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AS I SEE IT

Skillful Out-leakage Detection

3

COVER STORY

Onsite Oil Analysis Drives Down Maintenance Costs

6

EDITORIAL FEATURES

Publisher's Note

Reading a magazine becomes thoroughly enjoyable, when you see value in the subjects covered. Machinery Lubrication India (MLI) magazine covers various advancements in the lubrication industry and makes you well-informed.

It is impossible to find a single industry unaffected by technological change. These days you suddenly hear a lot about Chat GPT and AI everywhere. Today's buzzword, Chat GPT is an AI model developed by Open AI. This free AI Chatbot allows you to have human-like conversations. With this many possibilities have opened up, and you can ask anything and everything to get infinite responses.

Chat GPT is transforming the lubricant industry. Chief advantage of Chat GPT is its ability to quickly and accurately address technical inquiries. By recognizing complex terms and concepts, the chatbot provides thorough explanations and examples to help users grasp complicated topics. Moreover, Chat GPT delivers personalized responses to users by learning from previous interactions and using that information to offer more relevant and useful responses in the future. This feature enhances the user experience and simplifies the process of finding information for petroleum industry professionals.

Chat GPT facilitates proactive maintenance scheduling, resulting in reduced downtime and cost savings. The model can forecast equipment failure by being supplied with relevant data concerning the equipment, operating conditions, and past failure history. It can act as a virtual assistant for employees, aiding them in day-to-day activities like scheduling meetings, setting reminders, and offering industry-related information. By incorporating it into messaging platforms, employees can engage with it efficiently. An appropriately designed approach to AI can increase efficiency and productivity and reduce costs in the petroleum industry.

Chatbots can automate jobs that can provide greater efficiency, improve customer service, increase customer satisfaction, provide on-demand support for workers, both on-field and in the office, offer real-time solutions to onsite workers, ease the learning curve for new hires, prevent potentially costly issues and much more.

Though it's said that shortcuts don't exist but this tool is a shortcut that enhances your work, helps you progress, enhances results and makes you more efficient.
Some of the negative impacts of this technology include the risk of jobs that requires more doing and less thinking. You can continue to embrace this tool and stay relevant by letting the brain juices flow. You can use this technology to come to your conclusions and answers. It is important to remember that AI programs are not a replacement for human interaction. Rather they complement human interaction.

The cover story, takes a detailed look into using data to decrease maintenance costs and increase the bottom line. This article addresses the role of key performance indicators (KPIs) in predictive maintenance, how to gather useful data that aligns with KPIs and reviews a few case studies. When adding onsite oil analysis to a facility, the management and proper distribution of the data to equipment owners becomes pivotal in justifying program costs and sustaining a reliability program.

Some other topics covered in this edition include: Lubricant selection and LIS fight the current lack of supply, little- known sources of contamination ingression, onsite labs vs. offsite labs: which is best for my lube program? Environmental training: how to get your team onboard.

We look forward to your support and feedback to enable us to improve the content and layout of Machinery Lubrication India. We welcome readers to participate by sending their feedback & contributing articles and case studies. We look forward to the continued patronage of the advertisers and the subscribers.

Warm regards,
Udey Dhir

Skillful Out-leakage Detection

"Why did the leak occur, and why was it allowed to advance?"

This is the most common form of leakage. It is also known as external leakage. Out-leakage relates to a failure of containment. Typically, liquids or gases follow the path of least resistance, going from high pressure to lower pressure. A crack, clearance, orifice or unsealed space becomes the leakage path through which the fluid, gas or even solids (aggregate) exit to the surrounding environment.

The machines most prone to oil leakage are compressors, process pumps, engines and hydraulic systems. Think of an automobile engine, the product of billions of dollars of engineering advancements spanning more than a century. As sophisticated as it might be, we still see the ubiquitous presence of oil and coolant leakage on the pavement of garages and parking lots. We, therefore, must depend heavily on early detection and prompt corrective action to keep leakage under control.

For certain machines and production processes, out-leakage can result in the contamination of the product being produced (food, beverage, paper, etc.). Hydraulic systems, due to their high pressures, are the most prone to leakage, which can occur in multiple locations but is usually seen at fittings, hoses, dynamic seals and static seals. Seals used to control out-leakage are called retention seals. Many seals attempt to serve both functions of retention and exclusion.

Visual Out-leakage Detection

External leakage is the easiest to identify in most cases. When a

piece of equipment is inspected, the area around it serves as a tell-tale sign of an active lubricant leak. There may be a small drip of oil coming from a drain valve or a puddle of oil surrounding the machine that would indicate a mechanical or fluid level issue. However, determining the source of an external leak can be difficult.

When diagnosing a leaky system, first look for reasons that may cause the leak. For instance, leaks are often triggered by pressure buildup. Check for plugged vents, overfilling and elevated heat levels. Stress from too much torque can result in gasket failures that lead to leaks. Seal failures are often caused by misalignment.

Leakage is a fault and compromises machine reliability and all of the consequences of failure (plus a few more). As

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such, the P-F Interval clearly applies. Everything maintenance and inspection resources can do to extend the P-F Interval to allow for safe and convenient remediation is justified. To do this, we need to ask why. Why did the leak occur, and why was it allowed to advance?

How to Find the Source of an Oil Leak

One way to find the source of a tough-to-trace oil leak is to start by cleaning the area you can use a fast-dry solvent like break cleaner. Next, spray the area with an aerosol such as athlete's foot powder (baby powder can also be used). The powder sticks to almost any surface, and the oil will leave a trail through the powder right to the source of the leak. A thermal imaging IR camera will also show hot oil or grease oozing out of the source.

Detect Steam and Air Using Ultrasound

Ultrasound instruments are versatile. Because they use sound to detect leaks, they can be used to detect multiple kinds of leaks, including leaks in liquid systems, gas systems and vacuum systems, as well as internal or external leaks.

Ultrasound instruments are often used to save energy by locating compressed air and steam leaks. Compressed air is a costly utility, and according to the Department of Energy, around 30% of all compressed air produced in the United States is lost as a result of leakage. It's a similar story with steam, another costly utility. Besides being a waste of energy, steam leaks also present the threat of water hammer, which can increase operating costs by damaging steam system components.

UV/Dye Detection of Oil Leaks

Fluorescent dyes are sometimes used with UV lamps to trace the pathway of the streaming liquid to its origin. This requires first wiping down the machine, followed by introducing the dye to the fluid reservoir inside the machine. By reducing ambient light, a UV lamp is often very effective at detecting the leak source. Once detected, the leak source should be immediately tagged. *ML*

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.

In a recent plant reliability survey, 60% to 70% of industrial facilities consider oil analysis an important part of their reliability programs. Oil analysis gives a snapshot of machinery health, preventing unnecessary oil changes and assisting in predicting equipment failures. This article will take a detailed look into using data to decrease maintenance costs and increase the bottom line. Being able to extend oil drains or even shorten them to eliminate failures can be an easy way to reduce maintenance costs, but data must be available that allows for making those decisions. This article will address the role of key performance indicators (KPIs) in predictive maintenance, how to gather useful data that aligns with KPIs and review a few case studies where onsite labs were able to use data to take advantage of warranty periods, justify keeping assets after warranty and extend the interval between oil drains to reduce oil consumption.

Oil Analysis Introduction

Lubricant analysis is much like a blood test for humans. By trending the correct parameters like blood pressure and cholesterol, the patient gains an understanding of overall health. Deviations in those trends over time indicate that action needs to be taken. The same concept can be applied to machinery health when looking at the three key areas of oil analysis: wear, contamination and chemistry. Using data in these three areas can lower overall maintenance costs, reduce unplanned downtime and increase asset life. Within a plant setting, oil analysis is often paired with several other technologies that encompass the Condition-based Maintenance (CBM) Program. The most common technology seen is vibration analysis. Typically, vibration analysis picks up on faults just a little bit later in the failure progression process than oil analysis, which is why they are typically paired together. Infrared thermography and motor circuit analysis are also used from time to time. Pairing technologies together gives confidence in the results and helps the engineer make critical decisions (if needed) to take a machine offline or remove it from service.

Figure 1 shows a typical machine failure curve. The diagram illustrates that oil analysis tests like viscosity, elemental count and particle count are useful parameters to trend even when equipment condition is considered satisfactory. Any issues detected would still be early enough in the failure process to perform the necessary maintenance far in advance

ONSITE OIL ANALYSIS DRIVES DOWN MAINTENANCE COSTS

Lisa A Williams, Ametek Spectro Scientific | **Rachel Li,** Ametek Spectro Scientific | **Dennis Uh,** Novaspect, Inc.

of an actual failure. This keeps the cost of repairs relatively low. As the machine failure progresses, abnormal wear can be detected and still addressed early in the process to keep costs under control. Typically, the cost of repair goes up, and production time is lost the later in the process that failure occurs.

Establishing Oil Analysis KPI

Strong reliability programs typically have Key Performance Indicators (KPIs) tied to company financial goals. KPIs are measurable values that demonstrate how effectively a company is achieving key business objectives. Understanding the company goals is typically going to come from the top down and likely will strictly be expressed in numbers. A manager may say maintenance costs are cut by 25% and end there. If cutting costs by 25% is the main goal of the year, it must be broken down into tangible goals that the maintenance department can achieve. Some tangible examples include increasing the production of machines by 25% and/or reducing oil consumption by 25%. However, these are still broad KPIs that need to be broken down even further to achieve the goal. The question then becomes, how do we reduce oil consumption by 25%? Extend oil changes? Sweeten oil when necessary instead of draining the entire reservoir?" Data helps drive these decisions.

Data is powerful, but it must be the correct data that aligns with the KPIs to achieve company goals. If trying to increase production on a particular machine by 25%, it is necessary to reduce the chances of unexpected downtime. Unexpected downtime can be related to several issues, some of which relate to either improper equipment installation or lubricant contamination issues. A great place to start is lubricant contamination issues and getting control of moisture and particle contamination. Typically, about 80% of machine failures can be traced back to particle contamination. By starting with filtration, the chances of increasing uptime are strong. Increasing bearing life can also be related to lubricant cleanliness. Reducing oil consumption can be related to contamination and preservation of the oil and additive chemistry. Extending oil changes will be related to preserving and maintaining the integrity of the oil chemistry and keeping the oil clean. For additional assistance in developing test slates and choosing the correct parameters, ASTM Standards and ICML guidelines are available; ASTM D6224, ASTM D4378 and ICML 55.1 Section 7 can be used.

Onsite Oil Analysis Solutions Support Reliability

Advances in software that integrate the expert knowledge of the onsite equipment specialist and lubricant analyst are available to help maintenance professionals justify oil analysis programs within their facilities and maximize equipment life. Understanding how to quickly and effectively implement Industry 4.0 techniques becomes increasingly important in an era when many maintenance programs are being downsized or absorbed by other areas of the company.

Effective oil analysis techniques that provide value to the facility require the incorporation of two main concepts: knowledge of the component behavior and an understanding of the lubricant data generated by the component. By pairing these two concepts, proper diagnostics and recommendations can be made that are practical and easily implemented by the maintenance staff.

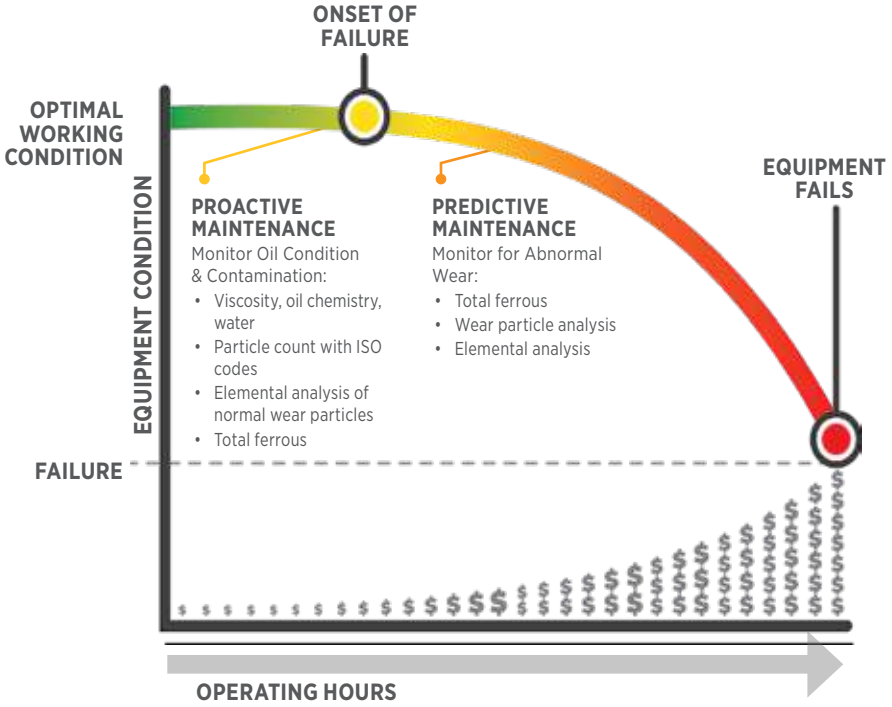

Figure 1: Machine Failure Curve showing the typical progression of problem to failure of the component.

Connecting Globally

Enterprise thinking is the practice of considering the entire organization in the decision-making process, not just an individual department or group. Enterprise thinking can make the organization leaner and more agile.

Enterprise solutions typically develop at the corporate reliability level with the intention of promoting efficiency, consistency and a more system-wide approach to the complex process of asset management. Networking of knowledge is an efficient way to share information over a certain platform at varying locations. This mentality works best when an organization already has a well-established site and can easily share that information with other locations or parts of the organization. Organizations that have standard equipment across multiple sites, have similar KPIs or use the same software are good candidates to deploy enterprise solutions.

Onsite Analysis Case Study: Food and Beverage Industry

In the Food and Beverage Industry, there are two processes where oil analysis can play an important role: the washdown process and the drying process. In food processing applications, proper cleaning and sanitation are key to producing a safe product. Cleaning and sanitation involve a washdown process. They usually have 16-18 hour shifts of running equipment, then shut down for 4-8 hours for the complete washdown and cleanout of the facility. During this process, water contamination is of primary concern. For the dry processes, like breakfast cereal, fine dust particles in the air can enter the oil. In this case, oil cleanliness is of primary concern.

In the Food and Beverage Industry, the real interests lie in increasing availability and avoiding shutdowns and unnecessary spending. Here is an example:

- A plant has 1000 assets.
- 10% are considered critical equipment (100 of them are critical).
- Overall equipment availability is 93%.
- Total downtime is 58,800 hours.
- Downtime Cost = $200/hour.
- Equates to about 11.8M annual downtime cost.
- Assuming implementing an onsite oil analysis program improves the availability by 0.1% (from 93% to 93.1%).
- Drive down the downtime by 840 hours (from 58,800hrs to 57,960hrs).
- Equals to $168,000 in annual downtime cost savings.

Conclusion

Maintenance cost savings and an increase in productivity continue to be driving forces for implementing condition monitoring programs. Lubricant analysis plays a critical role in a condition monitoring program and pairs well with other technologies such as infrared, ultrasound and motor circuit analysis. Being able to quickly and effectively implement the data is now a reality with advancements in onsite techniques. When adding onsite oil analysis to a facility, the management and proper distribution of the data to equipment owners becomes pivotal in justifying program costs and sustaining a reliability program. Software that captures expert knowledge of the machine behavior and lubricant are both critical in creating analysis reports that are helpful and easily implemented at the plant level. Once those initial rules, limits and observations are captured by the expert, enterprise tools and other features can be deployed company-wide to synchronize reliability programs within an organization. ***ML***

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Jim Fitch wrote a pretty comprehensive article recently, going into the finer minutia of what to do when you can't get the lubricants that you normally use. I wanted to take some time and give you a pretty good strategy to help mitigate some of the woes of having to swap suppliers to get the lubricants that your machines need for proper operation.

First off, don't be brand loyal. The lubricant manufacturers aren't paying your bills. They aren't loyal to you — they sell to your competitors. Unfortunately, you just aren't that special to them, so you don't owe them anything.

Formulations might be "unique" from brand to brand, but that doesn't mean that your current lubricant is the only one that can get the job done (and done well). Start looking at the technical specifications for these lubricants and the specific needs of the equipment versus looking for a specific brand of lubricant.

Technical Specs

One of the first things you are going to want to do is label your oils. Not the way that most folks do it, with the brand

name and whatever iteration of oil/grease it is, but with the technical specifications for the given lubricant.

Believe it or not, there are technical specifications for pretty much any lubricant out there, and even an ISO standard that defines the specifications based on usage. ISO 6743 (as well as ISO 11158:2009) has the areas broken down into 15 different buckets and then another 250+ specifications as to what type of base oil it is, types of additives, thickeners (for greases), etc. And since this is an ISO standard, it is recognized internationally; that means if I know the specifications for my

Image courtesy of aminternationaltnllc.com

lubricants, I can ensure they are meeting these standards regardless of who I am getting them from. The general populace may not know about this standard, and lubricant suppliers may feign ignorance, but rest assured, 99% of lubricant suppliers will know about this standard and which of their oils meet which specifications.

This standard can be a fantastic tool. You can contact your supplier and ask them about the lubricants you are currently using and where they fall within this ISO standard. Once you have this information for your current lubricants, you can start looking into other lubricants for when you are in a pinch or to see if there is a better deal out there somewhere.

For example, let's look at hydraulic fluids, which are absolutely everywhere. What we typically run into is an ISO 68 AW hydraulic fluid. Let's say that this is a hydraulic system for a 70-foot truck dumper in South Alabama.

The OEM gives specifications for the oil and lists the major brands and options. Well, it is safe to assume that the named lubricant meets the required specifications from the OEM. So why can't we look at those specs and reference this against all other oils out there that meet these specifications? This is exactly what we should be doing.

An OEM recommends specific lubricants not because they are fans of a specific lubricant manufacturer but because that lubricant has specific additives and performance characteristics that are best suited for their equipment. Now keep in mind that their specifications may or may not match your use of their equipment exactly (as far as the viscosity portion goes), but the performance of the overall formulation is what they are looking at. So why not use this formulation performance as our standard identifier for the lubricant?

Let's say that the OEM for a given truck dumper recommends Mobil DTE 10 Excel 46 for their system. It just so happens that Mobil has given us the specifications in their technical data sheet. Under these ISO standards, the Mobil product meets the requirements for both HM and HV classifications. So if I find myself in a pinch and can't get my hands on the Mobil product, I can look to other lubricants that meet the same standards. Like I said, these are globally recognized standards, and your suppliers know about these standards. Sometimes it is as easy as looking at the TDS, but other times you might have to reach out to your suppliers to get these identifiers. ***ML***

Here's what I would do:

1. Take an inventory of all the lubricants that are used in my facility.
2. Contact all suppliers and ask them what the ISO 6743 identifier is for your lubricants.
3. Make sure you know the viscosity of the fluids.
4. Come up with a color and shape (a large swath of people are color blind, so let's make things easier on them) system as your everyday label.
5. Use these ISO standards to create the "key" to your lubricants. This way, when a change is made to a product you are using, you don't have to change labels on anything, just the key.

About the Author

Jeremie Edwards is an Associate Technical Consultant at Noria Corporation. He is one of an elite few certified by the International Council for Machinery Lubrication (ICML) as a Machinery Lubrication Engineer (MLE) and did so in order to become the best advisor for clients when it comes to their continuing education needs. Before joining Noria, Jeremie served six years in the U.S. Army as a parachute rigger and was deployed in Afghanistan, Uzbekistan, Turkey and Germany. Contact Jeremie at jedwards@noria.com

Oil Cleanliness: On-line Condition Monitoring

Technology innovations and success stories

" During the past two decades, there have been different developments and improvements in the principles of oil cleanliness devices and sensors."

One of the main tools of operational reliability in the industry is the use of proactive and predictive maintenance, whose objectives are to detect and predict events in machinery and systems that may interfere with the production process and take actions to avoid them, for which they use different techniques and tools to develop their work. As plants and their assets are being digitized and moving towards Industry 4.0, new scenarios are emerging for technological advances in tribology and condition monitoring.

Lubricants and hydraulics are critical fluids for any type of machinery. Many diverse studies have demonstrated that fluid cleanliness is one of the most powerful strategies to eliminate root cause failures of critical assets such as power generation units, hydraulic systems, air compressors and gearboxes. On-line monitoring for critical fluids can be strategically deployed to provide early failure diagnosis, supporting accurate engineering decisions to improve reliability and cost savings.

On-line Oil Cleanliness Technology

Nowadays and worldwide, lubricant condition monitoring philosophy is beginning to be integrated into Industry 4.0 using different types of monitoring techniques such as bottle sample routine with laboratory analysis, on-site laboratory routines with automatic instruments, visual field inspections and real-time monitoring through on-line sensors. Unless companies have their own laboratories, a subcontracted laboratory must be hired, and the samples moved to their location. All types of samples, either of used or new oil, should be taken carefully in challenging environments, using the proper techniques and devices to get accurate and representative results. Laboratory analysis can take a couple of days to get results after the sample arrives, which means it takes considerably more time to know the fluid condition and take timely actions.

Emerging sensor technologies have evolved over traditional lubricant condition monitoring techniques in such a way that integrating laboratory analysis with data generated on-line will help lubrication engineers extend the life of machines.

A sensor can be defined as a device that transforms a mechanical, chemical, movement, pressure, temperature or other signal into an electrical signal to be detected by a control system. There are different types of sensors for each application; the important thing is their detection process by which they transform the signals. Among he most common, we find inductive, capacitive, optical and ultrasonic sensors.

Real-time sensing in critical machinery fluids brings the benefit of timely detection of a problem associated with lubrication, contamination or operational conditions. The timely detection allows for prompt actions, such as planned inspection, validation through other predictive techniques or starting a filtration or water removal process. What follows is a summary of current lubricant cleanliness monitoring technologies.

During the past two decades, there have been different developments and improvements in the principles of oil cleanliness devices and sensors. Portability, accuracy, interface experience and on-line capacities provide the lubricant teams with an easier-to-use and flexible tool. Automatic particle counters based on light extinction are still the most common method used by the industry for particle contamination analysis. (Fig 1) As a particle passes through a light beam, the light intensity received by a photo-detector is reduced in proportion to the size of the particle. Special care should be taken to mitigate inaccuracies due to air and water bubbles, which are very common in lubrication circuits of the machinery.

Mesh blockage devices are an effective alternative to light extinction, especially in conditions where the fluid is opaque or where free water or air bubbles are present. (Fig 2) Mesh blockage devices determine particulate contamination levels by passing a specified flow of sample fluid through a series of calibrated mesh screens in a specified sequence. Pressure drop build-up (or flow degradation) is dependent on particulate contamination levels. The mesh is cleaned by backflushing.

New technologies are emerging from the development of digital high-resolution image processing. (Fig 3) In this type of cutting-edge sensor, the particle passes between a light and a lens, and an integrated Complimentary Metal Oxide Semiconductor (CMOS) Sensor and processor acquires and automatically processes microscopic images of fluid contamination, detecting, quantifying and classifying the particles by size. Then, computing logarithms and artificial intelligence transform the images obtained into technical data.

It is possible to get the on-line cleanliness ISO4406 code with portable monitors or sensors connected to the machines. Depending on the type of application and the characteristics of the fluid, a particle monitor can be connected to a representative point of the system and display the data through a local screen, printer, USB memory or by extracting the data through a cable. In many cases, for critical machines, a sensor connected directly to a live turbulent pipe allows monitoring of the condition of contamination and wear downstream of the mechanical components, thus obtaining real-

On-line Oil Cleanliness Technologies (direct connection to system)

Method	On-line capacity	Affection by air and water bubbles	Affection by Dark colors	Particle Shape recognition	Portability	Principle
Optical Particle Count Monitor	☑	☒	☒	☒	☑	Laser / light extinction
Optical Particle Count Sensor	☑	☒	☒	☒	☒	Laser / light extinction
Mesh Blockage Cleanliness Monitor	☑	☑	☑	☒	☑	Mesh Blockage
Optical Particle Count Monitor DI Processing	☑	☑	☒	☑	☑	Image processing
Optical Particle Count Sensor DI Processing	☑	☑	☒	☑	☒	Image processing

☑ Effective ☒ Ineffective

Table 1. On-line Oil Cleanliness Technologies. RAMGUZ

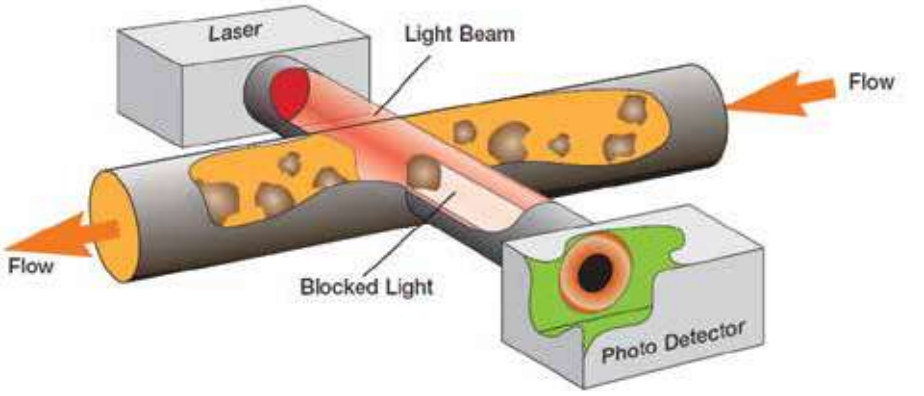


Figure 1. Light Extinction Principle. Pall Corporation

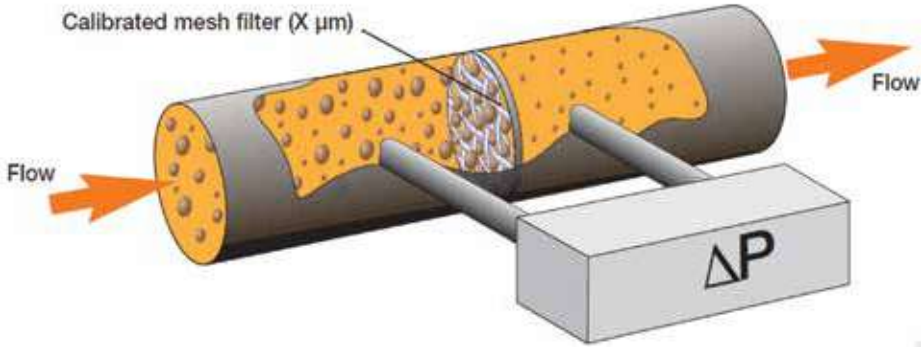


Figure 2. Mesh Blockage Principle. Pall Corporation

time readings on a computer or smart device.

The advances in air and water bubble detection should not be overlooked to avoid false readings, especially when there are low pressures, like in cases when sampling is needed in return point lines and external filter carts. Particularly interesting are the innovations to permanently quantify the lubricant color in such a way that changes can be contrasted and related with new oil color, and possible fluid degradation, varnish or cross-contamination can be detected. Furthermore, the possibility of measuring in real-time the size and quantity of particles, as well as the shape of each one, allows detecting trends to determine the root causes of wear present in the machine fluid.

The level of contamination with particles measured by on-line devices must allow the personnel to take fast actions regarding the lubrication program and contamination control strategies. It could be useful to coordinate the starting of kidney loop filters when the ISO4406 code is going above proactive limits until the cleanliness objective is achieved. The on-line monitoring of the differential pressure of the lubricant filters allows for the recording of the capture efficiency and contrast conditions of particle overloads to identify abnormal wear or contaminant ingress. Changing the filters by condition could also be done using these techniques.

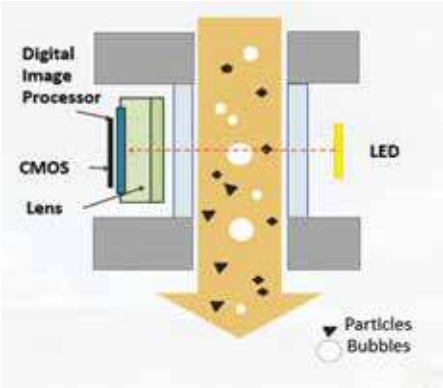
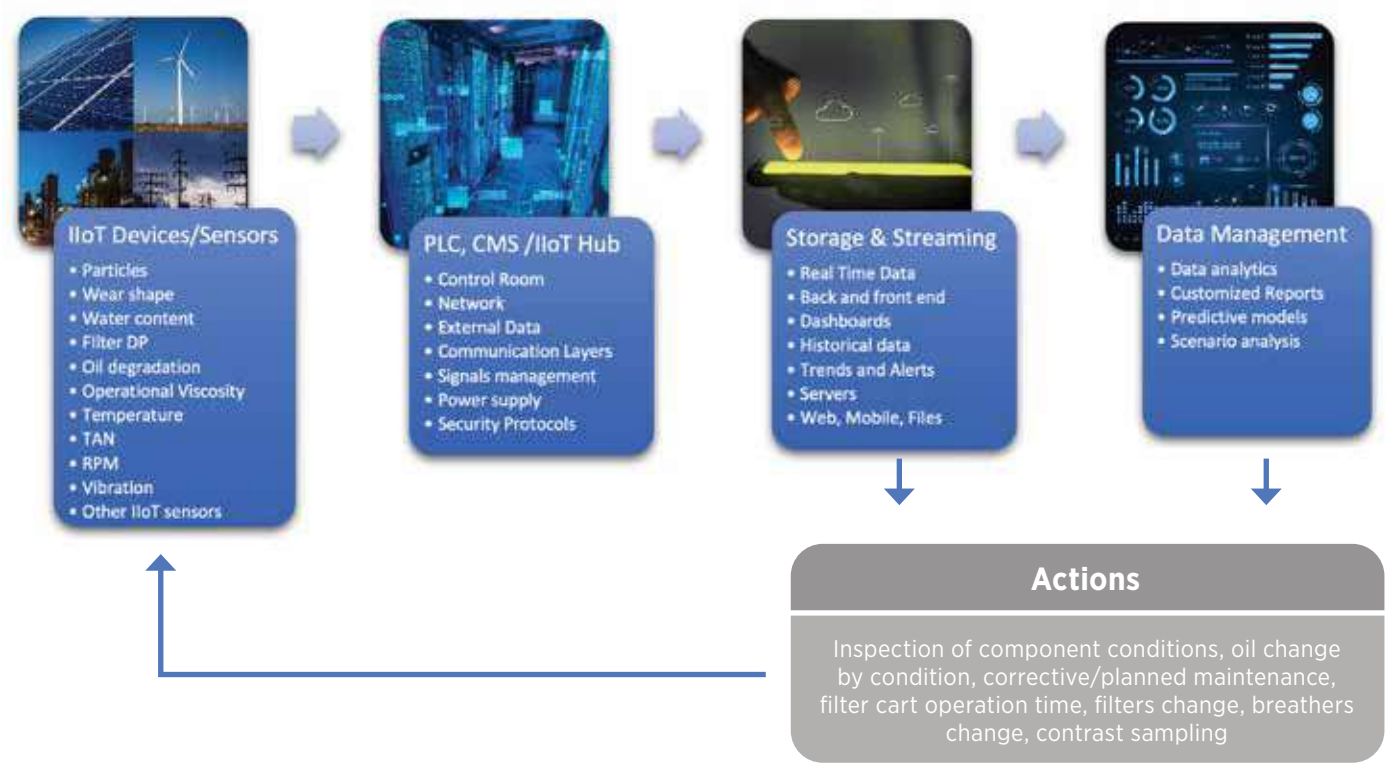


Figure 3. High-resolution image. Processing Principle.

In addition to particulate contamination, water contamination in lubricants can cause serious problems, reducing the health of the fluid and increasing the wear of the machine surfaces. Capacitive water sensors incorporate a probe that can be directly immersed in the fluid to monitor dissolved water content and temperature. The electrical resistance of the dielectric polymer changes as the relative humidity changes. Today it is also possible to measure the free and emulsified water content using Near-infrared (NIR) spectroscopy sensors. All states of water and different sizes and shapes of particle contamination in critical fluids can be monitored by attaching sensors to a strategic lubricant sampling point and integrating them into a complete architecture of an on-line monitoring solution.

Architecture of an On-line Fluid Cleanliness Installation

Real-time data from the sensors and monitors can be shared locally in the plant or company network through a PLC or SCADA control system or through an Industrial Internet of Things (IIoT) platform. The data collected should be properly stored and protected so as to know the current status of the fluid and to build new insights about fluid cleanliness and machinery health correlated with different operational information.



A typical installation includes at least four layers of connectivity and integration; firstly, a physical layer with different on-line IIoT devices and sensors measuring fluid contamination variables (particles, wear shape, water content, filter condition and oil degradation). At this point, it is also important to link operational variables such as temperature, RPM and pressure with fluid health variables such as viscosity and TAN. Predictive maintenance monitoring data like vibration can also be useful. One or more of these sensors should be properly selected for the operational and fluid conditions, building a pathway to avoid machinery failure root causes. The installation of the devices at representative sampling points is crucial to get the best possible value for the investment, ensuring autonomy, interoperability, security and simplicity.

A second layer, the network and communication layer, integrates all the logic controllers, gateways and supporting electronic and network devices. All these signals must be properly managed to form a comprehensive vision for the engineer or analyst in front of the data, ensuring coverage and security.

The third layer is formed by the data storage and streaming processes that could be transferred into the cloud or local servers. At this point, different IT activities are deployed to complete a condition monitoring system, such as back and front-end design, live data dashboards and valuable condition alerts and trends that help the end-users in the plant notice the condition of their critical assets' vital fluids.

There is a fourth, primal layer for industry 4.0 essence: managing data to get maximum value for sustainability. New efforts are directed towards the research and development of new predictive models in the lubrication of machinery and its relationship with the real-time cleanliness of fluids. The proposed architecture of an on-line cleanli ness monitoring solution is effective when it is redirected into proactive and predictive maintenance actions to ensure a cost-effective proposal.

On-line Fluid Cleanliness Cases Studies

Case Study 1: Fluid Cleanliness Optimization: An open-pit mining maintenance department installed a new filtration system in the hydraulic hoist and brake circuit of a 240-ton haul truck to validate the effectiveness of a high-efficiency in-line filter. An on-line particle sensor was connected upstream of the new auxiliary filter to measure the progress of the ISO4406 cleanliness level in real-time.

On-line particle monitoring showed the complete process while the filtration update was taking place, from the start of the truck, followed by the initial flushing and calibration on the sensor, then the permanent filtration process until the truck stopped. End-user maintenance costs were also reduced, not only by the cost of hydraulic components but also by the use of in-line, onboard filtration, which avoids the need for servicing kidney loop filtration in the shops.

Case Study 2: Early Failure Detection: A wind power generator utilized an on-line particle sensor to monitor the cleanliness level of the gearbox lubricant. This sensor was useful to help monitor both the oil and filter conditions since the mechanical components were not easily accessible.

The real-time ISO code started to rise continuously, so the customer decided to stop for a detailed inspection (correlated to hours of operation). Thanks to the early failure detection of a gearbox, the customer did a minor repair with a cost of $17,500 instead of a fatal failure (which would've cost $522,000).

Opportunities and Recommendations

The real-time reporting sensors have the utility of detecting contaminants in fluids quickly and creating an early alert to the maintenance department about performance, warnings or abnormal conditions, which can be of great value for high-cost equipment or performance evaluation processes.

The on-line monitoring of the hydraulic and lubricating system cleanliness in real-time allows for a practical observation of the ISO4406 levels of the oil. This ensures that the sample results are representative of the oil's condition, increases the speed at which crews can respond to emerging problems and reduces the possibility that samples will be drawn from off-line, non-representative locations due to machine accessibility.

The utility of the cleanliness sensors and devices for data correlation can be achieved by initially identifying the failure modes and then evaluating how, with the sensor location, the data can collaborate to solve the problem. For example, if it is required to observe the condition of a critical component such as a piston pump, it is recommended to install the sensor downstream of the component so that the response is short and effective.

A robust architecture, including electronic and IIoT communications equipment, is required to guarantee its performance and service life. It is recommended to use an IoT system that at least has capabilities such as a backup battery, IP65 protection, data logger, digital outputs and CAN bus outputs and that meets SAE J1455 vibration guidelines (Sec 4.9.4.2 fig 6-8), MIL-STD-810G and shock MIL-STD-810G (Sec 516.6).

There are many opportunities regarding the analytical management of the data captured for all kinds of on-line sensors in critical machinery fluids, which opens up an interesting study space for the future. ***ML***

How to Conduct Machine Inspections and Put Inspection Data to Use

In today's world, making data-driven decisions lies at the foundation of a top-tier maintenance program. A good chunk of this data is collected through machine inspection, whether it's checking oil level in a sight glass or performing a more advanced inspection like measuring bearing friction with ultrasonic tools. When gat hered correctly and consistently, the data from machine inspections can be a powerful tool to unlock higher profit margins, less downtime and longer machine life.

Why Prioritize Machine Inspections?

It may seem tedious to record and analyze data from every individual inspection, but doing so pays off tenfold. Regular machine inspections allow you to improve your understanding of each individual asset, gaining in-depth knowledge of the unique components of a machine. Aside from gathering more data to plan maintenance and repairs, this strategy can help you use your intuition to service machines. For example, if you know a specific asset is dangerously low on grease every time you perform an inspection, you'll know to increase the grease interval and inspect it more frequently.

Who Should Perform Machine Inspections?

Recognizing the signs or symptoms of machine failure is a required skill for those who work with machines and are responsible for their maintenance and care. Inspections should be conducted by trained operators, technicians, mill wrights or others who have frequent access to machines; however, they are often performed without the required skills, motivation and frequency. Checklists are helpful when completing these tasks - these can be posted on or near the machine itself, but the ideal location is within your lubrication routing software. The range of inspections will vary considerably depending on the machine type and how it has been accessorized for inspection activities.

Getting Started with Regular Machine Inspections

An inspector who is eager to determine the state of machine health - good or bad needs to ensure machine readiness before getting started with regular inspections. Start by compiling a list of machine faults and root causes you want your inspection program to reveal. This is generally a list of all the things that could go wrong that you definitely don't want to go wrong without

early warning. If you're currently running a maintenance program without formal procedures for machine inspections, remember it's okay to start small with a few routine inspections and build over time. Let's look at what goes into a simple oil level inspection and how you can use the collected data to determine machine healt hand create an action plan.

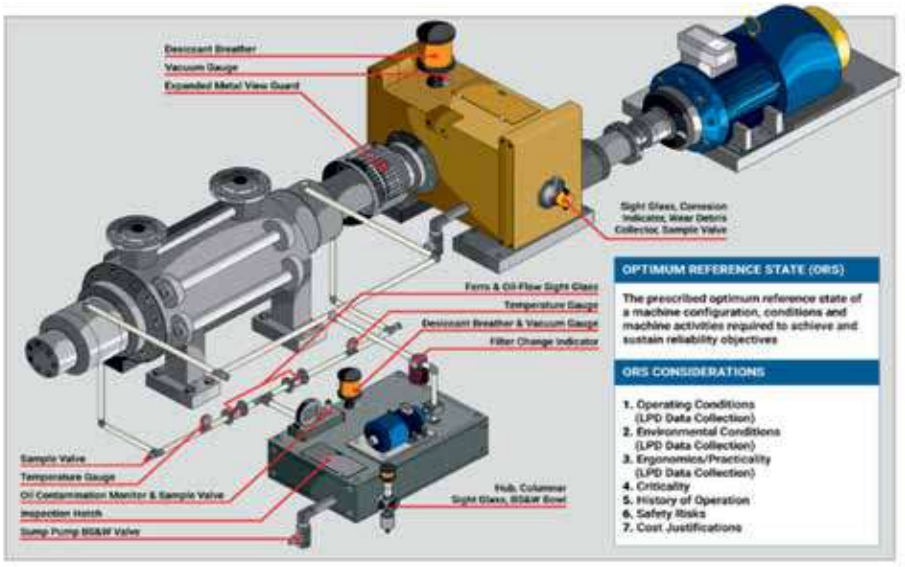
Oil Level Indicator Inspection

A sudden change in oil level, either up or down, or the presence of water or sediment in oil is a telegraphed alert that something is wrong. This "something"could potentially be serious. Deferring maintenance or ignoring this alert could lead to a costly repair and longer downtime in the future. The frequent examination of quality oil level sight glasses by trained inspectors is a sound condition monitoring practice, perhaps the most important of all lubrication related inspections.

How to Perform

Use level gauges, sight glasses, dipsticks or inspection ports/hatches to determine the oil level. Additionally, a bottom, sediment and water (BS&W) bowl can be used to view sediment, water, foam and wear debris, making it the ideal tool for an oil condition inspection. A slight drift in oil level (up or down) can be acritical alarm. In some rare cases, it would be beneficial for an oil sight glass to be placed on both sides of a centrifugal pump. If the pump is not centered in the casing, the oil level will not read correctly in the sight glass due to oil movement by the bearing. However, if you have two level gauges, an average of the two readings will give a better estimated oil level.

When you perform an inspection, it's important to not just look at a bearing, seal, coupling or pump. Instead, examine these components with a keen and probing eye.



Machine hardware used for inspection and sampling.

Seek to extract information and translate machine "language" into prescribed activities and instructions that stabilize reliability. This technique, known as Inspection 2.0, ensures no machine inspection is a waste of time.

What to Look For

Whether oil goes up or down, any sudden change in the oil level requires troubleshooting in search of the cause and corrective action. Just adding more oil or removing excessive oil is an activity of treating the symptom, not the cause. It's true that some oil level changes are rather common and quickly understood. For instance, if oil goes sharply down, you might have a conspicuous leak (internal or external) that can be easily found and corrected. Inversely, a rising oil level may be due to the introduction of new fluids. For example, perhaps someone added too much oil, or another fluid like a coolant or fuel has entered the system, raising the oil level.

Causes of High Oil Level

When oil levels rise above the acceptable range, usually something new hasbeen added, i.e., a new fluid, but there are other possible causes.

- **Too much makeup fluid** - Adding makeup fluid without carefully watching sight glasses can cause over-lubrication.
- **Oil drain back -** If the fluid is topped off while the machine is running, theoil level can climb; when it stops, oil drains back from gears, bearings, oil galleries and distant zones or oil ways.
- **Aeration and foam -** Such conditions can double or triple the apparent oil-level.
- **Internal leakage -** Various sources of internal leakage can cause other near by fluids to invade the sump. These include coolant, washdown fluids, fuel, heat transfer fluid, hydraulic fluid, grease and process fluids. Oil analysis can identify these

Causes of Low Oil Level

This is usually caused by leakage, but there are other reasons.

- **Out-leakage -** This is an alert to examine the machine for any visual sign of oil leakage to external surfaces (oil exiting the machine).
- **Internal leakage** - If no out-leakage is

observed, are there other internal path ways and compartments where the oil might have gone? Look for rising fluid levels in these zones and compartments.

- **Gear climbing -** Oil lifters, including paddle gears, slingers/flingers and the rotation of moving parts (gearing in particular), all draw oil out of sumps and reservoirs and lower the apparent oil level during machine operation.

- **Oil pump out -** After startup, oil reservoirs can go down as the pump fills system lines and cavities such as gear cases, bearings, oil galleries and distant oil ways.

- **Bleed purge -** Hydraulic and circulating systems often have bleed valves that, when opened, allow trapped pockets of air to purge and become replaced by oil. This draws the oil level down in the reservoir.

- **Aeration and foam -** Foam lowers the liquid portion of level gauges, sometimes substantially. When the foam collapses (e.g., when the machine is at rest), the correct level should return unless foam was pushed out of vents and other headspace openings.

- **Excessive misting and volatilization -** This is a form of out-leakage from various causes, such as the wrong oil (e.g., wrong viscosity), high temperature, excessive agitation, headspace vacuum, atomization/sprays or aeration.

Documenting Data

Depending on the work experience of the lube staff and the available time intended for the lubricating tasks, the lubrication operator should provide the following information about the machine condition:

- Visual analysis of the lube oil condition (in this case, the oil level and signs of contamination)

Documenting data in the LubePM app

- Lube oil system condition (oil leaks, tank cleanliness and superficial condition, oil filters, oil drains, etc.)
- Mechanical condition of the machine (vibration, noise, bearing temperature,etc.)

- Miscellaneous (information on new machinery installed at the plant, reportsof other problems in the plant that affect the lubricated machines, etc.)

This data should be added to the system database as soon as possible to help promptly solve any prlems detected within the machines. The faster the information is added to the system, the faster the plant's reliability engineer can analyze the mchine condition with more avanced predictive technologies.

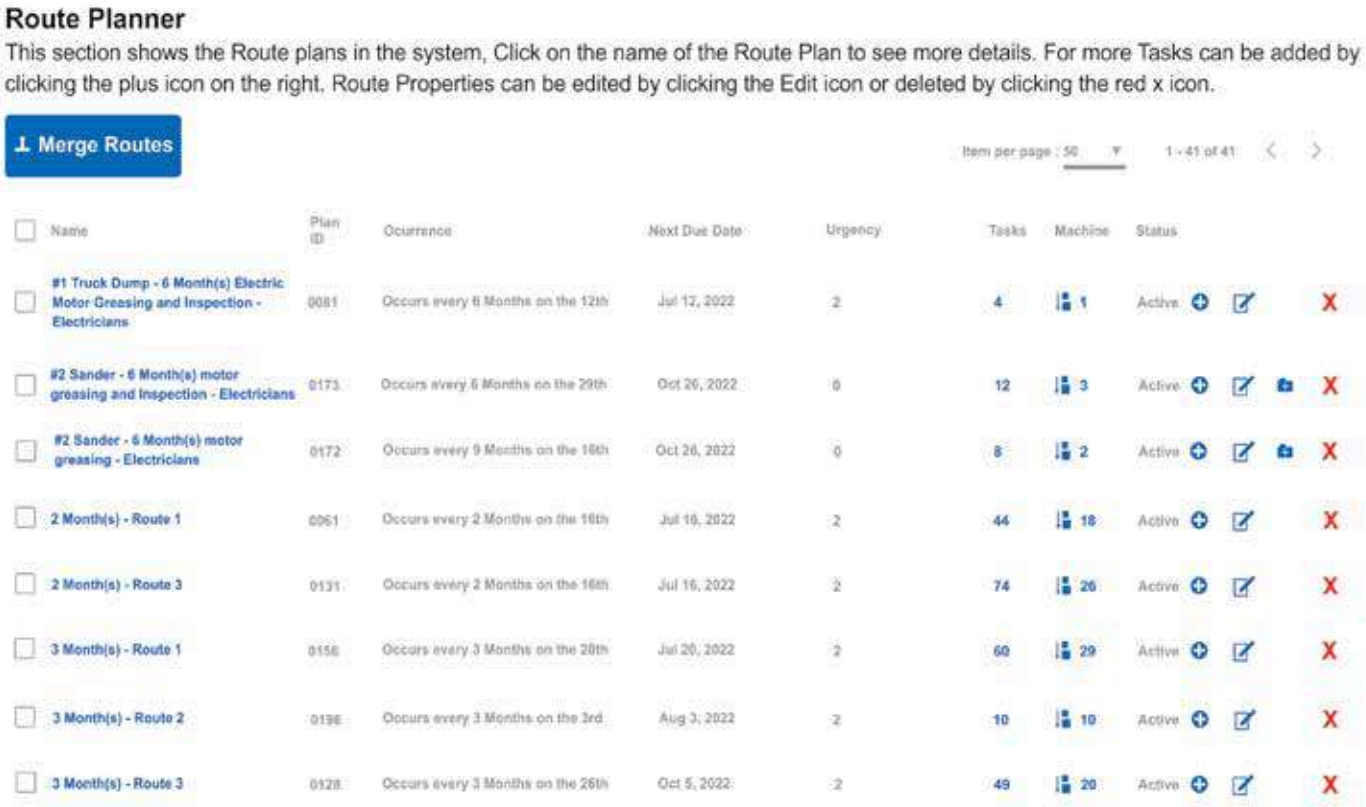
Using Data to Make Decisions

When it comes to performing machine inspections correctly, having an organized platform to record and analyze data is key. This is where a lubrication program management platform comes into play. This allows the user to document detailed inspection data for each asset and view trends that reflect machine health over time.

With the right lubrication routing software, you can automatically include every lube point that has been found to be in poor condition in the next planned route. With this automatic process, the lube points that are deficient are revised more frequently until the correcting actions have the desired effect. An alarm system for the machine's lube condition can also be implemented based on the information collected from the lubrication routes.

From this starting point, there are multiple strategies that can be implemented to optimize the lube-route schedule based on the machine condition and how often anomalies are detected. If an integrated system is employed, other information about the machine status can be used to improve the schedule and more frequently inspect the machines that are in poor condition.

The lubrication frequency of points in poor



LubePM's routing software designs lubrication routes based on inspection data.

condition that need to be inspected again will correspond to the maximum number of lube points included in the same processing unit of the plant. For example, let's say the available lubrication frequencies in one unit will be a multiple of a fixed number of days (15, 30, 45,60 days, etc.). This method allows the mechanical workshop to manage only the planned work orders. The difference is that the number of lube points will beslightly increased depending on the machine's oil status.

There are other improvements that can be implemented when tailoring lubrication routes and PMs based on the information collected from field personnel, including:

- The status of the lube point inspected in the last route can be included in the guideline table for the next route. This allows personnel to pay more attention to the most critical points.
- Any valuable information or pending work orders on the machine can beincluded in the guideline table and taken into account by the lube operator.
-
- Any automatic alarm or advice intended for taking further action, like oilanalysis, vibration measurements, etc., will improve the performance of thesystem.
- Other information based on the machine type and the organization of the reliability and maintenance departments can be utilized.

Bottom Line

Machine inspections are a fundamental part of a well-rounded maintenance program. However, they only prove to be effective when the data is recorded and analyzed correctly. If you're building or revamping your inspection program, having a lubrication program manager with routing capabilities can be a catalyst in getting desired results. This software creates an organized space for data input and assists with the analysis of the data over time, allowing you to service your machines efficiently and optimally.

About Author

Travis Richardson is aTechnical Consultant for Noria Corporation. He holds a Level II Machine Lubrication Technician (MLT) certification and a Level II Machine Lubricant Analyst (MLA) certification through the International Council for Machinery Lubrication (ICML). He is the Product Owner of LubePM, Noria's digital lubrication program manager.

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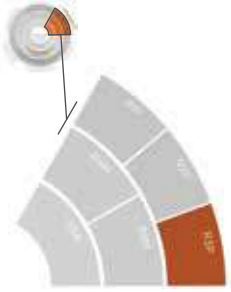
Lubrication Safety Practices:

DOs AND DON'Ts

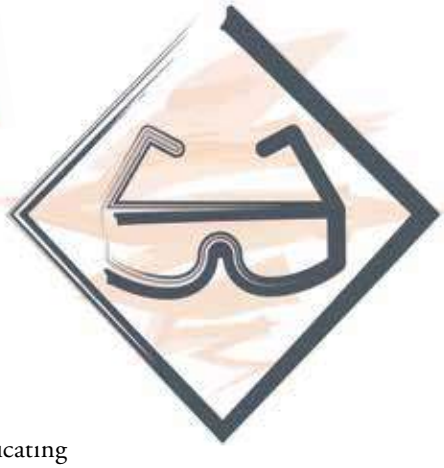
More about this **ASCEND™ Factor**



Factor:
R3P — Lubrication Safety Practices
Level:
Platform(P)
Stage:
Lubricant Reception And Storage
About:
Lubrication safety practices should include clearly marked aisles where lubricants are stored, evacuation routes, fire equipment locations, smoke detectors installation, available personal protective equipment, and mandatory materials safety data sheets (MSDS) readings before employees handle and transport lubricants.

Learn More:
noria.com/ascend/

DOs



- Do be aware of your surroundings at all times. Situational awareness as an industrial worker is paramount.
- Do perform proper Lock-Out/Tag-Out procedures when applicable.
- Do wear appropriate fall protection when relubricating overhung or hard-to-access machinery.
- Do use proper protective equipment when handling any lubricant or other hazardous materials such as mineral spirits, degreasers, aerosols, penetrating lubricants, etc.
- Do utilize the two-person lift method when moving large volumes of oil (generally in drums). Proper lifting techniques are a must. Bend at the knees, not at your hips; keep your back straight; drive your heels into the ground and keep your chin up. Utilize a hoist or mechanical advantage whenever possible.
- Do wear sturdy, non-skid footwear — steel-toed or safety-toed if applicable to the facility. Slips, trips and falls are the most common workplace injuries. When working with lubricants, the risk of slipping, sliding, tripping or falling is heightened.
- Do be aware of the nearest eye wash station or safety shower when handling lubricants or other hazardous materials.
- Do be aware of the nearest fire suppression equipment when handling lubricants or other hazardous materials — fire extinguishers, fire alarms, AFFF hoses, etc.

DON'Ts

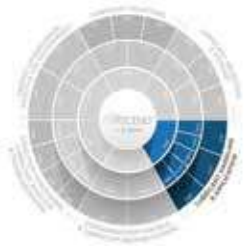
- Don't goof around or conduct horseplay within the lube room.
- Don't wear open-toed shoes.
- Don't leave ANY lubricant container open to the environment.
- Don't store used or waste oil in the lube room.
- Don't eat in or around the lube room.
- Don't perform non-lubricant-related activities within the lube room.
- Don't store gasoline, diesel, kerosene or other flammable substances in the lube room.
- Don't hold the grease gun coupling as you grease a component.
- Don't reach into or past any machine guards.
- Don't lubricate energized equipment unless the proper safety measures are in place to prevent injury, harm or death.
- Don't drain the oil in a rotating gear box.
- Don't smoke or have an open flame or spark nearby when relubricating.
- Don't perform any lubrication or maintenance-related task on a machine unless the proper Job Safety Analysis (JSA) has been filled out.
- Don't allow untrained personnel to perform lubrication tasks. Call Noria to get them the proper training.

Stay Safe

You may have heard a lot of these before, but they still ring true whether you're the oiler, the maintenance tech or just a helper. Safety should be a priority to each individual, not just each facility. I personally follow safety guidelines so that I stay healthy and fit to go do the things I love to do outside of work. I would hate to get hurt on the job and not be able to work or be there for my family if needed. So remember, when you are sitting in a long safety brief, that safety starts with you, and it is for you.

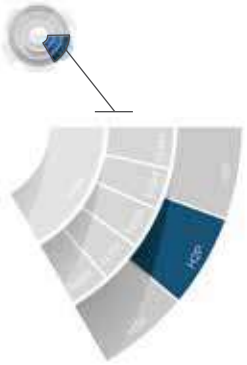
About the Author

Paul Farless is an Associate Technical Consultant for Noria Corporation. His duties include collecting data and preparing reports for the engineering team. Prior to joining Noria, Paul worked as an automotive maintenance technician for an auto-repair service company. He also served four years in the U.S. Navy as a gunner's mate third-class petty officer and as a seaman deckhand, where he was responsible for the troubleshooting and maintenance of electromechanical and hydraulic systems. A detail-oriented team player, Paul works well in fast-paced environments and uses his military background to excel and maximize efficiency.



Don't Waste your Time Tracking These KPIs

More about this **ASCEND™ Factor**



Factor:
H2P – Handling and Application Devices

Level:
Platform (P)

Stage:
Lubricant Handling & Application

About:
Often overlooked, proper machinery configuration ensures that machines designed for generic applications match specific operational contexts.

Learn More:
noria.com/ascend/

Deciding which Key Performance Indicators (KPIs) to track can be a difficult task. A KPI needs to be purposeful; it needs to indicate the causality between action and reward; it needs to be able to alert us to any concerns. Effective KPIs show what changes are taking place (altered processes, implementing new technology, etc.) and how those changes are impacting key business objectives (reduced equipment failure, improved manpower efficiencies, etc.). KPIs also reveal the extent to which current legacy activities continue to provide sustained benefits, revealing if the margins are closing in. After all, if we aren't improving, we're falling behind.

Lubrication has a critical impact on equipment reliability and, as such, has associated reliability objectives and goals — our daily actions have everything to do with reaching these objectives and goals. To define these goals, we often apply the tenants of SMART Goals

SMART Goals:

- Specific
- Measurable
- Achievable
- Relevant
- Time-bound

Once these goals are set, KPIs can be used to measure the progress on these goals over time — or at least they should. For KPIs to have any value at all, they must have a clear association with actions that are specific, achievable and relevant. If you don't know what is influencing a change in a KPI, you may be wasting your time by measuring it. The following infographic describes a few KPIs associated with lubrication tasks and the factors that make them effective.

About the Author

Bennett Fitch is the Chief Strategy Officer for Noria Corporation. He is a mechanical engineer who holds a Machinery Lubrication Engineer (MLE) certification, a Machine Lubricant Analyst (MLA) Level III certification and a Machine Lubrication Technician (MLT) Level II certification through the International Council for Machinery Lubrication (ICML). Contact Bennett at bfitch@noria.com.

DON'T MEASURE... UNLESS.

1. Don't measure lubrication inspection effectiveness unless

- The correct inspection tools are used
- Machines are modified for quality inspection
- Machinery lubrication training has been provided
- A method more thorough than pass/fail identification is in place for tracking abnormal conditions

2. Don't measure lubrication route effectiveness unless

- Routes have documented procedures
- Those performing the routes are trained in best practices
- Route tasks are organized and optimized (such as by type, frequency, required skills, type of lubricant, operating condition (ON/OFF), geographic location, etc.)
- Task times are measured
- Appropriate tools are identified and available
- Efficiencies (for scheduling, sequencing, etc.) are considered

3. Don't measure the unavailability of machines or production loss hours related to lubrication tasks unless

- Root Cause Analysis and FMEA are being performed
- Proactive and predictive maintenance are emphasized
- The "rights of lubrication" have been established for each measured component

4. Don't measure the compliance of plans for training and certification of your lubrication technicians unless

- Lube techs are given the resources to prepare (training courses, books or other reference materials)
- Lube techs are given time to prepare (while training usually requires at least a three-day course before certifying, it's important they are not distracted by emails or other work obligations during this time)
- Lube techs understand what's in it for them (often, there may be a pay incentive for becoming certified or successfully implementing changes to improve lubrication)

5. Don't measure total lubricant consumption unless

- The volume of oil lost related to leaks is estimated
- The volume of oil used related to oil drains and oil flushes is measured
- Oil analysis is being used to identify condition-based oil changes
- Grease relubrication is based on proper calculations or feedback tools to identify regrease volume and intervals

6. Don't measure the overall lubrication program effectiveness unless

- All six lubricant lifecycle stages (see Ascend Chart) are being taken into consideration
- A lubrication champion is identified and provided with resources and support and is empowered to make changes
- A training plan is in place to generate awareness of lubrication initiatives across the organization to minimize pushback, as many will resist change

Factor: C1P

Little Known Sources of **Contamination Ingression**

More about this **ASCEND™ Factor**

Factor:
C1P - Contaminant Exclusion

Level:
Platform (P)

Stage:
Contamination Control & Lubricant Reconditioning

About:
Contaminant Exclusion: Developing a contamination exclusion strategy can protect against machine failure and increase the life of both lubrication and machinery.

Learn More:
noria.com/ascend/

You are probably familiar with a lot of the different ways contaminants can find their way into your machinery. For example, one of the most common ways that contaminants enter your lubricant is through poor headspace management. Having an open vent or a factory vent plug on the machine doesn't really do much for contaminant prevention. Yes, those vent plugs allow the machinery to "breathe," but who knows what type of harmful particles that machine is actually sucking in. Those vent plugs and J tubes might as well just be a wide-open port. Another common ingression point that we are all

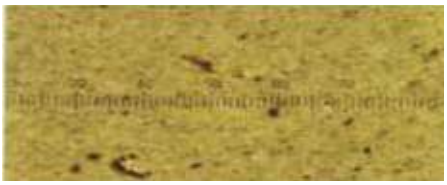
aware of is water. Water contamination can happen through poor headspace management, blown seals, improper seals or by utilizing a lubricant that isn't compatible

with the seal. Water ingression can come from condensation, rain or even the industrial process that the machine is involved in; these are issues we know about. What I want to focus on, though, is uncommon ingression sources. What sources allow contaminants that we don't think about or aren't so obvious?

New Oil

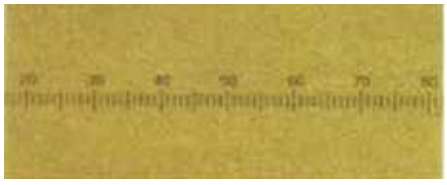
It starts with the reception of new lubricants. Each facility should implement and utilize a quality assurance/quality control procedure for receiving new lubricants. Is it the correct oil? Cross-contamination is still contamination; for example, if you mix two gear oils that are going into a worm gearbox, but one has EP additives, well, you can say bye-bye to the yellow metals in that gearbox.

The next question you need to ask is, "How dirty or contaminated



System with Typical Hydraulic Filtration 20/18/16

New Oil from Barrel 22/20/18



System with β3 >200 Filtration 14/13/11

New System with Built-in Contaminants 23/22/20

is the new oil coming in?" If you have ever taken Noria's Machinery Lubrication Level I training, you should know that new oil is NOT clean oil. We pound this into your head during training. So, as far as uncommon contaminant ingression sources, new oil is one that is often overlooked. It should become standard practice to sample new oil coming in and to clean it before putting that lubricant into service. I always advise "filter in and filter out," meaning to filter new oil coming into your storage tank and filter that same oil as it comes out of the storage tank and into a container to fill a machine. If it is going straight from the oil drum to the machine, then make sure to utilize a filter cart to clean that oil before it enters the machine, which brings me to my next uncommon ingression source: improper lubricant handling practices.

Lubrication Handling Practices

As a traveling consultant, I visit just about every type of manufacturing industry across the board, from food to fuel, roofing to flooring and everything in between. If I had to make a blanket statement about something every plant could do to improve its contamination prevention practices, my advice would be to improve your handling practices. The most common factor we see that leads to contaminant ingression is mishandling lubricants as they are being put into service. By this, I mean utilizing reusable funnels, dirty top-up containers, dirty fill nozzles in bulk storage, dirty lube rooms, galvanized top-up containers, non-dedicated equipment and having no dryness or cleanliness targets (this list doesn't end here, I could quite literally go on all day long). Utilize the ISO 4406 Standard and set some cleanliness targets for each lubricant, especially the oils that go

into critical equipment. My point is, from the time your facility receives that new lubricant until that lubricant gets put into service, the process of handling that lubricant should be as squeaky clean as you can possibly make it. I mean, truly take ownership of your lubricants for maximum machinery reliability and machine life extension. Be a stickler about the process so that, come game day, your lubricant performs as optimally as possible. ***ML***

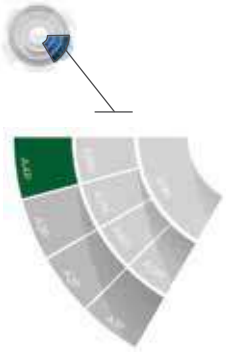
About the Author

Paul Farless is an industrial service technician for Noria Corporation. He holds a Machine Lubricant Analyst (MLA) Level II certification through the International Council for Machinery Lubrication (ICML). His duties include collecting data and preparing reports for the engineering team. Prior to joining Noria, Paul worked as an automotive maintenance technician for an auto-repair service company. He also served four years in the U.S. Navy as a gunner's mate third-class petty officer where he was responsible for the troubleshooting and maintenance of electromechanical and hydraulic systems. A detail-oriented team player, Paul works well in fast-paced environments and uses his military background to excel and maximize efficiency. Contact Paul at pfarless@noria.com.

Factor: A4P

Onsite Labs vs. Offsite Labs:
Which is Best for My Lube Program?

More about this **ASCEND™ Factor**



Factor:
A4P — Sampling Tools & Methods

Level:
Platform (P)

Stage:
Sampling Tools & Methods

About:
Accurate sampling is critical when developing a lubrication analysis program. Inaccurate samples can lead to incorrect decisions regarding machine performance.

Learn More:
noria.com/ascend/

With facilities running on leaner staff, increased run times and the expectation of fewer failures, quality data from lubricant analysis has only grown in importance. By looking at the data contained within an oil or a grease sample, we can determine if the lubricant and the machine are still healthy and ultimately make maintenance decisions that impact one or both. With many organizations pushing for data-driven decisions based upon machine condition (rather than a static time interval), lubricant analysis is being relied upon more heavily. We are in an age where we are used to finding, in near real-time, the information we use to make choices on everything from what product we buy off the internet to where we are going to eat. This has also made its way into maintenance, and now more professionals are looking with renewed interest at a question that has existed for some time: should we perform our lubricant analysis in-house or rely on a commercial laboratory?

For more mature programs, there is often a desire to bring the majority of the testing in-house or to have the ability to do some analysis to determine if there could be problems with equipment or lubricants. While this can be incredibly beneficial, there are downsides as well.

As is the case for most improvement

projects, there would need to be a cost-benefit analysis or, even more simply, a pros and cons list. If we were to provide that for most facilities, it might look something like the following (far from exhaustive, but a good starting ground to understand the impacts).

BENEFITS OF ONSITE ANALYSIS

Turnaround time — Perhaps the most significant tangible benefit to performing the testing under your own roof is the ability to sample and analyze much quicker than what is traditionally possible when using a commercial laboratory. A scenario such as someone hearing a strange noise or noticing an increase in temperature could trigger an immediate response; we could receive useful data in a matter of hours to make corrections and stave off failure or downtime.

Data availability — When the analysis is performed in-house, it is easier to create your own data repository or data archive. This could include any known faults and the corresponding analysis that confirmed them. Take this a step further and include the corrective action taken and the results of that action, and you are now building out a decision matrix for your equipment based on your own onsite analysis. This could be a powerful tool, especially in the age of staff turnover and retirees taking decades of experience with them when they leave.

Customized testing — If you were to build your own testing program, you could piece together the exact tests and instruments that give you the most useful data based on your application and environment. You wouldn't be constrained by the ability of the commercial labs or their testing equipment. Some people have even modified test standards to better meet their needs, further streamlining the analysis process.

Centralized testing capabilities — For some facilities, there could be a geographical advantage to onsite testing, especially if there are multiple facilities in close proximity. One of the facilities can act as the hub or the lab, with the other facilities sending their samples for analysis. I've seen this done very successfully in a plant not far from our office. This helps dilute the cost of the equipment and the ongoing cost of upkeep.

Program ownership — Once you take control of your testing and results, you truly are the owner of your analysis program. This can help convey a sense of pride throughout the team and serve as a critical piece of your lubrication program. Oftentimes, people see the creation of an onsite lab as an opportunity for advancement from lube tech to lab tech and as a visual reminder of the importance of lubrication overall.

DRAWBACKS OF ONSITE ANALYSIS

Cost — Naturally, the most common roadblock is the cost of starting an in-house lab. While most people would focus on the cost of the actual equipment, there are other expenses that would need to be justified as well. Depending on the number of samples per day, week or month, there could be someone dedicated to operating the lab, interpreting results and setting corrective actions. This person would not only have to be trained in the equipment but also in oil analysis, so not only is there a personnel cost, but a training cost to coincide with that. For many of the oil analysis tests, reagents, solvents and general consumables such as oil-absorbent materials will be required.

Lab space — The lubricant analysis lab should have a mostly dedicated space in a climate-controlled area in the plant. Special consideration needs to be given to cleanliness, ease of mobility within the space, and access to a computer station to record the results. Space like this can be at a premium at most industrial facilities, and sometimes this will need to be constructed, or a plug-and-play solution for officing may have to be used.

Blind spots — As most onsite labs can't produce the full scale of what a commercial lab can, there can be blind spots in the data that might not point out an impending problem. Testing needs to be stacked in such a manner that the strength of one test can provide insight for another test that might have weaknesses in that area. Too often, people rely on a single test to tell them everything about the fluid and the machine; this just isn't effective.

The same conversation can be had about using a commercial laboratory for all analyses. While it does address some of the issues that arise with onsite testing, it is not without its own drawbacks. Third-party testing is a key piece to nearly everyone's lubricant analysis program, but it is important not to just stumble in blindly to anyone that is capable of testing lubricants. You need to carefully consider if an outside lab is right for your program.

BENEFITS OF OFFSITE ANALYSIS

Data quality and integrity — Most commercial laboratories are certified ISO facilities and have rigorous checks and calibration standards to ensure the data they produce is as accurate and precise as possible. They follow ASTM procedures or may have developed some methods to enable better testing than what many onsite lab technicians might be able to do. Unfortunately, we have seen people with onsite lab equipment neglect the maintenance and calibration of their equipment, which can severely impact the data that they produce.

Specialized testing — Whether due to cost, complexity or need, onsite labs are not usually equipped to do some testing that may be required to truly understand the lubricant's or machine's health. Some of these tests include analytical ferrography, RPVOT/RULER testing and elemental analysis. Of course, all of these tests can be run onsite but are commonly not. This results in missing the whole picture of what may be happening within the machine.

Price advantaged — Similar to buying in bulk to save money on a unit price, if you can commit to a volume of samples per year, the expense of a single sample can be relatively low. This is even more true if a company forms a sole-sourcing agreement with a lab for services rendered for their entire fleet of facilities. Sometimes lubricant suppliers will also help offset the cost of analysis. Anytime the cost of analysis is being analyzed, you must also ensure that the test slate isn't compromised to reduce lab costs.

Big data — Perhaps the buzziest of buzzwords in recent years is "big data," but it does have a place in our analysis program. When you submit your sample to a commercial lab, you are benefitting from the lab's experience with similar equipment or, better yet, from their data stores of similar equipment operating in similar environments. There is power in an extensive data set of equipment test results that can help more accurately predict normal versus abnormal wear or even provide better insight into maintenance strategies to aid in extending the equipment's life.

DRAWBACKS TO OFFSITE ANALYSIS

Timeliness — When utilizing an offsite lab, you must accept the slower turnaround time associated with shipping and subsequent testing. While this can be mitigated with expedited shipping, there is added cost to this. Some believe that the oil sample degrades the longer it stays in the bottle, but the bigger issue is that the oil in the bottle becomes less representative of what is inside the equipment. The conditions inside the machine are constantly changing, so it is imperative to analyze the lubricant as quickly as possible to understand what those conditions are.

Garbage data — While this can hold true for both onsite and offsite analysis, it is more commonly seen when relying on an outside lab. The lab can only test the fluid that they receive, so it is imperative that they get the most representative sample. A lack of focus on the importance of the lubricant

analysis program can lead to problems such as improper sampling, waiting weeks to send samples off, not supplying ancillary machine data to the lab and ultimately not being able to make accurate decisions based on results coming back in the reports.

Lack of focus — For those that bring testing in-house, there is usually a sense of program ownership and pride within the lubrication and reliability program. While relying on an outside lab doesn't mean that these feelings can't exist, it is more heavily reliant on the internal champion to ensure the buy-in of all personnel into the program. If using an offsite lab is a requirement, share the results from the lab with all stakeholders and post the results in a conspicuous area to make the program's successes and failures visible, allowing for a more honest exchange of thoughts and ideas.

USING BOTH METHODS

It is important to point out that this decision doesn't have to be an all-or-none approach. Following our logic of the optimum reference state, the ideal solution may be some arrangement where we are reliant on both options. Sometimes that could look like the following:

- Use quick onsite tests to screen new lubricants or even in-service lubricants to determine if they need to be sent to a commercial lab for further or more in-depth testing.
- Get all stakeholders and employees involved in the analysis program trained in what tests tell you, how to interpret the results and how to ensure that prac tices in the field don't skew the data.
- With the rise of oil analysis sensor technology, there is an opportunity to include real-time data with periodic analysis. This can help focus the corrective actions and provide a better understanding of how the equipment is actually working.

By blending the best of both onsite and offsite analysis, we can improve the reliability of our equipment and ultimately be able to achieve the "do more with less" approach that is becoming the norm.

About the Author

Wes Cash is the Vice President of Services or Noria Corporation. He serves as a senior technical consultant for Lubrication Program Development projects and as a senior instructor for Noria's Oil Analysis I and Machinery Lubrication I and II training courses. He holds a Machinery Lubrication Engineer ((MLE) certification, a Machine Lubrication Technician (MLT) Level II certification and a Machine Lubricant Analyst (MLA) Level III certification through the International Council for Machinery Lubrication (ICML).

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Factor: E4M

Environmental Training:
How to Get Your Team Onboard

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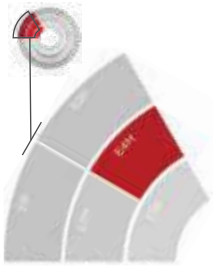

Factor:
E4M — Energy Conservation, Health & Environmental Training

Level:
Management & Training (M)

Stage:
Energy Conservation, Health & Environment

About:
To implement lubrication excellence, all staff should receive training on the impact of lubricants on the environment, ecological disposal options and strategies to reduce consumption and environmental impact.

Learn More:
noria.com/ascend/

Most of the facilities we enter as consultants have pretty strict environmental standards that the facility must uphold. The Environmental Protection Agency (EPA) does NOT play around when it comes to industrial plants. Generally, most of these plants are on the edge of towns, though some are in a rural setting. Power generation facilities, for example, are usually located near a river or lake and must abide by very strict rules and regulations set by the EPA. Every facility has to dispose of its manufacturing byproduct, debris, disposables and waste properly or risk being shut down. Proper, thorough environmental training is a large part of ensuring that these rules and regulations are met.

Scheduling

Training in these facilities, no matter the industry, is usually death-by-PowerPoint style training. Pulling the techs out of the field when they have a thousand things going on and making them sit through a two-hour PowerPoint presentation and then pulling one of them out every five minutes to "fight a fire" is probably the worst way to do training. I understand that time is nearly impossible to carve out in today's industry. Since the pandemic, I have yet to go to a facility that isn't running as lean as possible: each team member is wearing multiple hats and is busier

than they have ever been. I think the first step in getting your team onboard is to schedule the training around major events months in advance. Schedule these trainings carefully and deliberately.

Passive Training and Delivery Method

As for environmental training regarding lubrication, I always think of spill containment and utilizing the correct lubricant type, such as an environmentally acceptable lubricant (EAL). Whenever there is a potential risk of lubricants entering a water source, not utilizing the correct procedures and precautions can lead to a total plant shutdown. So even though it isn't a PowerPoint or instructed type of training, training through posted bulletins can help achieve the goal of being environmentally safe and friendly. I have mentioned this in a few of the articles I have written for Machinery Lubrication — constant, conspicuous reinforcement.

If I see training posters all around the shop (and the plant in general), I am more likely to incorporate that knowledge into my everyday process. Think of it like flashcards when studying for a test; after a few rounds of flashcards, you start to remember key words and phrases that hint at the answer. The same concept can be applied to processes and procedures. I like to call this "passive training," whereas a PowerPoint presentation is a direct form of training. With direct training, you sit down and try to absorb as much as you can within a set time frame and hope for the best. Passive training is the slow integration of knowledge into your brain over time. I think of it as the drip method of training, and it can save you and your technicians a lot of time.

Think of a water spigot over a five-gallon bucket and think of the water as time. The water drips into the bucket and takes a very long time to fill it, but since there is no pressure, the water does not splash out of the bucket — no wasted water and no wasted time.

Buy-in or Absorption

Buy-in to training isn't all about what type of training it is; sometimes it's just about the delivery method of the training you are presenting. Overall, do we want to just sign off that the training was completed and waste some precious time doing it? Or do we want to actually allow the team to absorb the knowledge and put it into use, thus changing the culture of the plant? ***ML***

About the Author

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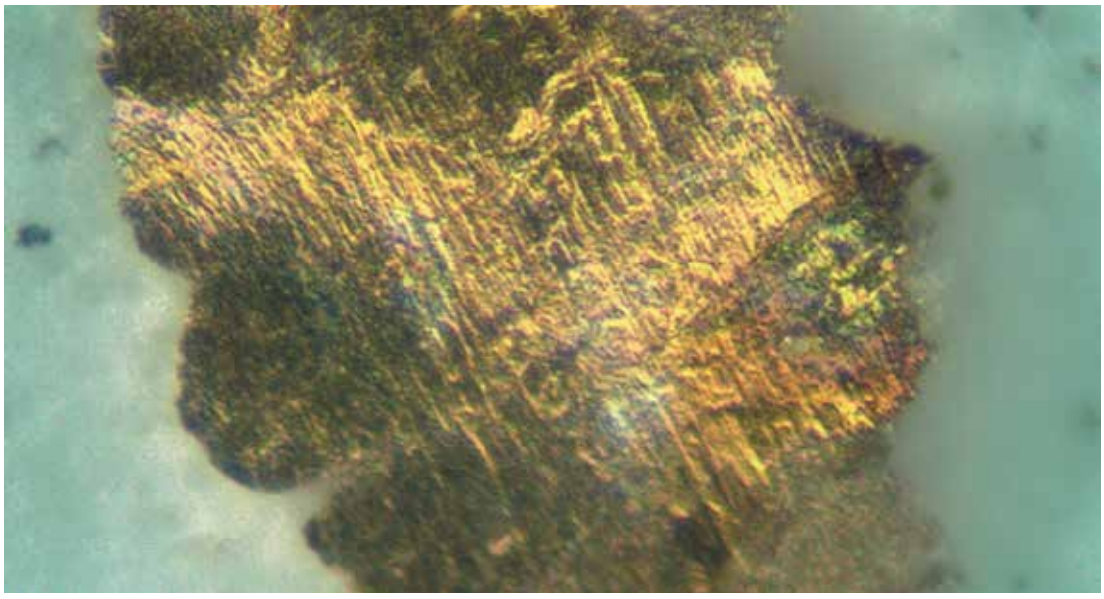
The "Lube-Tips" section of *Machinery Lubrication* magazine features innovative ideas submitted by our readers.

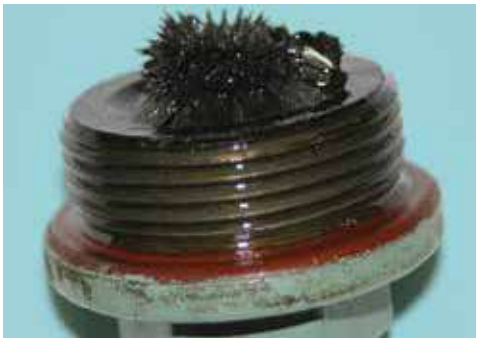


Sources of Copper in Oil

Typical sources of copper within engines include wrist pin bushings, thrust washers, oil pumps, governors, valve train bushings, cam bushings, oil coolers and bearings. Copper can also be an antiwear additive in some oils. Additionally, high copper readings may occur during the run-in of a new engine (say, after 500 to 1000 hours of service) and when changing from one brand of oil to another.

Getting a Handle on Drums

Proper handling of drums is important. Drums aren't designed to be bounced or dropped. Full drums weigh approximately 450 pounds, while empty drums weigh around 36 to 38 pounds. A pail of oil weighs about 40 pounds.



Gearbox Magnets Are Effective

In enclosed gear drives with either splash or circulation systems, a magnetic plug or magnetic filter will help collect harmful wear debris. For splash systems, use a magnetic plug or a magnet at the bottom of the case. For circulation systems, a magnetic filter can be used. Removing wear debris can help extend oil and machine life. Wear debris can also be examined upon removal for troubleshooting purposes. ***ML***

Did You Know?

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

Have Some Tips?

If you have a tip to share, email it to editor@noria.com.

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. Practice Questions supplied by Noria Academy. Visit **noria.com/academy** to learn more.

1. If a plant's lubricant consumption ratio drops by 25%, what amount of reduced lubricant purchases occurred?

A. 0.25
B. 0.5
C. 0.75
D. 1

2. What are the two main contributors to equipment failure?

A. Management and budget
B. Operations and the environment
C. Maintenance practices and outside influence
D. Reliability and market costs

3. In the SAE 0W-30 crankcase viscosity classification, what does the "W" stand for?

A. Winter
B. Webster
C. Weather
D. Weight

4. API is an acronym for which governing body?

A. American Petrochemical Institute
B. American Petroleum Institute
C. Association for Petroleum Inspection
D. Analytical Petroleum Institute

5. Which polar mechanism does a rust inhibitor use?

A. Mass transfer
B. Metal wetting
C. Water emulsifying
D. Particle enveloping

ANSWERS

1.A 2.C 3.A 4.B 5.B

Shell India signs actor Shahid Kapoor as brand ambassador

Shell India has onboarded Bollywood versatile actor Shahid Kapoor as the brand ambassador for its Lubricants business in India. Shell is looking to expand its customer base and will bank on Kapoor's pan-India popularity and youthful energy across all age groups.

The brand also launched its new campaign, 'Rukna Mushkil Hai,' for Shell Advance range of motorcycle oils today. It celebrates the spirit of new India and the unstoppable Indian riders powered by passion, determination, hope, vision, and Shell Advance engine oil. Aimed towards everyday Indian riders, the new campaign celebrates the rider community for whom their bike is not just a machine or a mobility device but a true partner in their growth journey.

Announcing the new brand Ambassador and the campaign, Amit Ghugre, Automotive Sales and Marketing Manager, Shell Lubricants India, said, "At Shell, we constantly strive for progress. This collaboration strengthens our goal to support the hardworking spirit of bikers and power their progress. Shahid is an obvious choice as he has the right appeal and passion for love for bikes that has endeared him to millions of Indians, as a beloved youth icon. We are truly delighted to have Shahid on board as the Brand Ambassador for Rukna Mushkil Hai" Sharing his excitement, motorcycle enthusiast and brand ambassador, Shahid Kapoor said, "'Rukna Mushkil Hai' showcases how Shell Advance transforms into a catalyst that enables and empowers riders to achieve their goals. I am proud to partner with Shell Lubricants India to bring the brand closer to Indian bikers, to be a part of their unstoppable journey and make a difference." To capture the brand's youth centricity, Shell Lubricants India roped in MTV Hustle contestant Gaurav Mankoti, also known by his stage name, VOID, to compose the upbeat track that features in the TVC starring Shahid Kapoor. Shell Advance range of motorcycle oils is designed for different types of motorcycles and riding styles and includes Shell Advance Fuel Save, Shell Advance Ultra, Shell Advance AX7, Shell Advance AX5 and Shell Advance AX3. The portfolio represents mineral and synthetic 4T, 2T motorcycle, and scooter engine oils recommended for different types of motorcycles and riding styles.

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