, developing standards for each area and then working to sustain those standards through regular audits. MLI

About the Author

David Dise is an associate technical consultant for Noria Corporation. He has been certified as a Level II Machine Lubricant Analyst (MLA II) and a Level I Machinery Lubrication Technician (MLT I) by the International Council for Machinery Lubrication (ICML). Contact David at ddise@noria.com to learn how Noria can help you incorporate 5-S into your lube room.

BASE OIL REPORT

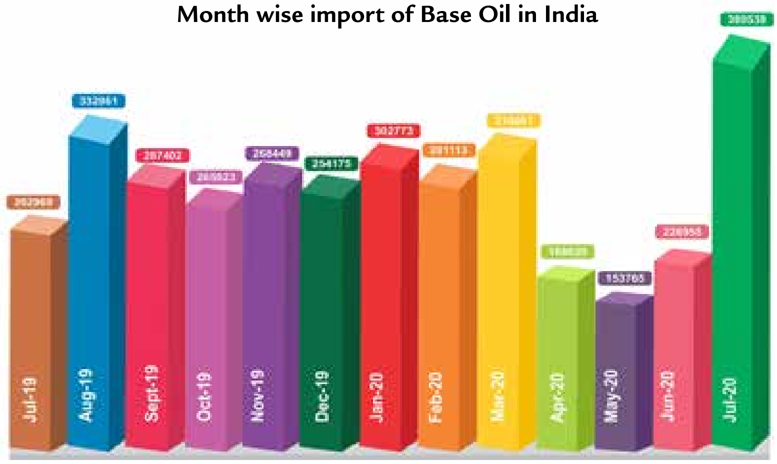
India paid much less for the crude oil imported between April and July 2020 compared to the same period last year, due to the significantly low oil prices and lower import volumes amid decreased fuel demand. Because of the slump in international oil price benchmarks, India's crude oil import bill was US$12.4 billion in April-July, the first quarter of India's fiscal year. For this sum, India imported 57.2 million tons of crude oil, compared to imports of 74.9 million tons worth US$36.2 billion for the same period of 2019.

The Indian domestic market Korean origin Group II plus N-60–70/150/500 prices at the current level are marginally up for lighter grades and heavier grades. As per conversation with domestic importers and traders prices for N – 70/ N- 150/ N - 500 grades and at the current level are quoted in the range of Rupees 39.90 – 40.15/41.15–41.35/45.00 – 45.15 per liter in bulk plus 18% GST as applicable. The above mentioned prices are offered by a manufacturer who also offers the grades in the domestic market, while another importer trader is offering the grades cheaper by Rs.0.30 – 0.35 per liter on basic prices. Light Liquid Paraffin (IP) is priced at Rs.41.65 – 41.80 per liter in bulk and Heavy Liquid paraffin (IP) is Rs.47.55 – 47.75 per liter in bulk respectively plus GST as applicable.

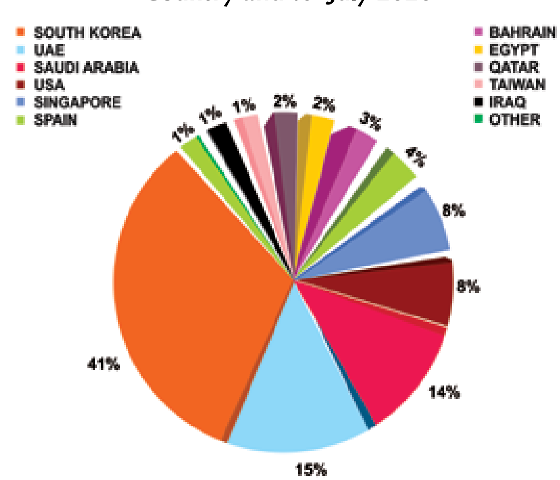
While in the month of July 2020, India imported 380538 MT of Base Oil. India imported the huge quantum in small shipments on different ports like 190850 MT (50%) into Mumbai, 43303 MT (11%) into Hazira, 42400 MT (11%) into Pipavav, 28849 MT (8%) into Kandla, 27537 MT (7%) into Mundra, 21996 MT (6%) into Chennai, 20266 MT (6%) into JNPT, 1990 MT (1%) into Ennore and 3348 MT (1%) into Other Ports.

Dhiren Shah
(Editor – In – Chief of Petrosil Group)
E-mail- dhiren@petrosil.com

Month wise import of Base Oil in India



Origin wise Base Oil import to India, Country and %- July 2020



Base Oil Group I & Group II CFR India prices:-

Month	Group I - SN 150 Iran Origin Base Oil CFR India Prices	Napthenic Base Oil HYGOLD L 2000 US Origin CFR India Prices	N- 500 Singapore Origin Base Oil CFR India Prices	RPO Drums CFR India Prices
July 2020	USD 440 – 460 PMT	USD 530 – 550 PMT	USD 495 - 515 PMT	USD 240 – 250 PMT
August 2020	USD 460 – 480 PMT	USD 555 – 575 PMT	USD 525 - 545 PMT	USD 255 - 265 PMT
September 2020	USD 470 – 490 PMT	USD 570 - 590 PMT	USD 540 - 560 PMT	USD 250 – 260 PMT
	Since July 2020, prices have increased by USD 30 PMT (7%) in September 2020.	Since July 2020, prices hiked up by USD 40 PMT (7%) in September 2020.	Since July 2020, prices have increased by USD 45 PMT (9%) in September 2020.	Since July 2020, prices have gone up by USD 10 PMT (4%) in September 2020.


www.tribologysolutions.com
When World's Largest Two Wheeler manufacturing company was looking for a partner for world class "Lubrication Services"