Machinery Lubrication

INDIA March-April 2018

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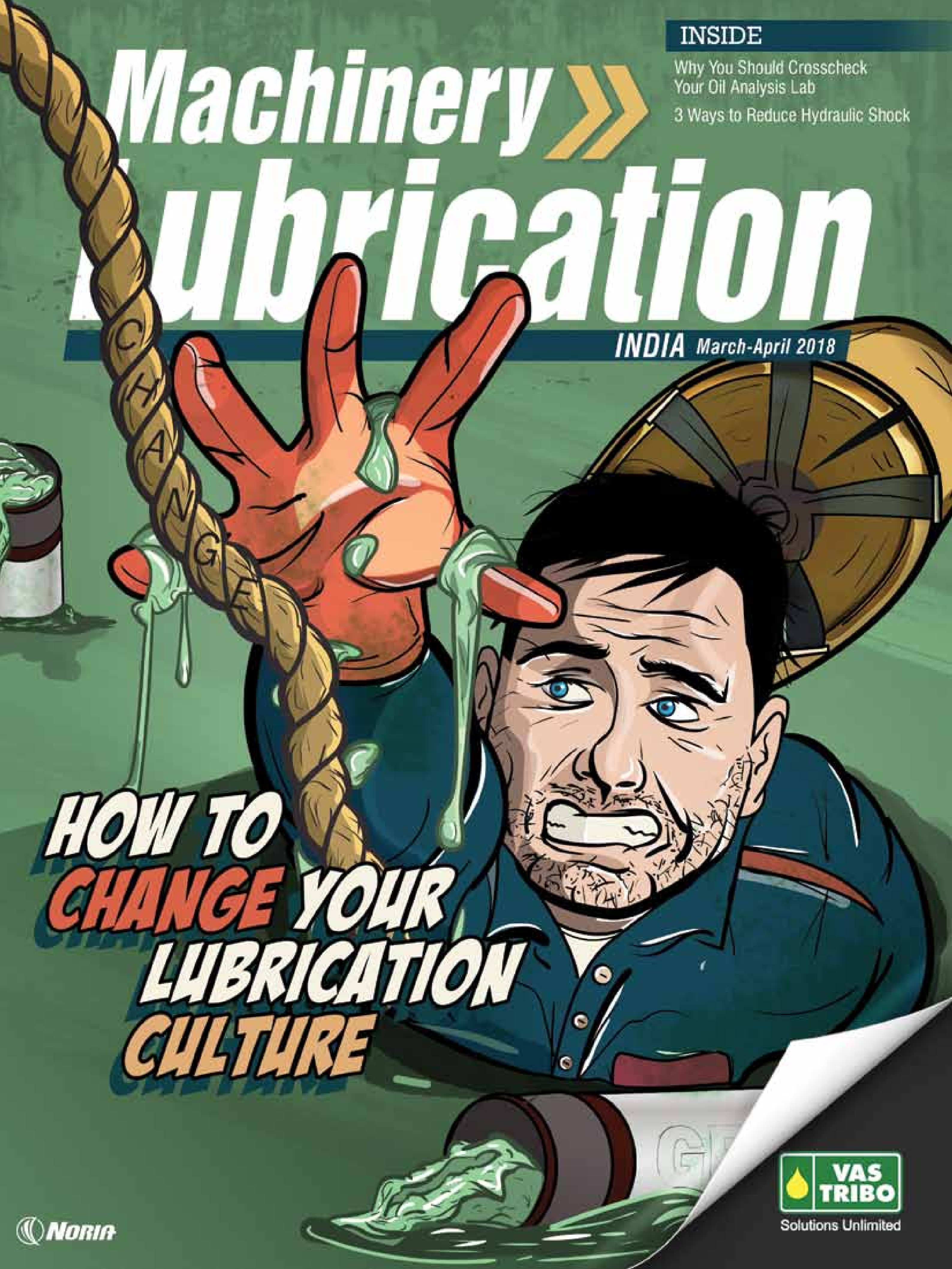
3 Ways to Reduce Hydraulic Shock



HOW TO CHANGE YOUR LUBRICATION CULTURE

NORIA

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Publisher's Note

As per a recent study it was found that over 92% of lubrication professionals do not use any biodegradable lubricants at their plant. Strong environmental concerns and growing regulations over contamination and pollution in the environment have increased the need for renewable and biodegradable lubricants. Accelerating research and development in this area has also been driven by public demand, industrial concern, and government agencies. The depletion of the world's crude oil reserve, increasing crude oil prices, and issues related to conservation have brought about renewed interest in the use of bio-based materials. Emphasis on the development of renewable, biodegradable, and environmentally friendly industrial fluids, such as lubricants, has resulted in the widespread use of natural oils and fats for non-edible purposes.

The application of plant oils and animal fats for industrial purposes, specifically as lubricants, has been in practice for many years. Environmental and economic reasons lead to the utilization of plant oils and animal fats, or used oils and fats after their appropriate chemical modification.

Compared to petroleum-based lubricants, use of bio lubricants produces a cleaner, less toxic work, offers better safety, produces lesser emission, highly biodegradable, costs less over the product's life-cycle, less maintenance and less storage and disposal requirements.

A tremendous demand for plant oils in the lubricant industry is expected over the next few years because plant oils are also cheaper than synthetic oils. They will become an important class of base stocks for lubricant formulations due to their positive qualities. Plant oils, in comparison to mineral oils have different properties due to their unique chemical structures. Some plant oils have better lubrication ability, viscosity indices, and superior anticorrosion properties, which are due to the higher affinity of plant oils to metal surfaces. In addition, flash points greater than 300 deg C classify plant oils as non-flammable liquids. To improve characteristics such as sensitivity to hydrolysis and oxidative attacks, poor low temperature behaviour, and low viscosity index coefficients, plant oils may be chemically modified. Plant oils may be used in almost all automotive and industrial applications. It will become more difficult to find a balance between the economic possibilities of Bio lubricants and their ecological requirements. Products with toxicological and ecological issues must be excluded from further use in lubricants, if they pose a significant health risk. However, it must be taken into account that the technological level of lubricants will decrease if unnecessary restrictions are put into place. In conclusion, plant bio-based oils are an important part of new strategies, policies, and subsidies, which aid in the reduction of the dependence on mineral oil and other non-renewable sources.

We would like to thank you for the heartening response to our last edition's cover story –"How to Evaluate a New Lubricant" and other articles. Our current issue's cover story is on "How to change your Lubrication Culture". This will help readers to know how to change from a culture of over-lubrication to best-practice lubrication through sharing of knowledge and application of predictive maintenance technologies.

As always, we look forward to your valuable suggestions and feedback.

Warm regards,

Udey Dhir

JIM FITCH | NORIA CORPORATION

How to MEASURE the Effectiveness of CONDITION MONITORING

Condition monitoring should never be limited to a single technology or method. Instead, it should combine and integrate an optimum selection of purposeful tools and tasks. Condition monitoring can be largely technology based but can also be observation or inspection based.

Most machines share condition monitoring and inspection needs with many other types of equipment. This is because they have components and operating conditions in common, i.e., motors, bearings, seals, lubricants, couplings, etc. At the same time, their operating conditions and applications may demand unique inspection requirements. These influence failure modes and machine criticality.

As discussed in previous columns, inspection should be viewed with the same serious intent as other condition monitoring practices. In my opinion, a world-class inspection program should produce more "saves" than all other condition monitoring activities combined. It's not an alternative to technology-based condition monitoring but rather a strategic and powerful companion.

The technologies of infrared thermography, analytical ferrography, vibration, motor current and acoustic emission are generally used to detect active faults and abnormal wear. Conversely, a well-conceived inspection program should largely focus on root causes and incipient (very early stage) failure conditions. Detection of advanced wear and impending failure is secondary.

Remedy to Condition Monitoring Blindness

Consider this: How could any of the mentioned condition monitoring technologies detect the sudden onset of the following?

- Defective seal and oil leakage
- Filter in bypass
- Coolant leak
- Air-entrained oil
- Oil oxidation
- Varnish
- Impaired lubricant supply (partial starvation)
- Bottom sediment and water (BS&W)
- Defective breather or vent condition

Even if the technologies could detect these reportable conditions, this ability is constrained by the condition monitoring schedule. For instance, consider a condition monitoring program that is on a monthly schedule and conducted the first day of each month. If the onset of a reportable abnormal condition occurs the following day, it goes undetected by technology-based condition monitoring until the next month (up to 30 days later).

You could say that inspection provides the eyes and ears for everything that condition monitoring can't detect and is a default detection scheme during the intervening days when no technology-based condition monitoring occurs. In other words, inspection fills in critical gaps where there is detection blindness of the technologies and schedule blindness for the time periods between use. Higher inspection frequency and more intense examination skills (by the inspector) significantly increase condition monitoring's ability to detect root causes and symptoms of various states of failure.

Build a Condition Monitoring Team

Condition monitoring should be a team effort. As with most teams, each member contributes unique and needed skills to enhance the collective capabilities of the team. One member cannot or should not do the tasks of others. In American football, you can't turn a linebacker into a quarterback. While the team members are different, they are all working toward a common goal.

Condition monitoring should be a team effort.

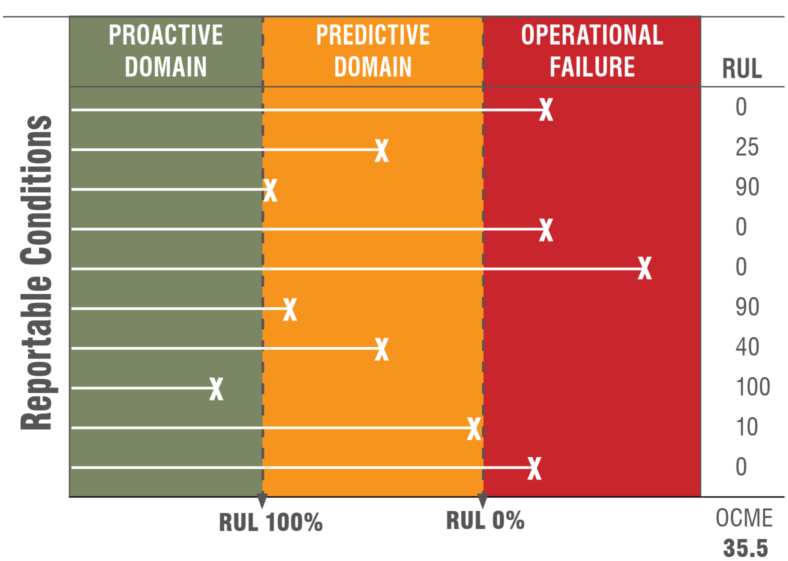
Managing a condition monitoring program is a team-building activity. You have your "A" players and your "B" players. Some are generalists, and some are specialists. You have leaders, and you have followers. All the classical elements are there. The condition monitoring team includes people (inspectors, analysts, etc.), technologies (vibration, portable particle counters, infrared cameras, etc.) and external service providers (an oil analysis lab, for instance).

Overall Condition Monitoring Effectiveness (OCME)

Team performance requires one or more metrics aligned to well-defined goals. Some metrics are micro (e.g., vibration

CASE 1

	INTERVAL	INTENSITY
Condition Monitoring	Moderate	Low
Inspection	Frequent	Low



CONDITION MONITORING SUMMARY
RC Saves = 10%
Predictive Saves = 50%
Misses = 40%

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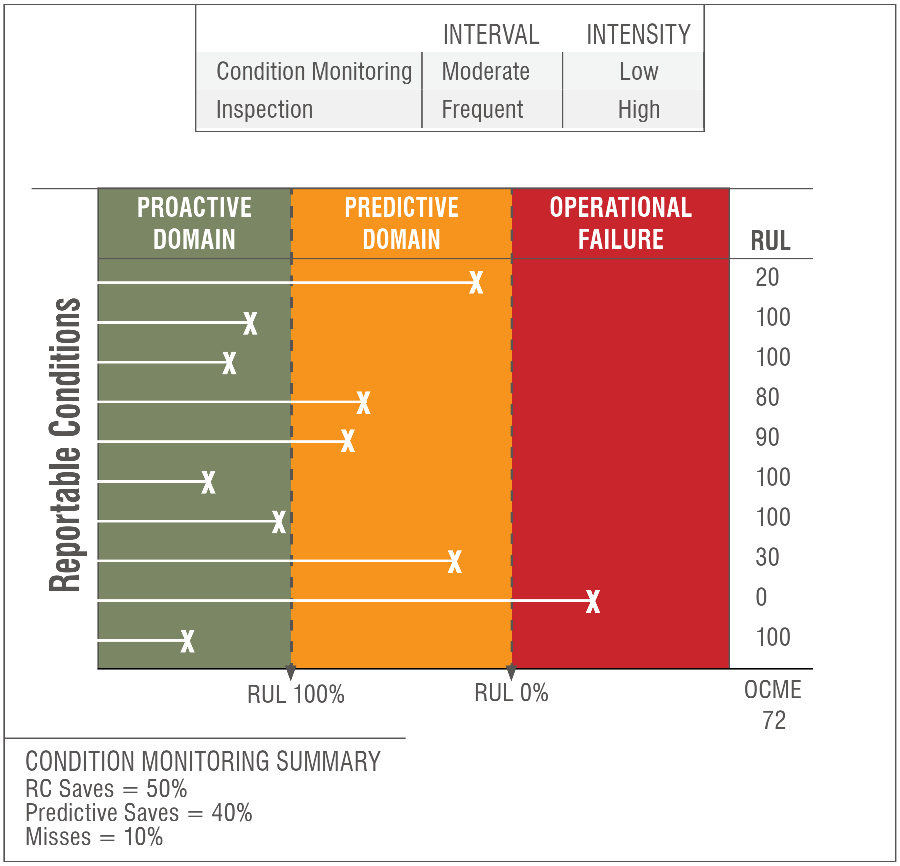
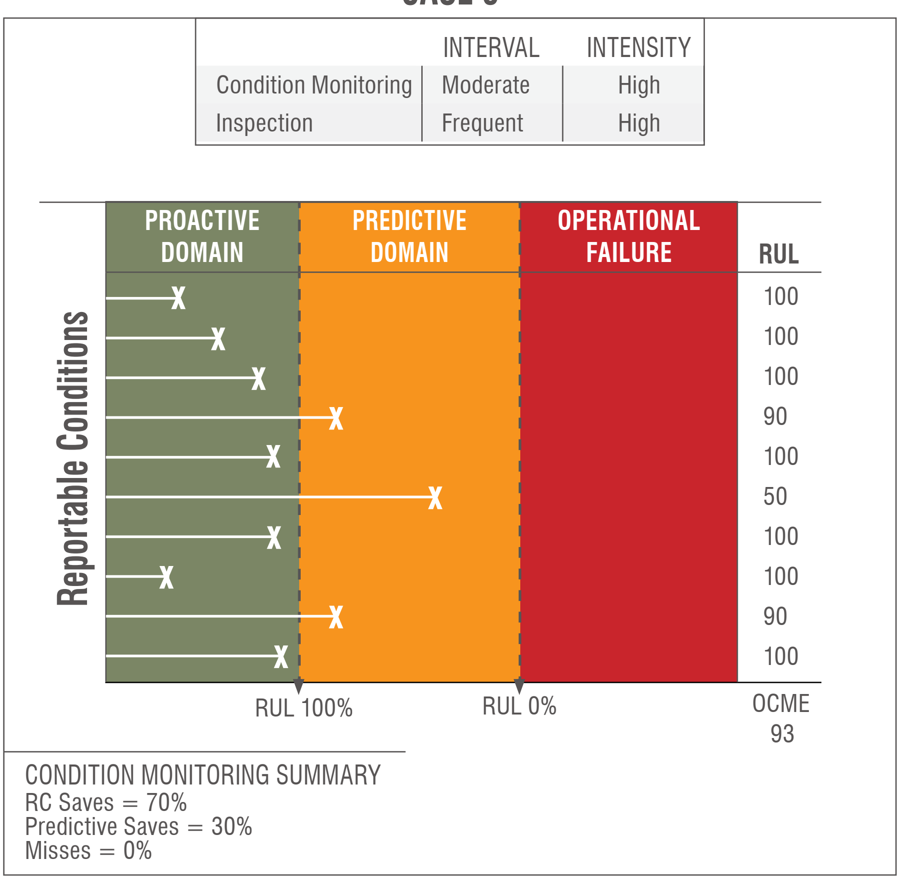
CASE 2



CASE 3



overalls or lubricant particle counts), while others are macro to capture overall team performance. In reliability, macro metrics might look at the cost of reliability (team spending) and the overall level of reliability achieved (by condition monitoring and other activities).

To illustrate the concept of a macro metric, I am introducing Overall Condition Monitoring Effectiveness (OCME). This somewhat theoretical metric drives home several important points. OCME is defined by the overall effectiveness of condition monitoring (inspection combined with technology-based condition monitoring) in detecting root causes and early detection of failure symptoms.

This is quantified as the average percentage of remaining useful life (RUL) across all machines and reportable conditions during the reporting period (say, one year). The higher this number, the more effective condition monitoring is in detecting and correcting reportable conditions early. Machines that have no reportable conditions or failures are not included in this metric. A perfect OCME score is 100, meaning the RUL across all machines from the beginning of the reporting period to the end was unchanged. This can be normalized to total machine operating hours (for the entire group of machines included in the OCME metric).

To show how the OCME works, let's look at three examples. Refer to the sidebar on page 6 for definitions of the terms used. Each of the three cases considers different condition monitoring and inspection intervals (frequency) and intensity. Again, intensity refers to the skill and effectiveness of condition monitoring and inspection tasks.

Terms and Definitions

- **Reportable Condition** — This is an abnormal condition that requires correction. A reportable condition could be either a root cause or an active failure event or fault.
- **Proactive Domain** — This is the period of time when there is a reportable root cause condition but no significant loss of machine life has occurred. Unless detected and corrected, the condition will advance to the predictive domain.
- **Predictive Domain** — This follows the proactive domain and is also known as the failure development period. The predictive domain begins at the inception of a reportable failure condition (e.g., severe misalignment) or fault and ends at the approaching end of operational service life.
- **RUL** — Remaining useful life is an estimate of the remaining service life of a machine when an active wear or failure condition has been detected and remediated. Machines start with an RUL of 100 percent. As they age and wear occurs, the RUL approaches zero.
- **Root Cause (RC) Saves** — Root cause saves is the percent of reportable conditions that were detected and remediated in the proactive domain. The higher this number the better. All RC saves leave RUL unchanged.
- **Predictive Saves** — This refers to reportable conditions that have advanced to the predictive domain and are detected and remediated prior to operational failure. The RUL of the machine was lowered during the time the reportable condition remained undetected and uncorrected in the predictive domain.
- **X** — This is a timeline point when a reportable condition (e.g., root cause of a fault) is detected and remediated. It also represents operational failure when not detected in the proactive or predictive domains.
- **Misses** — Misses refer to the percentage of reportable conditions that advance to an undetected operational failure. The lower this number the better.
- **Overall Condition Monitoring Effectiveness** (OCME) — This metric defines the overall effectiveness of condition monitoring (inspection combined with technology-based condition monitoring). This is quantified as the average change in percent of remaining useful life (RUL) across all machines and reportable conditions during the reporting period. The higher this number, the more effective condition monitoring is at detecting and correcting reportable conditions early.
- **Condition Monitoring Interval** — This refers to the time interval between technology-based condition monitoring events (vibration, oil sampling, thermography, etc.).
- **Condition Monitoring Intensity** — This refers to the number of condition monitoring technologies in use and the intensity of their use. For example, an oil analysis test slate involving numerous tests with skillful data interpretation would be referred to as intense.
- **Inspection Interval** — This refers to the time interval between machine inspections by operators and technicians.
- **Inspection Intensity** — This refers to the number of inspection points and the examination skills of the inspector.

Ten hypothetical reportable conditions are used in each case. These could be misalignment, unbalance, hot running bearings, high wear debris, wrong oil, lubricant starvation, water contamination, etc. Reportable conditions detected in the proactive domain are considered to have 100 percent RUL. Operational failure means zero percent RUL. Those conditions detected early in the predictive domain have a higher RUL than those approaching operational failure. The beginning point of the predictive domain is the inception of failure.

Case #1: Common Intervals at Low Intensity

In this scenario, very few of the reportable conditions are detected in the proactive domain (at the root cause stage). Most conditions advance to the predictive domain or operational failure. The causes of this are low skill and intensity of the condition monitoring and inspection tasks. The RUL of each reportable condition is estimated and tallied up to derive the OCME score, which is 35.5 in this case. Some 40 percent of the reportable conditions were misses, and only 10 percent were root cause saves.

Case #2: Common Intervals at High Inspection Intensity

This case is the same as the first with the exception of the inspection skill and competency (high intensity). This dramatically affects the OCME (score of 72). Instead of 10 percent root cause saves, we now have 50 percent and only 10 percent misses.

Case #3: World-class Condition Monitoring and Inspection

This case applies high inspection frequency and intensity for both technology-based condition monitoring and inspection tasks. At this high level of surveillance, most all reportable conditions are detected and remediated in the proactive domain (70 percent root cause saves). All others are detected early in the predictive domain. This translates to an impressive OCME score of 93 across all machines and reportable events.

Optimization

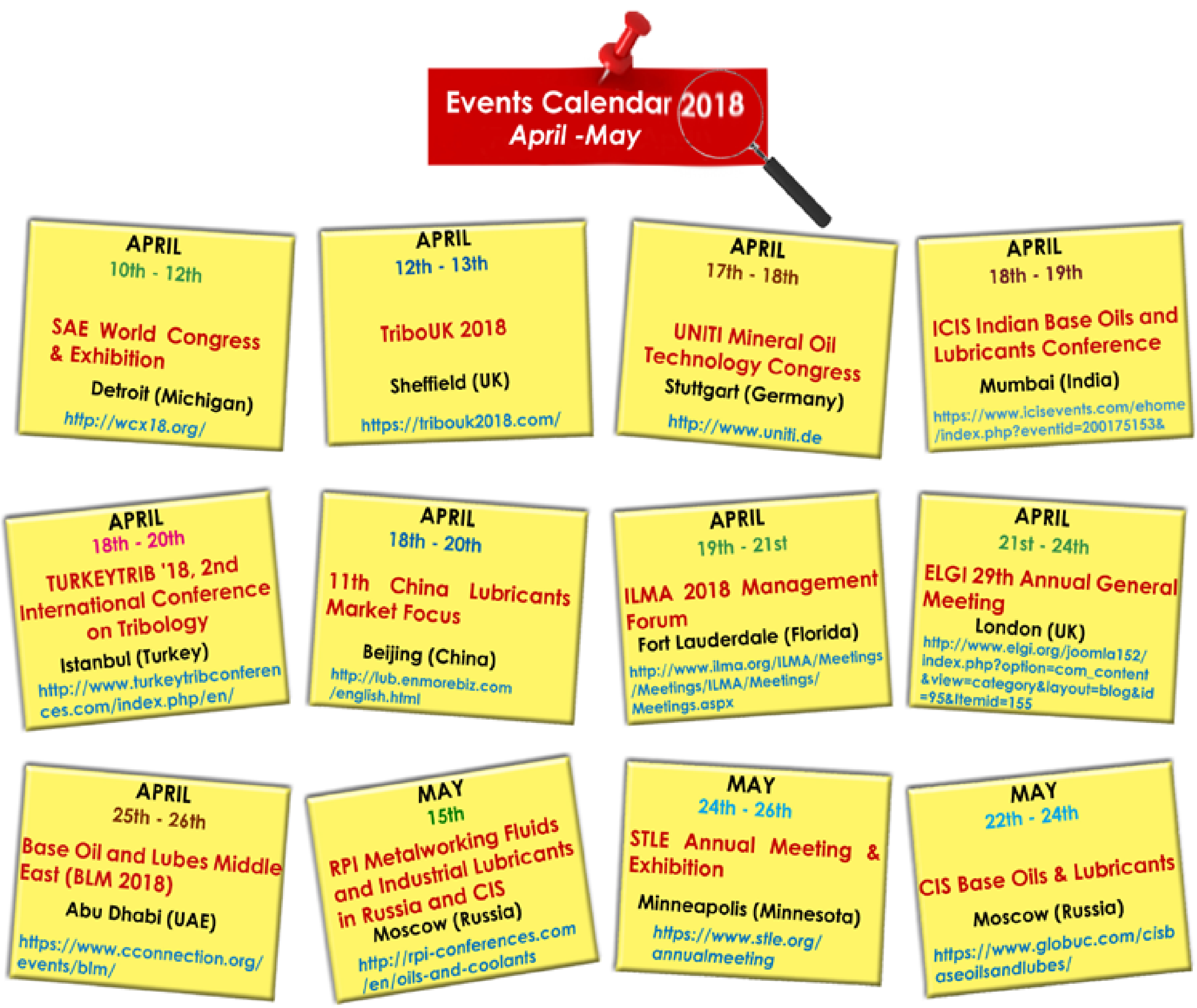
It would be negligent to conclude this column without a short reminder about optimization.

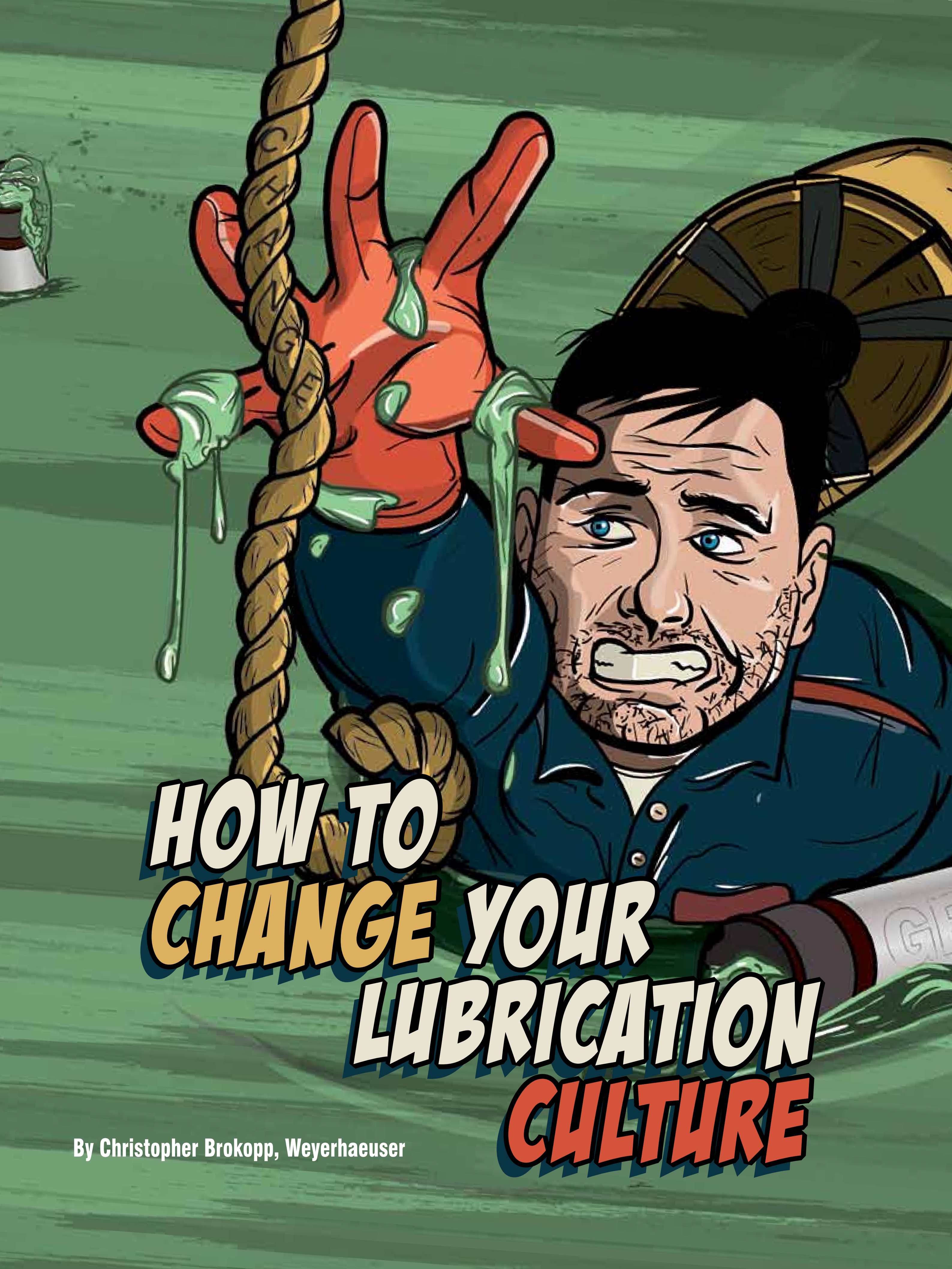
There is a cost to condition monitoring, as we all know. This cost is influenced by frequency and intensity. The optimum reference state (ORS) for condition monitoring and inspection must be established. Our objective is to optimize the OCME in the context of machine criticality and failure mode ranking. I've addressed this subject extensively in past columns. Please refer to my *Machinery Lubrication* articles on the ORS, overall machine criticality (OMC) and failure modes and effects analysis (FMEA).

As a final note, my reference to intensity should not be glossed over as unimportant. It is a driving factor to boosting the OCME score. Achieving condition monitoring and inspection intensity has as much to do with culture as it does with the available budget or access to technology. Training and management support define the maintenance culture. These soft, human factors require a high level of attention to achieve excellence in lubrication, reliability and asset management. You can read more about these factors at MachineryLubrication.com.

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.





HOW TO CHANGE YOUR LUBRICATION CULTURE

By Christopher Brokopp, Weyerhaeuser

There is a misconception in industry that bearings should be lubricated like bushings. Many people are under the impression that if a little lubricant is good, a ton must be better. However, overlubing a bearing can cause the same or more catastrophic problems than underlubing. Although this practice is slowly being eradicated as its ineffectiveness becomes common knowledge, the old ways of overlubing continue to persist in some areas of our workplace.

DAMAGING PRACTICES

It is inherent in the millwright culture to want to see grease oozing out of bearings. We had oilers that would push 20 pumps into a bearing even if grease started spewing out after the first pump. During my training in the lubrication department, one of our more experienced oilers took me to a machine and told me to put in 10 pumps of grease every week. This machine is indoors in one of the cleanest areas of our mill, except for the big piles of grease directly below the bearings. As I put in the first pump, the same volume came spewing out of the sides of the bearing.

On another occasion when I was an apprentice millwright, a journeyman told me I had to be their "human Q-tip" to go through all the excess grease that had been dumped out of the bearings via overlubrication. Being new, I hesitantly opened the access panel to find calf-deep sludge made up of grease and bark dust. Luckily, he was joking, and I didn't need to crawl in. Unfortunately, this took overlubrication to a whole new extreme. This was common practice. It was normal to see puddles of grease. If I came across a place where there wasn't grease oozing out of the bearings, I knew I had better find an oiler to add a little more grease.

IMPROVEMENT OPPORTUNITIES

We experienced regular bearing failures that were associated with a lack of lubrication. Everyone knows the old saying that hindsight is 20-20. Well, now we know that lubrication was a factor in all these failed bearings, but more appropriately they were a consequence of our overlubrication culture. After going through Noria's Machinery Lubrication training, it became apparent that we had an opportunity for improvement in this area.

Our new and improved predictive maintenance (PdM) department started cleaning up this practice. We did calculations for specific bearings and started to properly lube our machinery. At first, maintenance personnel were indignant, thinking that since grease wasn't oozing out, the bearings were not being lubed. I had to explain that the bearings were finally being lubricated properly.

CALCULATING GREASE QUANTITIES

Thanks to SKF and its simplified formula, you can easily calculate the volume of grease needed by multiplying the bore diameter by the bearing width and a constant of 0.114. If you can safely reach the bearing, you can measure it, but most of the time our access was drastically restricted. When this was the case, I would look up the bearing dimensions online. Once we had our measurements and figured out the calculation, we were in the ballpark for how much grease to put in the bearing.

For example, let's say a bearing requires 1 ounce of grease. What is an ounce of grease? One pump? Ten pumps? Who knows? Even if the grease gun is rated for a certain amount, it is not always accurate. Therefore, it is imperative to calibrate all grease-dispensing equipment at your facility. Use a kitchen or postal scale to determine the weight in ounces per stroke of each grease gun. You can find quality scales for less than $15. At our facility, one of our maintenance coordinators borrowed his wife's kitchen scale for us to use. I highly recommend you refrain from stealing your wife's scale and instead buy one specifically for this purpose. At our plant, we line the scale with a rag, zero it out, then squirt 20 pumps of grease onto the scale and divide the total weight by 20 to get an average. We then label each gun with the average volume per stroke. That way the delivery means our technicians use doesn't matter. We can still ensure the bearing is receiving the proper volume of grease.

Knowing the quantity of grease the bearing needs, we can calculate how many pumps it will take based on the gun's average output per pump. We also utilize battery-powered grease guns with a digital readout. These are calibrated with the same method.

DETERMINING RELUBRICATION FREQUENCIES

Our next obstacle was determining how often to apply this amount of grease. There are multiple tables, charts and calculators for establishing the proper frequency. The major factors in determining relubrication frequency are load, operation time, type of bearing, speed, temperature and environment. Keeping these factors in mind, the formula we use is: $T = K \times [(14{,}000{,}000/n \times (d0.5)) - 4 \times d]$, where T = the time (in hours) until the next relubrication, K = the product of all the correction factors, n = speed (revolutions per minute), and d = the bore diameter (in millimeters).

The correction factors account for temperature, moisture, contamination, vibration, position and bearing design. Fortunately, most of our equipment runs at about the same speed, temperature and vibration. We also use very similar bearing designs. This leaves us accounting for moisture, contamination and position. It is astonishing to see how small changes can affect the time between regreasing. For instance, mounting a bearing at a 45-degree angle or with temperatures of more than 150 degrees F will cut the interval in half.

At our mill, contamination and moisture are the greatest challenges after installation. We use the same style of bearing in a variety of applications. One is indoors but contends with some light abrasive debris. Another is outside and battles moisture and heavily abrasive debris. Under ideal conditions, this type of bearing would need just more than an ounce of grease every 2,828 hours. However, since it sees light abrasive dust, we need to adjust the correction factors.

This slow-moving bearing has a speed of 120 revolutions per minute with a 74.6125-millimeter bore diameter. Based on the correction factors, which are represented in the equation as K, the interval should be reduced to 1,131 hours. If water is introduced into the equation with heavily abrasive dust and the correction factors are adjusted accordingly, the relubrication time drops to 56 hours. Thus, even though it is the same bearing, you cannot make a blanket statement that it requires the same amount of grease. From this example, it is easy to see why some people think bearings need lots of grease.

NEW TECHNOLOGIES

The advancement of new technology enables you to fine-tune your lubrication program. Two such technologies are ultrasound and vibration analysis. How does listening to a bearing in a noisy environment help you with lubrication? How can feeling a bearing with all those other machines chugging along tell you anything?

Ultrasound is high-frequency sound that is above the range of normal human hearing. Typical applications for ultrasound include air and gas leak detection; electrical inspections to detect corona, tracking and arching; steam traps; and mechanical inspection of rotating equipment, including condition-based lubrication.

Vibration analysis is another

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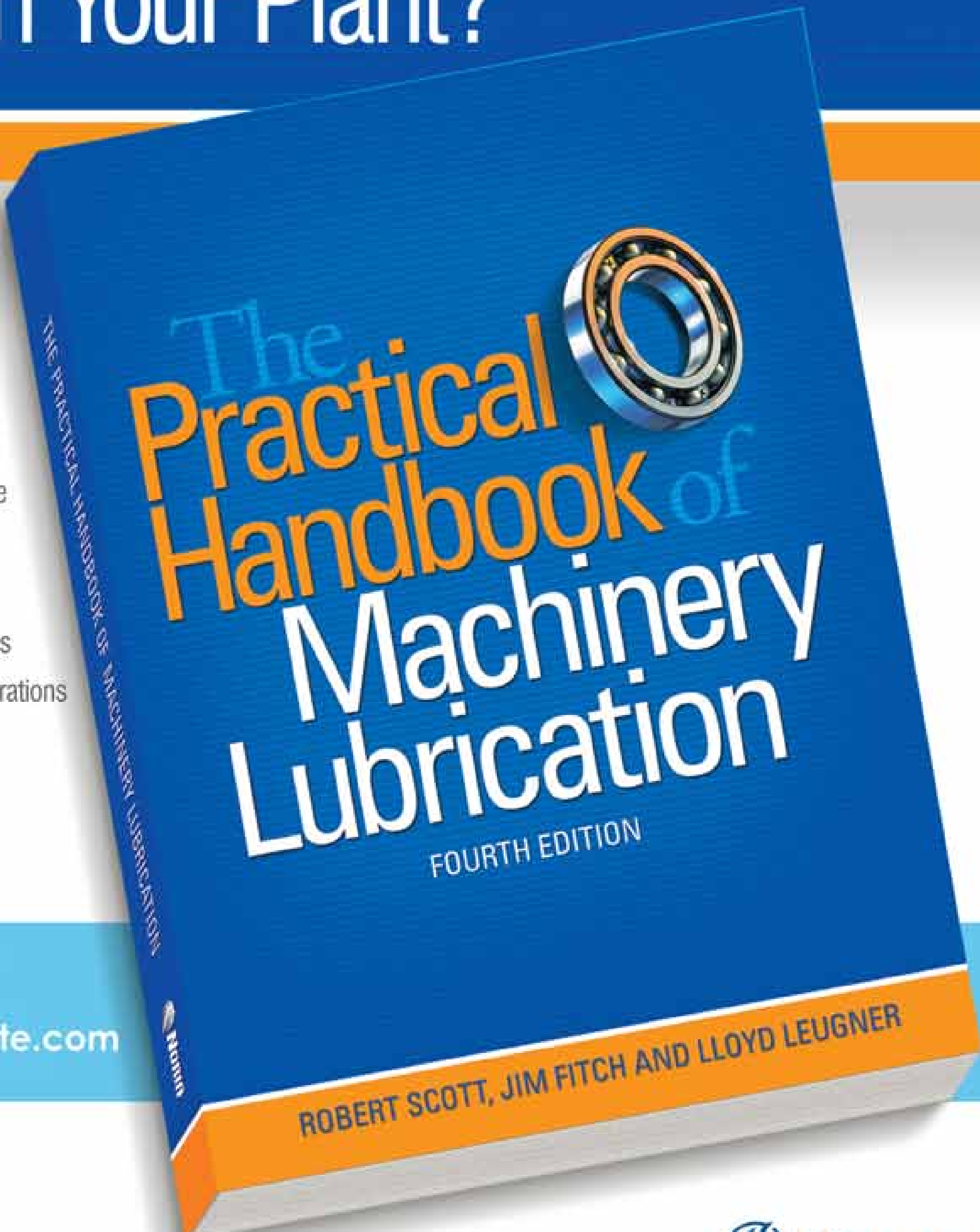

- Fourth edition – completely rewritten and reorganized to be more reader friendly
- Restructured chapters and new sections providing more detailed information on specific topics
- Updated to include recent changes in industry practices
- Improved graphics and illustrations to make the content easier to understand

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NORIA

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Robert "Bob" Scott has more than 30 years of technical experience with lubricants, lubrication and related machinery. With extensive laboratory and field experience in the development of lubricants, Bob has been certified as a Lubrication Specialist (CLS), Oil Monitoring Analyst (OMA), and is also ICML MLT Level II and MLA Level III certified.For the past nine years, Bob has worked for Noria Corporation as an instructor of Machinery Lubrication and Oil Analysis courses throughout the U.S. and Canada.

Jim Fitch, the founder of Noria Corporation has been awarded a number of patents on oil analysis instruments and has published over 200 books, journal papers and technical articles. As a senior technical consultant, Jim has advised hundreds of companies on developing their lubrication and oil analysis program. He has served as U.S. delegate to ISO for oil analysis standards and is also active with ASTM D02 related to in-service oil analysis test standards.

Lloyd "Tex" Leugner, President of Maintenance Technology International, Inc., has 38 years of experience in the field of industrial and mobile machinery maintenance, lubrication and oil analysis, and has written over 300 articles and technical papers. An international expert in preventative/predictive maintenance and lubrication engineering, he has completed audits and presented seminars for many of Canada's major oil and gas producers, drilling companies, mines, pulp and paper producers and transportation fleets.

IT IS NEVER TOO LATE TO START YOUR CULTURAL TRANSFORMATION. IN FACT, YOU SHOULD START TODAY. JUST PACE YOURSELF. THE ROAD AHEAD IS A LONG ONE.

technology that can enhance your lube program. It is defined as analysis of vibration monitoring data to track the characteristic changes in rotating machinery caused by imbalance, misalignment, bent shaft, mechanical looseness, faults in gear drives, defects in rolling-element bearings and/or sleeve bearings, or more commonly referred to as the movement of a body about its reference position.

There are several advantages of using these technologies. The greatest is the amount of money you can save. Since the bearings are receiving precisely the correct amount of grease, lubrication-related bearing failures will decrease, potentially reducing unscheduled downtime. Less downtime equals more profit. Savings can also be realized in motor and equipment repair costs as well as in decreased lubricant usage.

CHANGE YOUR CULTURE

Through the application of these technologies, you can confirm the quantity of grease that a bearing requires for optimal performance. However, be sensitive to experienced craftsmen while proving that overgreasing is a real problem. It is hard to argue that "we do it this way because we have always done it this way" when there is a precision-measuring tool telling you otherwise. Remind these veteran workers that new bearing manufacturers are creating tighter tolerances that require more precise lubrication methods. In respect to these new lubrication methods, technicians need to remember the six "Rs" — the right type, right time, right quantity, right place, right way and right condition.

The right type of lubricant accounts for the grade, base oil viscosity, additives, pumpability, load, speed and thickener type. When calculating time and quantity, use the formulas mentioned previously. In regards to the right place, you need to ensure that the lubricant can handle the environmental factors it will face, such as moisture, temperature and vibration. The right way of lubricating equipment will be crucial to its longevity. Remember, some grease guns may create extreme pressures that can blow out supply lines and/or seals. The right condition of the lubricant refers to its age, if the base oil has started "bleeding" from the thickener and how clean the grease is entering the component. Just because the grease in the gun is new and clean, don't forget to make sure the tip of the gun is clean as well as the grease fitting.

The more you lubricate a bearing, the greater the chances of introducing particles into it. Once these microscopic particles get into the bearing, they wreak havoc on the precision-machined surfaces. Too much of anything is a bad thing, and you can lubricate something too much. Bearings are designed to operate with a certain amount of grease in them. Put in too much, and they will fail earlier than expected.

It is never too late to start your cultural transformation. In fact, you should start today. Just pace yourself. The road ahead is a long one. Stay positive and focus on the old saying of "slow and steady wins the race."

Increasing the life of components, decreasing downtime and being good stewards of the environment by not creating puddles of grease will help the bottom line of any facility, but getting there involves all workers. When every employee thinks about reliability to the same degree as others do about safety or cost controls, you will have reached a new level of trustworthy operations. Then, and only then, can leaders or stewards say they have achieved their goal of reliable and safe facilities.

This is an ongoing discussion at our mill with maintenance personnel explaining why bearings receive different amounts of grease. It is only through sharing this knowledge that we can start to persevere and attain lubrication excellence. ■

BY AL SMILEY, GPM HYDRAULIC CONSULTING

3 Ways to Reduce Hydraulic Shock

Hydraulic shock occurs when oil rapidly starts or stops flowing in a hydraulic system. The oil flow rate in the pressure line of systems below 3,000 psi is usually 15-20 feet per second. In systems above 3,000 psi, the flow rate can be as high as 30 feet per second. Shock can also occur when an external force acts on a hydraulic cylinder or motor.

Unlike air, hydraulic oil is generally considered to be non-compressible. Oil will only compress one-half of a percent when pressurized to 1,000 psi. When a pressure spike occurs in the system, the pressure can increase four or five times above the normal operating pressure. Since the average duration of a shock spike is 25 milliseconds, the pressure gauge cannot respond fast enough to give an accurate indication. Pressure transducers are normally used to record pressure spikes.

Shock spikes that are not properly dampened or absorbed can result in leakage and damage to the lines and components in the system. This article will look at three things that can be done to reduce hydraulic shock.

Install an Accumulator

A hydraulic accumulator is pre-charged with dry nitrogen. Some type of

Figure 1. A bladder accumulator

separating device such as a piston, bladder or diaphragm is used to separate the nitrogen from the hydraulic oil inside the accumulator. A bladder (Figure 1) or diaphragm type is recommended to absorb shock. Both of these accumulators contain rubber elements that will be compressed when the hydraulic pressure rises above the dry nitrogen pre-charge. Depending on the system, the accumulator should be pre-charged to 100 psi below to 200 psi above the maximum operating pressure in the system. Accumulators that are used for shock can be small in size, usually one quart to one gallon.

The accumulator should be installed as close as possible to where the shock spike is occurring. For example, if the pressure spike takes place when a cylinder fully extends, the accumulator should be installed near the port connected to the full piston side of the cylinder.

Accumulators are often used to absorb high flow surges in return lines. In this case, the pre-charge should be lower than the maximum pressure rating of any return filters or heat exchangers located downstream. Any time an accumulator is used in the pressure line, an automatic and/or manual dump valve should be installed to bleed the hydraulic pressure down to zero once the system is turned off.

Add Directional Valve Pilot Chokes

A typical two-stage, hydraulic-piloted, solenoid-controlled directional valve is shown in Figure 2. The valve contains pilot chokes, which are located in the block between the pilot valve on top and the main spool on the bottom.

Figure 2. A two-stage directional valve

The block includes two flow controls connected in a meter-out arrangement and two bypass check valves. When either of the pilot valve solenoids is energized, pilot pressure is ported through one of the internal check valves and to one side of the main spool. As the spool shifts, the oil in the pilot cavity on the opposite side flows through the flow control and back to the tank through the pilot valve. The setting of the flow control determines the rate that the main spool shifts. By allowing the spool to gradually shift, the pump volume is gradually ported through the valve and to the system.

Several years ago, I was asked to consult with an oriented strand board plant in Minnesota about reducing shock on its hot press. The lines had been welded many times over due to the leakage that occurred because of pressure spikes. The press used eight 109-gallon-per-minute vane pumps to supply a high volume of oil for closing the press. Directional valves, like the one shown in Figure 2, were used to port the pumps' volume back to the tank when in idle mode and when no longer needed in the rams. When the command was given to close the press, it sounded like eight sledgehammers banging away on the reservoir. Once the press was closed and the solenoids were de-energized, a tremendous amount of vibration and shock occurred in the lines. This was due to the rapid change of flow direction from the pumps. Instead of going to the press, the pumps' volume rapidly changed direction and returned to the tank through the dump valves. It took an entire day to adjust the pilot chokes on all eight pumps. At the end of the day, the pumps were coming in and unloading smoothly.

Pilot chokes are considered optional equipment on directional valves. On valves that do not have them, once the pilot valve solenoid is energized, pilot pressure will be ported to shift the main spool at a very fast rate. This allows the pump volume to immediately flow through the valve, which generates a shock spike. Pilot chokes can easily be added to existing valves by using longer bolts to mount the pilot valve and block to the main spool housing.

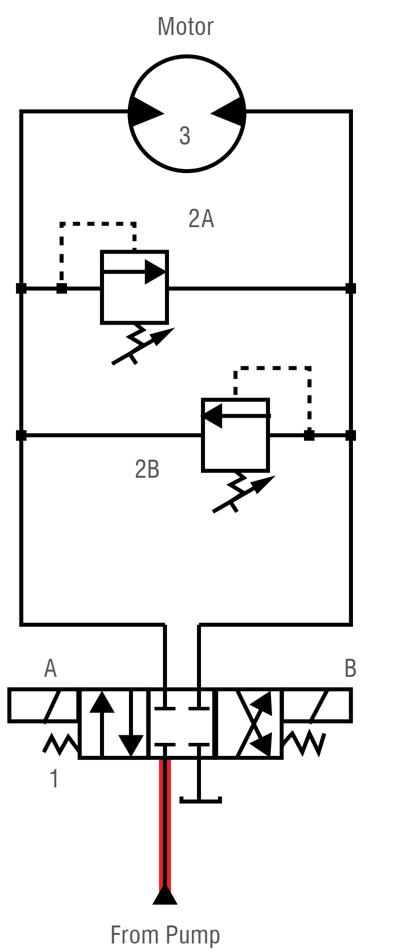


Figure 3. A circuit with a closed center directional valve (1), two crossport relief valves (2A and 2B) and a hydraulic motor (3)

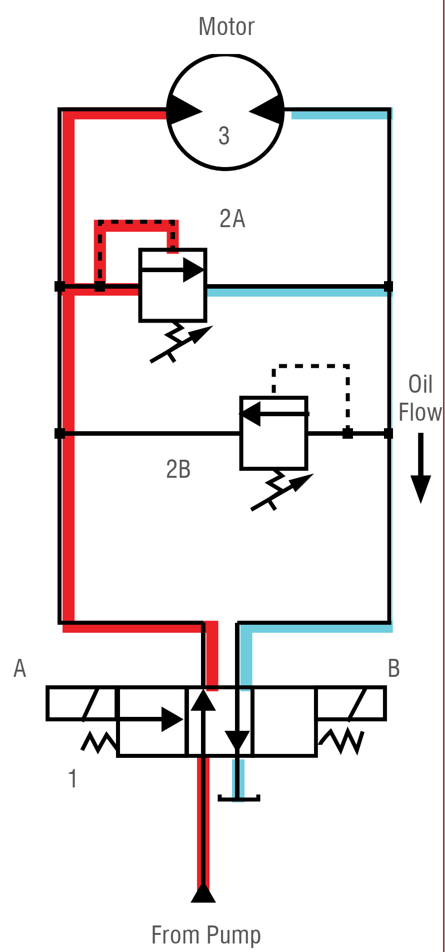


Figure 4. A circuit with the "A" solenoid of the directional valve energized to direct the pump volume to the motor

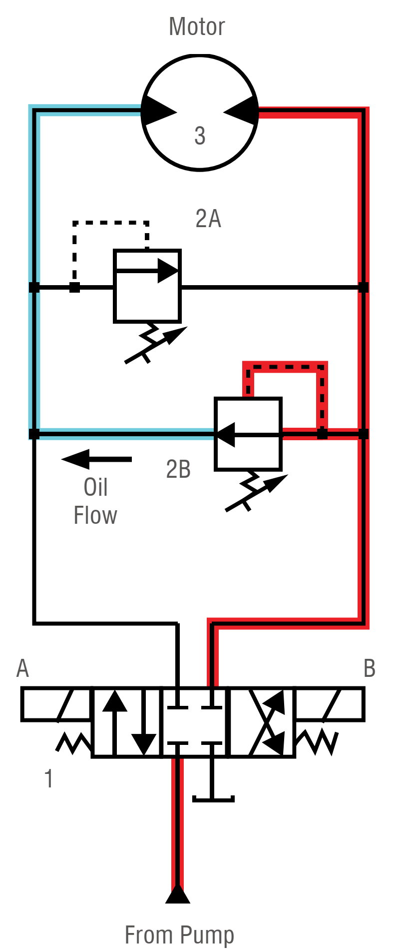


Figure 5. A circuit with the directional valve solenoid de-energized to stop the motor and the valve spool shifted to the closed center position

Use Crossport Relief Valves

Crossport relief valves are commonly used with hydraulic motors when it is necessary to stop a load relatively quickly. The main issues with crossport relief valves are that they are usually omitted from the system, are set too high or are mounted too far from the motor. In Figure 3, a typical circuit is shown with a closed center directional valve, two crossport relief valves and a hydraulic motor.

Crossport relief valves perform two functions in the hydraulic system: They absorb the initial shock spike that occurs when oil is first ported to drive the motor and bring the motor to a stop when the directional valve is de-energized.

Crossport relief valves should be set 200-400 psi above the maximum pressure required to drive the motor. In Figure 4, the “A” solenoid of the directional valve has been energized to direct the pump volume to the motor. Once the pressure momentarily increases to the “2A” valve setting, the spool will shift open and port the pressurized fluid through the directional valve and back to the tank. When the pressure drops below the “2A” setting, the valve spool will shift closed and the motor will start rotating. When the directional valve solenoid is de-energized to stop the motor, the valve spool will shift to the closed center position (Figure 5). The motor will tend to continue rotating due to the inertia of the moving load and momentarily turn into a hydraulic pump, delivering oil to its outlet port. The pressure will build until the setting of the “2B” crossport relief valve is reached. The “2B” valve will then shift open and direct the oil flow back to the motor’s inlet port. The setting of the “2B” spring will determine how fast the motor will come to a stop.

If you’re experiencing shock and leakage issues with hydraulic motor circuits, first verify that the crossport relief valves are located in the system. I have seen some systems where they have been omitted, allowing the shock to be taken out in the lines, hoses and fittings, which results in leakage. Secondly, make sure the crossport relief valves are properly set. When there is a problem in a hydraulic system, usually the first course of action is to turn up the pressure. Thirdly, the crossport relief valves should be located as close as possible to the hydraulic motor.

A plywood plant in North Carolina was having a problem shearing the motor shaft off its rotary log-kicker hydraulic motor. As the logs came down the conveyor, the motor rotated and kicked the log off the conveyor and onto the infeed conveyor to the lathe. Upon inspection, the crossport relief valves were found in a block underneath the directional valve, which was mounted 30 feet away from the motor. An additional set of crossport relief valves was installed near the motor, which eliminated the shearing of the motor shafts.

Likewise, by using these three remedies, you can greatly reduce the hydraulic shock in your systems and help to eliminate oil leakage at your plant. ■

About the Author

Al Smiley is the president of GPM Hydraulic Consulting Inc., located in Monroe, Georgia. Since 1994, GPM has provided hydraulic training, consulting and reliability assessments to companies in the United States, Canada, the United Kingdom and South America. Contact Al at gpm@gpmhydraulic.com

MARCELLO GRACIA, CONFIALUB

Lube Program HELPS Anglo American Increase ASSET RELIABILITY

Anglo American is one of the world's largest mining enterprises. In 2008, the company purchased the Minas-Rio project for mining iron ore in Brazil. Consisting of a mine, a beneficiation plant, a filtration plant, a pipeline spanning more than 325 miles and a port where iron ore is shipped, the $8.8 billion investment included hundreds of assets. To ensure asset availability, Anglo American employed several key strategies, such as reliability-centered maintenance (RCM), failure mode and effects analysis (FMEA), predictive techniques (oil analysis, vibration and thermography), and online monitoring (vibration and temperature). However, perhaps most important was the implementation of a well-designed lubrication program. This program has resulted in significant financial gains and was chosen to receive the 2015 John R. Battle Award by the International Council for Machinery Lubrication (ICML) for excellence in machinery lubrication.

The Journey

At the Minas-Rio mine, lubricants, refrigerants and fuels are constantly in contact with sensitive asset components. Anglo American determined that efficient management of the contamination and cleanliness levels of these fluids could lead to improved equipment performance, optimized component life cycles, increased asset availability and reduced maintenance costs. The challenge would be to keep the fluids clean, cool and dry in order to obtain these benefits.

When a structured plan was created, it focused on three elements: the people, equipment and methods. The first stage started in October 2013 and included implementation of a training program for personnel on best practices as well as selection of an oil analysis laboratory. Specifications were developed to ensure proper receipt, storage, handling, filtering, measuring and application of lubricants. To prevent contamination by the external environment, vents, quick couplers, sampling valves, etc., were also utilized.

The second phase of the plan began in April 2015. It involved creating procedures for the management of clean fluids, writing specifications for the oil analysis lab, installing shielding devices, commissioning the tanking station, mapping application opportunities for special and synthetic lubricants, and conducting an audit of the "clean fluids" practices.

In addition, between 2015 and 2016, several training classes were held for Minas-Rio personnel. These classes resulted in the ICML certification of 20 employees as a Level I Machine Lubrication Technician or Machine Lubricant Analyst. Additional training classes are scheduled for 2017.

The third stage was recently launched and is scheduled to be completed in December 2017. This phase will see full operation of the oil analysis lab, development of the training program with leaders and lubricators, embedded filtering to increase the productivity of lubrication teams, improvement in safety conditions, maintenance of fluid cleanliness levels in critical equipment, continuity of audit processes and continuous improvement initiatives.

The Results

So far, the lubrication program has generated considerable cost savings thanks to

The plant's lubrication workshop (external view)

An internal view of the plant's lubrication workshop

The pipeline lubrication workshop

reduced lubricant consumption, extended oil changes and avoided acquisitions due to oil filtering activities. The certification program has been essential in the cultural change process, placing Minas-Rio in a prominent position nationally and in the mining industry. The clean fluids initiative is in the assessment process and may soon be used as a reference within the company and on a worldwide basis. This year will be extremely important for the mine in consolidating its practices, continuing to develop its culture and measuring tangible gains in reduced maintenance costs and increased asset reliability.

BY PRENTICE RICHARDSON, NISSAN NORTH AMERICA

Continuing the Journey to Lubrication Excellence

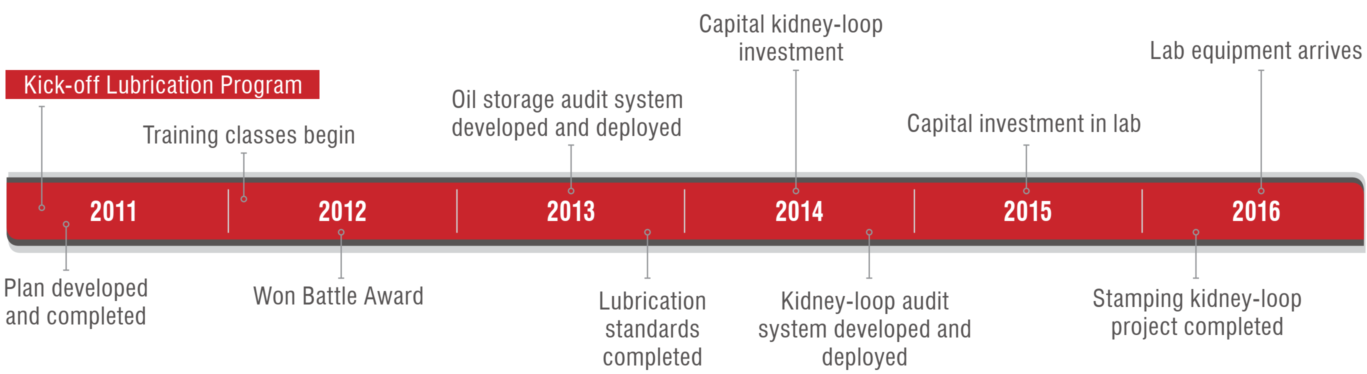
Nearly five years ago, the management team at Nissan saw the need to create a group that would lead the transition of its maintenance lubrication teams to a world-class level. In 2012, the Nissan stamping plant in Smyrna, Tennessee, succeeded in winning the John R. Battle Award from the International Council for Machinery Lubrication (ICML). Since that time, Nissan has developed a better mindset, emphasizing knowledge through education and training in the field of lubrication. Of course, even with a better outlook on lubrication, there are always opportunities to improve.

The Nissan team won the 2012 John R. Battle Award from the International Council for Machinery Lubrication.

Training and Education

The initial focus at the Nissan stamping plant was on education and training. The lubrication management group plays a significant role in this area. They set up training classes with the lubrication teams and are the go-to guys for resolving any lubrication issues. Many technicians are now educated and trained in the lubrication field. Nissan provides Level I Machine Lubrication Technician (MLT I) training and certification testing through the

Nissan's Lubrication Timeline



ICML. Currently, the facility has 70-plus MLT I certifications. Additional training opportunities, including supplier-sponsored and online training, have been incorporated as well. The plant's oil analysis expert has achieved his MLT I certification along with a Machine Lubricant Analyst (MLA) certification. He has been a big part of the lubrication program's success. Nissan also has ongoing training to educate its technicians on the importance of using an ultrasonic grease gun when lubing a bearing. This training is provided by an in-house ultrasound expert.

Controlling Particle Contamination

To address particle contamination, the plant concentrates on all new oil brought into the facility. Armed with the knowledge that new oil is not necessarily clean oil, the Nissan team has begun checking all received oil drums along with new bulk orders. With the new Karl Fischer testing system, the plant can now see if water is present in the oil. This is the appropriate way to determine whether good, clean oil is being received for the equipment.

Another significant step Nissan has taken to control particle contamination has involved selecting the right grease application for all new conveyor chains. The best grease is now identified before new conveyor chains are purchased to eliminate any cross-contamination in the facility.

The stamping plant must also manage its unique open-lube systems, which expose many of the equipment's vital parts to particle contamination. After a thorough investigation, it was determined that the most cost-effective way to control contamination was to use kidney-loop filtration. With these systems in place, particle contamination has been minimized, resulting in downtime being reduced by nearly 61 percent over 35 pieces of equipment. Achieving this type of reduction in downtime ensured management's support for implementing the contamination control and improved lubrication practices strategy on all presses with this design.

Dirt Reduction

Nissan recently saw considerable cost

savings by decreasing the dirt in its inline washing units. These units are used to reduce the number of contaminants before the forming process of surface parts. Previously, the filtration unit was a bag filter system, which was difficult to maintain, with a high cost for replacement filters. Oil testing also showed signs of degradation.

After the issue was studied, it was decided to implement kidney loops for the washing oil filtration process. By installing a kidney-loop system, the plant found that management of the filters is easier to maintain and more cost efficient, as the filters can be changed quickly without having to shut down the line. This has resulted in a cost savings of $166,000 through less downtime, scrap reduction and overall quality.

A New Style of Preventive Maintenance

At this stage in the program, Nissan's team had already tackled several of its biggest problems and had seen significant improvement in both uptime and employee morale. Moving on to address other important issues,

A kidney-loop system was installed to make it easier and more cost efficient to manage and maintain filters.

the team evaluated the plant's preventive maintenance (PM) and decided to introduce a new style of PM that would offer clear direction as to what was to be inspected, which lubricant to use and how much, as well as pictures for easy identification. The key was to engage all the technicians to assist in the process.

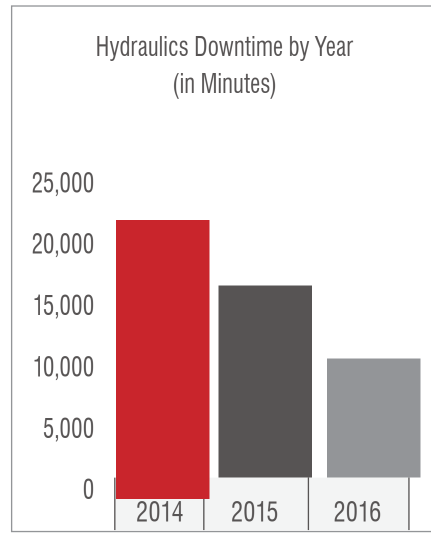
Now when PMs are generated and distributed, the technicians gather the necessary information from the equipment and write it on the PM. They also add any additional information about the equipment that may not be listed and mark off anything that does not apply. Calculations are then made to ensure that not only is the lubricant correct but also the quantities and application frequencies. This data along with the related pictures are put into the new format and released the next time the PM is performed. The PM-optimizing process has been a great opportunity for all personnel in the facility to strive for the best results with their lubrication practices.

Onsite Analysis

Another crucial component of Nissan's lubrication program is its onsite laboratory, which has proven its effectiveness in predicting failures and monitoring current equipment conditions. The lab has analyzed and optimized existing routes, and established a schedule for them to be performed on a monthly basis. If a problem is discovered or a trend changes, the lab can adjust the equipment testing accordingly. This method has been successful in identifying problems and allowing the maintenance groups to plan repairs. With this process, the lab has freed up additional time, which is now used to evaluate new equipment that can be added to the routes, such as drop lifters and overhead conveyor drives.

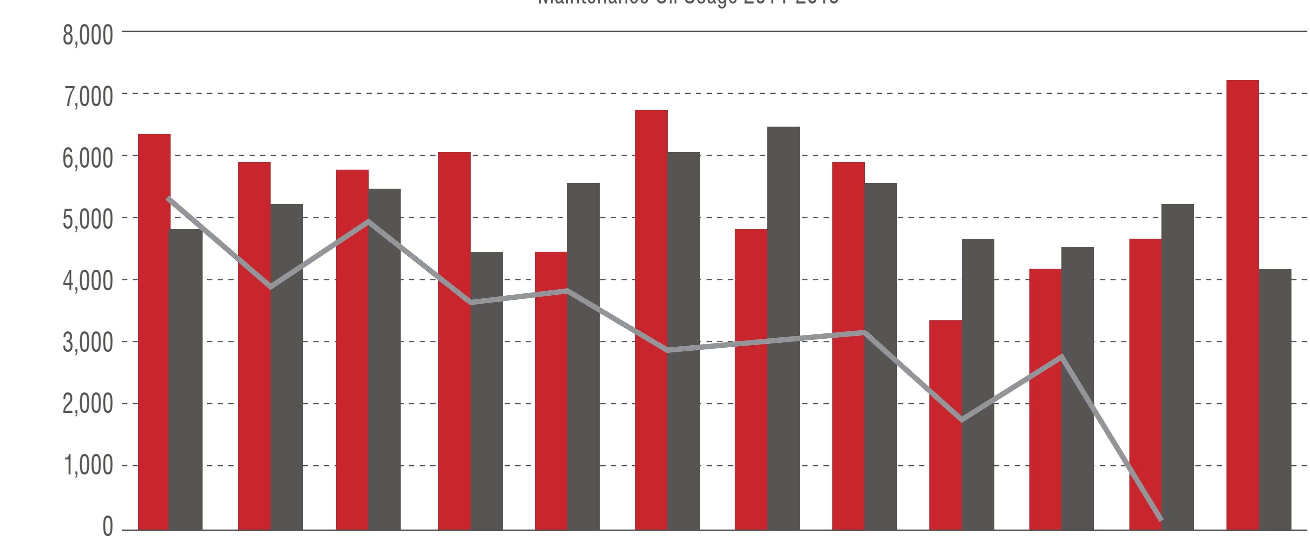
Management Support

Having the support of technicians and management has been critical in Nissan's success. Although the program is still very young, with strong roots in education, unquestionable management support for sustainability, standardization of procedures based on best practices, trending of critical metrics, use of information technology and a commitment to continuous improvement, the plant is definitely moving in the right direction. ■



The Nissan plant has seen an overall reduction in downtime of more than 60 percent.

Maintenance Oil Usage 2014-2016



	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
2014	6,354	5,901	5,787	6,057	4,512	6,741	4,864	5,934	3,290	4,128	4,684	7,253
2015	4,808	5,171	5,445	4,487	5,510	6,027	6,455	5,530	4,644	4,526	5,204	4,211
2016	5,315	3,913	4,946	3,639	3,787	2,858	3,074	3,163	1,735	2,744	125	

Good lubrication practices have led to reduced oil consumption.

BY BRETT MINGES, POLARIS LABORATORIES

Building a Successful Maintenance Program Through Oil Analysis

Integrating oil analysis into an established maintenance program can yield great returns in the form of more reliable, longer-lasting equipment. However, 43 percent of oil analysis programs leave half of their equipment unsampled, and 36 percent don't adjust their preventive maintenance based on the results. Moving a reactive or preventive maintenance program to one that predicts and avoids wear requires the right people, processes and technology, but the rewards are well worth the effort.

Build the Business Case

Many programs have a staggered start when they adopt oil analysis. They either test the value using a pilot program or pick a starting location that will discover the best way to fit the program into their processes before rolling it out to the entire company. Along the same lines, it's much more feasible to pick one or two types of equipment to test at the beginning. Adding the task of collecting oil samples regularly from all equipment isn't realistic for most maintenance programs out there, especially if they already feel the crunch of overtime hours.

The first step is identifying where testing would generate the most bang for the buck. Focusing efforts on increasing the reliability of critical and "problem" equipment especially helps time-starved maintenance programs get ahead of the work backlog. It also adds the bonus of demonstrating the strongest benefits to management.

For programs without data from past oil analysis, the best place to start is by pinpointing equipment that is experiencing high rates of failure. Units can be grouped by type, manufacturer, model, application, replacement cost, hours/miles operated or how vital they are to production. Calculating the maintenance costs (especially rebuilds and replacements) and the number of failures will typically identify the units that would benefit the most from oil analysis.

Presenting the business case this way should succeed, since you're speaking the language of management. Maintenance and equipment costs are unavoidable, but they can be reduced. Savvy businessmen are willing to listen to improvement ideas, especially when they are backed up by real-world data.

Develop a Plan and a Team

Once given the green light to begin, many want to jump in and start pulling samples. That sort of ad-hoc program can easily fizzle out or run into problems that kill momentum. In addition, easing into a program will allow time for staff to become acquainted with the new process so it doesn't feel like additional work piled on top of their already heavy workload.

Instead, create a detailed action plan, recruit personnel and begin training staff. Pin down exactly who will be responsible for what duties and how their efforts will be evaluated. Set dates or triggers for staggered rollouts, but remember to leave space in your timeline to deal with delays and unexpected issues that will eat up time. While there's nothing wrong with aggressive schedules, falling behind can be demoralizing to staff and raise management concerns.

Prepare Personnel and Equipment

Once the plan is in place, it is time to put it into action. Training and preparation are always required, even for oil analysis veterans. Everyone involved with the program needs to know how it will benefit the maintenance plan before they can start believing it will help them and the company. This training also provides an opportunity for feedback and can identify overlooked obstacles or weaknesses in the plan.

The equipment may need preparation, too. Retrofits, such as adding oil sampling ports, can expedite the sampling process and free up many maintenance hours. If nothing else, the equipment list needs to be updated in your computerized maintenance management system (CMMS) and oil analysis provider's files.

Grade Progress and Share the Wins

The best way to accelerate the adoption of a new program is to measure the progress and share the results. Necessary first steps, like the retrofits, training and list management steps mentioned previously, can get bogged down and delayed without a guiding hand directing (and sometimes pushing and pulling) them along.

One way to hurry the transition along is to "grade" the progress of each section/location/division and review them out in the open. Peer pressure and friendly competition can go a long way toward motivating slow adopters. Once the oil analysis program is up and running, your time can be devoted to providing additional motivation, such as sharing major saves, recognizing sampling compliance or establishing best practices.

Show the Financial Justification

It is important to capture information about maintenance and replacements that were avoided due to oil analysis. A lot of time can be saved when information is documented in the moment. Estimating the costs and time spent on projects can be difficult, especially if months have passed. Your management software or even a simple spreadsheet can track the hours spent and the cost of parts for each project.

Multiply the hours spent conducting repairs by the average labor rate or burden rate and add in the part costs to estimate what was spent on an individual repair. To evaluate the program as a whole, add in the cost of oil analysis testing and the labor spent collecting samples. By comparing this to the cost of complete unit replacement or more involved repairs, you can calculate the immediate return on investment (ROI).

A more advanced method of calculating ROI would be to factor in the cost of downtime to your company. This requires a lot of coordination with the production department, and this data isn't always available to maintenance divisions.

Make Decisions Using Data

The final step to integrating oil analysis into a maintenance program is to take advantage of the sample result data as a whole. Basic programs just review individual results for unexpected wear. This will definitely save equipment and reduce downtime, but all your past results contain a lot of statistics that can be mined for even more savings.

Oil analysis providers can sort and filter specific results from your data and compile them into a management report. A wide variety of reports are possible, and the helpfulness of each depends on the individual's position in the maintenance program. For example, having a daily list of high-severity maintenance recommendations is extremely useful for maintenance managers looking to assign work to technicians. The senior maintenance leadership for a national company will find little use for such a list, but they might want to see a monthly pie chart with the percentage of each severity.

The most sophisticated use of oil analysis data and management reports will aid strategic, companywide decisions with scattergrams and Pareto charts. Identify the types of equipment that break down the most, extend oil drains with minimal risk by finding the threshold where severity levels spike and make purchasing decisions based on which makes and models perform the longest before maintenance/replacement is required.

Create a Partnership

Each company is different, and an oil analysis program can be easily customized to deliver superior results. Sample bottle cleanliness, flagging limits, report delivery options, computer system integration and automatic management report subscriptions are just a few of the options that can be adapted to improve an oil analysis program. In this regard, an oil analysis company is more like a service provider than a simple supplier. ■

WES CASH | NORIA CORPORATION

Why You Should CROSSCHECK Your OIL ANALYSIS Lab

It has been a couple years now since the birth of my first child. I remember going to the doctor's appointments with my wife where countless exams and tests were conducted to confirm that the pregnancy was progressing as it should. There were measurements, readings and occasionally blood tests. One of the blood tests was designed to look for genetic abnormalities. The literature on this test explained there was a chance for false positives as well as false negatives. Several samples were taken to ensure the test was performed accurately and the results could be verified.

Our son was born happy and healthy, but the memories of all the testing and the quest for accuracy with the results stayed with me. Similarly, when you receive medical advice that you don't like or accept, you usually seek a second opinion from a different doctor or hospital. Although sometimes you may get better news or different results, oftentimes the same results come back, further substantiating the thoughts or recommendations of your doctors. This same logic can be applied to oil analysis laboratories.

Ensure the Integrity of Your Oil Analysis Data

How many times have you sent off an oil sample and had results come back that seemed odd or with information that you just couldn't accept? While this isn't the norm with oil analysis data, it does happen. Each result should be scrutinized and reviewed. Look for anything that seems out of the ordinary. At the end of the day, labs can make mistakes, so it is up to you to ensure the integrity of your data.

> Most oil analysis practitioners assume the data from their laboratory is accurate and irrefutable, but this may not always be the case.

In the past, oil analysis services were offered in which quarterly samples would be taken from machines and the results analyzed, with the customer taking the corresponding action. The methodology was very pedestrian. If the results were labeled as green, nothing was done. If the results were marked as yellow, another sample would be taken in the coming weeks. If the sample was flagged as red, the oil and filters were changed. There was no in-depth analysis, and whatever data

was presented on the lab reports was treated as absolute truth.

While this approach was overly simplistic, it yielded decent results for individuals in the field. However, if the lab made a mistake and reported a fluid property, wear or contamination parameter in a critical or red state, immediate action was taken, which normally meant dumping the oil charge and replacing the filters without ever taking a follow-up sample to confirm the evidence of an issue. If even one of those red reports had been a false positive, you could have avoided several man-hours of work and in some cases thousands of dollars in replacement parts. This could have easily paid for the secondary sample or follow-up action required to ensure the lab results were accurate.

When you receive less than desirable oil analysis results, the first step generally is to take a follow-up or confirming sample to send to the laboratory for more testing. Although this is an easy process to implement, it requires diligence on the part of the individual reviewing the data as well as the person taking the sample. If the original sample comes back in a critical alarm, taking another sample and sending it to the lab for immediate analysis must be pushed to the top of the priority list. This works well for most organizations that are willing to rely on the lab to have its own standards and policies for ensuring repeatability of the tests. Others would rather take this into their own hands and be the masters of their own data.

Onsite Oil Analysis

With many manufacturers of laboratory instruments now offering smaller and easier-to-use equipment for field applications, onsite oil analysis is becoming increasingly popular. These devices can perform a vast array of tests on used oil and provide useful data in nearly real time. Of course, the same consistency concerns that commercial laboratories must overcome also apply to onsite labs. These issues can be even more difficult for onsite laboratories due to the training and calibration requirements of much of the equipment. Still, these are fantastic tools for any oil analysis program.

Far too often when auditing lubrication programs, I see companies that have invested in testing equipment but do not properly maintain it or dedicate adequate personnel for its upkeep and use. Even for those who do make the proper investment in equipment and staff, the onsite lab should never replace sending periodic samples to an outside commercial laboratory. In most cases, the commercial lab will be able to perform more specialized tests than the onsite lab and can serve as a crucial check of your internal testing protocols and equipment accuracy.

Checking a Lab's Accuracy

One way to check the accuracy of any oil analysis laboratory is by using what is commonly referred to as a tracer sample. Think of this as a blind test to determine whether your sample preparation and results are what they should be. You can use the same fluid in multiple samples or change the fluid to see what the results will be.

The best practice is to utilize a reference

25%

of lubrication professionals say they would not understand how to interpret an oil analysis report received from a commercial laboratory, based on a recent survey at MachineryLubrication.com

sample of new oil, which you can then use to check for signs of additive depletion, viscosity changes or other physical property differences. Instead of extracting a single sample of new oil, you could take several. This will provide a bank of oil samples from the same batch of new oil. These now become your tracer samples.

Send the first tracer sample to the lab and have it tested against the normal test slate. The results should be archived. Several months later, send another tracer to the lab for analysis. Remember, oil ages, even inside a sample bottle, but the change is very slight. Therefore, the results of the additional tests should be in the same range. If the results vary widely, there is an issue with either the testing equipment or in the sample preparation. Ultimately, it will be up to the laboratory to determine the reason, but this merits a phone call to discuss the results. This process is equally effective for onsite labs. Just be sure they don't know when a tracer sample is coming.

To check the accuracy of specific tests, such as elemental analysis or particle counting, you might choose to employ different fluids. For example, an ultra-clean lamp oil could be used to test a particle counter. If a sample of this type of oil is sent for particle counting, the results should be very low. If high particle counts are seen, it could be an indication that something is not working properly.

Turbine oil can be used for checking elemental analysis. Most oil analysis results for turbine oils appear as a blank slate in the elemental signature. Sending a sample of a known turbine oil and then analyzing the results in the elemental spectrum can provide good information on the repeatability and accuracy of a lab.

Some companies prefer to use multiple commercial laboratories to test the same sample of oil and then compare the results. This is quite common and encouraged for the utmost data accuracy. While this may not be feasible for every oil sample, it is good practice to periodically send the same sample from a critical machine to two different labs and run the same test slate just to ensure your data is trustworthy.

ASTM Crosscheck Program

Most oil analysis practitioners assume the data from their laboratory is accurate and irrefutable, but this may not always be the case. Routine checking of your lab is crucial. Fortunately, a system already exists for this practice, known as the ASTM Crosscheck Program. Although this program is voluntary, it can confirm when a lab is able to produce accurate, consistent results.

The program is based on different types of oil testing, but includes several common tests that would be performed on industrial fluids, such as viscosity, particle counting and elemental analysis. As with most programs like this, there are various subcommittees for different oil applications, such as automotive and turbines. Regardless of the oil type, the testing parameters should be consistent no matter which lab conducts the test.

The program is quite simple. Oil samples are sent to participating laboratories and tested. All the results are then gathered and analyzed to determine how accurate the labs are in achieving similar results from similar oil samples. This is important information to look for or request when using a commercial laboratory. Ask if the lab participates in the crosscheck program and if it has any other quality-control accreditations. Sometimes these questions alone are enough to shed light on a laboratory's shortcomings.

If you plan to conduct your own crosscheck by utilizing the tracer method or employing multiple labs, make certain they all run the tests according to the same ASTM method. Even with some of the more common tests like elemental analysis, there are several ways in which they can be performed, with each producing slightly different results. To help minimize this risk, always ask or instruct the lab which ASTM standard of the test will be used. Also, be sure to select methods that can be crosschecked by either your onsite lab or another commercial laboratory.

If you suspect an issue with the testing, at the very least you should call the laboratory and ask for the test to be performed again. Most labs keep a small amount of each sample, commonly referred to as the retain. The retain can often be retested to confirm or potentially correct any error in the original sample. This practice is at the discretion of the laboratory, so it will require a conversation between you and your lab. This is more common among commercial laboratories and much harder for onsite labs to accommodate.

As you continue to refine your oil analysis program, keep in mind that the data from your laboratory may be incorrect. Use these recommendations and have an open conversation with your lab so you can rest easy knowing that the data you receive is as accurate as possible. And, as always, double-checking your lab is never a bad idea.

About the Author

Wes Cash is the director of technical services for Noria Corporation. He serves as a senior technical consultant for Lubrication Program Development projects and as a senior instructor for Noria's Oil Analysis II and Machinery Lubrication I and II training courses. Wes holds 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). Contact Wes at wcash@noria.com to learn how Noria can help you ensure the integrity of your oil analysis results.

LUBRICATION

OIL IN A MACHINE IS LIKE BLOOD IN THE HUMAN BODY


CEMENT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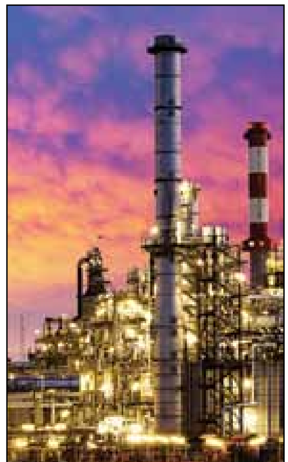
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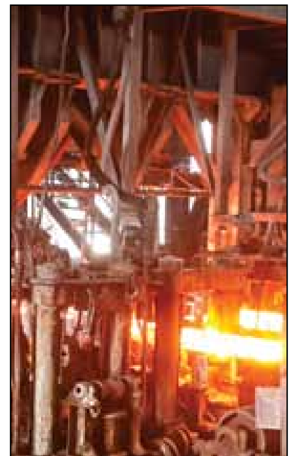
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"For gearbox applications, is it preferable to use mineral oil or synthetic oil?"

Most gear oils use a polyalphaolefin (PAO) as a base stock. This is essentially a man-made version of the naturally occurring mineral oil pulled from the earth and refined. The size of the molecules is all relatively the same. These are also saturated molecules, which makes them very stable.

The benefits of synthetic oils relate to the molecules' stable nature and include a higher degree of hydrolytic stability and demulsibility, a higher viscosity index (VI) and a lower pour point. The VI and pour point allow these oils to perform better across a broader temperature range.

The drawbacks of synthetic oils would include their cost and solubility concerns. PAOs generally have low solubility, which means they do not dissolve additives as readily as their mineral counterparts. Synthetic oils also have a difficult time suspending varnish-forming degradation byproducts.

While many people make the snap decision to switch to synthetic oils, the cost factor should be considered. Focus on the optimum reference state (ORS), which is the state that is best for a particular piece of equipment under its specific operating conditions and environment. It should also take into account the equipment's criticality as well.

For example, say you have two identical pumps with different functions in the plant and different levels of criticality. For one of the pumps, you might take vibration readings and outfit it with a desiccant breather, bottom sediment and water (BS&W) bowl, and minimess sample connection. The other pump receives none of this "special treatment." Why is that? It all comes down to a matter of cost. If the more critical pump fails, it will have a larger financial impact than the other pump.

This same methodology should be applied when deciding whether to use a mineral or synthetic gear oil. If the equipment's operating conditions and environment are not as stressful or the financial impact of a failure would not be as significant, then you could probably get by with a mineral oil, as you are not likely to gain enough benefits from the synthetic oil to justify the cost. However, if the environment is more severe, the temperature runs extremely high or low, there are extended oil drains, or the impact of a failure is considerable enough to justify the cost, then you should choose a synthetic oil.

"How do you spray-lubricate an open gear? Are nozzles commonly available for this? What air pressure is ideal? What is the best distance between the nozzle and application area? Is spray lubrication the best way to lubricate an open gear?"

When it comes to open gears, spray lubrication is a common practice. However, it isn't the only option. A variety of greases are specially formulated to work on open gears. That said, there are some key practices to follow when using a spray system on an open gear.

As with any lubrication system, it is important to verify that the appropriate volume and type of lubricant are being used. You must also ensure that the lubricant stays in place and is of the correct viscosity.

The distance between the gear teeth and the spray system's nozzles can vary greatly. Sometimes they may be placed as close as 2 inches, while in other cases a distance of 8 inches is desirable. It depends on the speed of the gear, the gear size and the spray nozzle in use.

A variety of nozzles are available, with each offering a distinct spray pattern and requiring a different air pressure. Selecting a spray pattern is one of the more critical considerations for this application. While most nozzles do a good job of atomizing the lubricant, you must make certain that the spray pattern coats the gear surface prior to the teeth meshing. This may require several nozzles. The entire width of the gear must be sufficiently covered with lubricant, and overspray should be minimized.

It is good practice to routinely inspect any spray system for proper operation. This includes confirming that the nozzles are spraying, there is adequate air pressure and there is lubricant in the reservoir. The nozzles tend to clog with debris or wax in some cases. Any clogging of the nozzles can have adverse effects on the spray pattern and the quality of lubrication that is occurring on the gear.

Spray lubrication offers a great way to lubricate open gears, but the same rules apply as with any lubrication practice. The system will only be as good as it is installed and maintained. Many excellent systems have failed due to lack of maintenance or inspections. With proper maintenance, these systems can provide increased reliability and decrease the manpower required to lubricate the gears manually.

If you have a question for one of Noria's experts, email it to editor@noria.com.

TEST your KNOWLEDGE

This month, *Machinery Lubrication India* 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.

1. The best location for a filter to achieve low-cost dirt removal is:

A) At the suction side of the pump
B) After the pump in the pressure line
C) In the return line
D) In an off-line (kidney-loop) system
E) No specific location has any advantage

2. The concentration of wear debris:

A) Always increases throughout the oil circulating system
B) Varies throughout the oil circulating system
C) Always decreases throughout the oil circulating system
D) Is constant throughout the oil system
E) Varies with the pressure in the oil system

3. Which component generally requires the cleanest oil?

A) High-pressure hydraulics
B) Gears
C) Engines
D) Turbines
E) Journal bearings

Answers

1. D
The off-line (kidney-loop) system is normally connected to the oil reservoir where most of the dirt accumulates.

2. B
It varies throughout the system because of the many components included. For example, the concentration of wear debris after the filter will be much less than before the filter.

3. A
This is due to the delicate components of hydraulic systems such as servo valves and the fact that contaminant sensitivity increases disproportionally to pressure.

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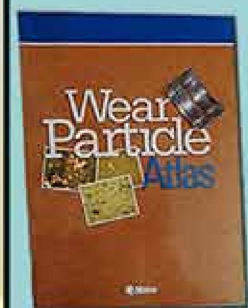

The Wear Particle Atlas provides information for the identification of various wear particle types, the description of wear modes that generate these particles, the consequences of these wear modes, and description of the techniques that facilitate wear particle analysis.

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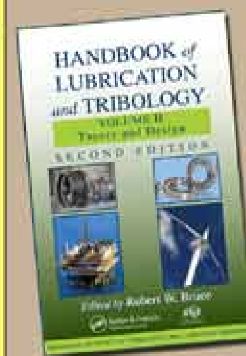

This book demonstrates how the principles of tribology can address cost savings, energy conservation, and environmental protection. This second edition provides a thorough treatment of established knowledge and practices, along with detailed references for further study.

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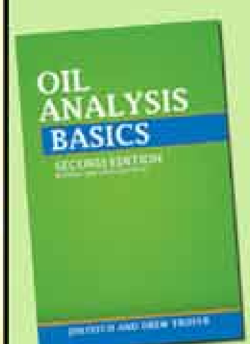

Oil Analysis Basics presents the fundamentals of oil analysis for machinery condition monitoring in an easy to understand format. You will learn everything from how to take a proper oil sample to how to select a test slate for your applications. With more than 90 illustrations, figures and lookup tables, you'll reference Oil Analysis Basics for years to come.

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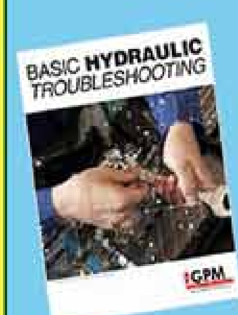

Basic Hydraulic Troubleshooting is written for electricians, millwrights, supervisors, reliability technicians and anyone who is responsible for the hydraulic maintenance of plant machinery. This fully-illustrated color manual contains nearly 300 pages of troubleshooting and reliability procedures. It can also be used as reference as actual machine problems occur.

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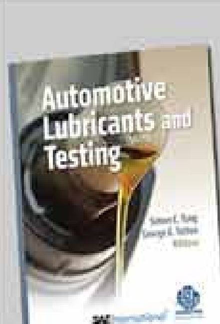

Automotive Lubricants and Testing provides a comprehensive overview of various lubrication aspects of a typical powertrain system, including the engine, transmission, driveline, and other components. It also covers lubrication fundamentals and lubricant testing methods that are influenced by lubricant additive formulation and engine hardware changes.

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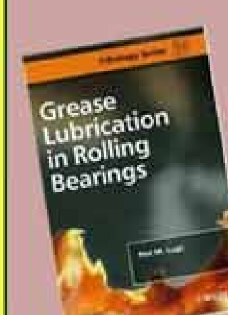

Grease Lubrication in Rolling Bearings provides an overview of the existing knowledge on the various aspects of grease lubrication (including lubrication systems) and the state of the art models that exist today. The book reviews the physical and chemical aspects of grease lubrication, primarily directed towards lubrication of rolling bearings.

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Lube-Tips™

THE "LUBE-TIPS" SECTION OF *MACHINERY LUBRICATION* MAGAZINE FEATURES INNOVATIVE ideas submitted by our readers. Additional tips can be found in our Lube-Tips email newsletter. If you have a tip to share, email it to editor@noria.com. To receive the Lube-Tips newsletter, subscribe now at www.MachineryLubrication.com/page/subscriptions.

Sampling Refrigeration Compressor Oils

When sampling refrigeration compressor oils, particularly some synthetics such as polyalkylene glycols (PAGs) and polyolesters (POEs), it is of paramount importance that the lubricant is exposed to the air for as little time as possible. This applies particularly in humid environments. The reason for this is that these lubricants are hygroscopic, which means they absorb uncondensed water vapor directly from humid air. An accurate moisture content reading is vital for the analysis of most refrigerant system lubricants. It is for this reason that the lubricant should be given as little exposure to the atmosphere as possible. Likewise, it is important that your laboratory take equal care not to expose the oil to the air when it carries out its tests. Ideally, the moisture content test should be the first one performed.

Advice for Sight Glass Inspections

If there is a sight glass for the reservoir of your bearing lubricant, make sure there is a line that marks the level of the lubricant when the bearing is running and a line that marks the level of the lubricant when the bearing is stationary.

Timing Diesel Engine Oil Changes

Users of large diesel engines should consider changing oil and oil sampling based on the gallons of fuel burned versus calendar or work hours of the driver. The driver may not actually drive all the hours for which he is paid. Likewise, some days using the calendar method will be weekends and holidays.

Filter Change Tip

When changing a filter element inside a housing, drain all the oil from the filter housing first. There should be a drain port near the bottom of the housing as well as a port on the top to let in air. This procedure will eliminate debris that was trapped in the filter element from rinsing out when pulled through the oil in a filled housing. This debris will get a free run at your system when restarted because it is already on the downstream side of the new filter.

How to Take Care of Idle Machinery

If electric motors are to be stored for a period of time, the vibrations created by the plant could cause false brinelling of the bearings. False brinelling occurs when the protective film of a lubricant is worn away by vibration and there is metal-to-metal contact between the edge of the rolling element and the bearing race. To prevent false brinelling, turn the shaft of the stored motor with your fingers a minimum of once a month. The same principle applies to idle machinery. The idle machine needs to be "bumped" to ensure that there is a film of the lubricant between the rolling element and the race.

Avoiding Bearing Contamination

Most large motors that have bearings with oil reservoirs are topped off through pipe plugs located on the top of the bearing housing. The problem is that as the top-off oil is added to the reservoir, it first passes over the threads for the pipe plug, washing any dirt, metal or other contaminants into the reservoir. To cure this, try screwing a short pipe nipple into the opening and capping it off with a pipe cap. Now when oil is added, it no longer passes over the active threaded area, helping to keep your top-off oil contaminant-free.

INDIA REMAINS A BRIGHT SPOT

India is already the world's third-largest finished lubricants market, and it holds great potential for marketers due to its fragmented nature, low barriers to entry and appetite for more players. The global lubricants industry is passing through a phase of little to no growth, but India remains a bright spot due to its steadily growing demand that offers opportunities despite the market's complexities. India has more than 35 well-organized, established companies and over 500 regional players, but suppliers can still boost their growth prospects by opting for co-branding with original equipment manufacturers, increasing distribution channels and communicating with consumers through relevant brand strategy.

There's a huge growth opportunity for both industrial & automotive lubes due to increasing population of both humans and vehicles in India. Challenges that arose due to the country's new Goods and Services tax regime and India's plan to jump from the Bharat Stage IV automobile emissions standard directly to BS VI in 2020 also offers huge growth potential to the companies that redesign their supply chain management and launch their products before the implementation of BS VI standard in the country. BS VI is equivalent to the European Union's Euro 6 standard and is expected to require engine design changes that require more advanced engine oils.

The Indian automobile industry – which includes passenger vehicles, commercial vehicles, three wheelers and two wheelers – produced 21.4 million vehicles in April-December 2017, up 11 percent from the same period last year, according to the latest data from the Society of Indian Automobile Manufacturers.

According to the latest 2018 global data show, India has overtaken Germany and has become the fourth largest automobile market in the world. Government is focusing more on the infrastructure, stricter tabs overloading ban and macroeconomic environment management so that our sales volumes remain strong and stable during this year.

Industry officials said that India's two-wheeler market – which includes motorcycles, scooters and mopeds – has already surpassed China's and will continue growing as vehicle ownership rises. The two-wheeler segment accounts for about 80 percent of India's automobile market.

USED LUBE OIL COLLECTION CENTRES TO BE SET UP IN INDIA

Public sector oil marketing companies (OMCs) are giving shape to an ambitious plan to move used lubricant oil handling in the country from the existing, largely informal sector, to a formal set-up focussed on environment-friendly recycling. The aim is to facilitate an ecosystem where handling of the used oil, which is a hazardous waste, is undertaken in a scientific manner. At the heart of this joint approach of Indian Oil Corporation, HPCL and BPCL, is the larger government mandate of utilising 25% re-refined base oil for lubricants by 2023. Given the country's status as a net importer of base oil — raw material for lubricants —the re-refine and re-reuse plan is expected to lead to substantial foreign exchange savings, conserve resources that are otherwise used for burning and importantly, protect the environment.

In a first step, the three entities have decided to engage consultants to guide them on setting up used lubricating oil collection centres on a pan-India basis. Besides assisting in establishing the facilities, the consultants would also be required to suggest the standard operating procedures to run them.

This is likely to be a phased program where the first phase would comprise of base lining current scenario of lubricants disposal mechanism, problem identification, regulatory challenges, comparison with other geographies/ sectors/ similar works with respect to best practices in the industry. This shall also focus on prioritizing identified ideas; developing detailed design/ business case, strategies for identified ideas and implementation plan; and then aligning stakeholders on implementation based on detailed design/business case. The second phase would focus on setting up of used lubricating oil collection centres in select region/geography based on study/ strategies identified in Phase 1.

SERVO WORLD-CLASS LUBRICANTS 100% PERFORMANCE. EVERYTIME.

UDAIPUR SERVO CEMENT MEET 2018

SERVO CEMENT MEET-2018: CEMENTING FUTURE WITH SERVO

SERVO Cement meet-2018 brought together all stakeholders of cement manufacturing industry such as participants from Cement Industries from Northern and western India & OEM. It was organised on 16th March, 2018 at Udaipur.

Sh. K L Murthy (Executive Director Lubes), Sh. Ravindra Garg (Executive Director RSO), Sh. Amitabh Akhauri (Chief General Manager-Lubes) & Sh. Jagdish Toshniwal (Manging Director, Wonder Cement) inaugurated the one day event by lighting the lamp.

SERVO CEMENT BROCHURE was launched by dignitaries.

Mr K.L.Murthy welcomed all participants and discussed role of cement sectors in infrastructure development in India and increasing demand of cement due to government infrastructure related schemes. He also discussed briefly about role of lubrication in cement industry and cementing future with SERVO. Mr Garg emphasized the need of such events to improve bonding of IOCL with its esteemed customers.

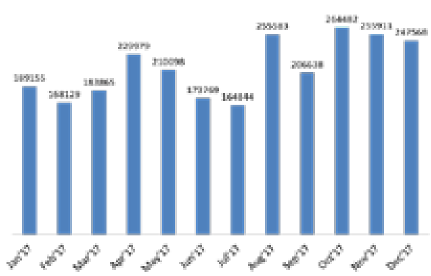
Program included panel discussion on present scenario in cement and related Lubrication Industry and three technical sessions, which included 17 technical presentations from cement industries, OEM, IOCL R&D and IOCL TS team. Sh. R. Suresh (Ex-Executive Director (Lube Technology), IOCL acted as moderator during plenary session and following three technical sessions were chaired by Sh. Y K Mathur (JK Cement Ltd.), Sh. Amitabh Akhauri (IOCL) and Sh. A.K. Dhar (Udaipur Cement) respectively.

A total of 150 participants from Cement industry and OEMs attended the meet. The cement companies represented were JK Cement, JK Lakshmi Cement, Nuvoco Vistas, Ambuja Cement, Ultratech Cement, Shree Cement, Nirmax Cement, India Cement, Wonder Cement, Udaipur Cement, ACC, Binani Cement, Birla Cement. The OEM participation was from Loesche, Elecon, Sadvik, Evonik,USA, CC Jensen Filtration, Denmark.

BASE OIL REPORT

Oil prices rose sharply on third week of March 2018, with Brent futures settling at their highest level in two weeks as traders focused on rising geopolitical risks in the Middle East, while gains in U.S. equity markets also boosted crude prices. U.S. West Texas Intermediate (WTI) crude futures for April delivery surged 1.88% to close at $62.41 a barrel. Meanwhile, Brent crude futures, the benchmark for oil prices outside the U.S., jumped $1.01 or 1.55% to settle at $66.13 a barrel. It was the highest settlement since February 28. For the week, WTI crude rose 0.48%, while Brent gained 1.1%. Oil prices rose amid speculation over the fate of Iran's nuclear deal, which allowed Tehran to boost oil production, in the wake of the firing of U.S. Secretary of State Rex Tillerson. Oil prices also remained supported after a report from the International Energy Agency on Thursday showed that supply from the Organization of the Petroleum Exporting Countries moderated in February on a drop in production from Venezuela. Import of the country has hike up by 1% during Jan to December 2017, as compared to the same period last year i.e. Jan to December 2016. The Indian base oil market remains steady with inventories at optimum levels with surplus of imported grades.

Month Wise Import of Base Oil in India

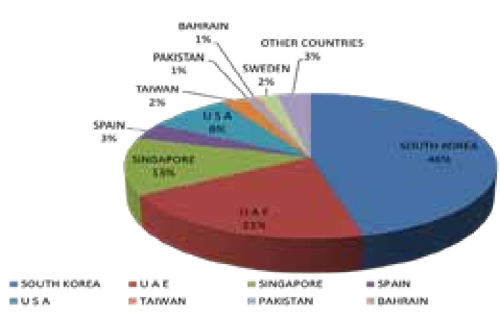


Dhiren Shah

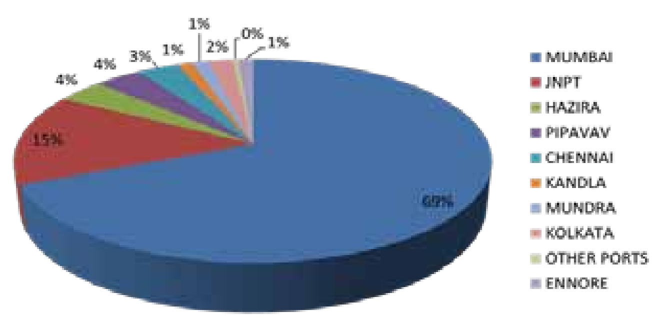
(Editor – In – Chief of Petrosil Group)

Petrosil Base Oil Report offers solutions to the entire base oil value chain, from refiners, suppliers, buyers, traders, agents, consultants, lubricant companies, professionals and logistic providers as well as any other entity of the base oil value chain.

Origin Wise Import of Base Oil into India - Country & % Jan 2017 – Dec 2017



Port Wise Import of Base Oil into India Ports & % Jan 2017- Dec 2017



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

Month	Group I - SN 500 Iran Origin Base Oil CFR India Prices	Group II -J-150 Singapore Origin Base Oil CFR India Prices	N- 70 South Korea Origin Base Oil CFR India Prices	Napthenic Base Oil HYGOLD L500 Prices
January 2018	USD 760 – 765 PMT	USD 735 - 745 PMT	USD 705 - 715 PMT	USD 760 – 770 PMT
February 2018	USD 790 – 795 PMT	USD 765 - 775 PMT	USD 735 - 745 PMT	USD 770 - 785 PMT
March 2018	USD 805 – 815 PMT	USD 780 - 795 PMT	USD 745 - 755 PMT	USD 765 - 780 PMT
	Since January 2018, prices have gone up by USD 45 PMT (6%) in March 2018.	Since January 2018, prices have gone up by USD 45 PMT (6%) in March 2018.	Since January 2018, prices have gone up by USD 40 PMT (6%) in March 2018.	Since January 2018, prices have hike up by USD 10 PMT (1%) in March 2018

PILOT (Practical Industrial Lubrication Orientation Training)

An accessory and activity based onsite practical lubrication training

PILOT is a skill based lubrication training program specifically designed for lube technicians, operators and shop floor associates. The objective of this training program is to upgrade the skill of technicians who actually perform the lubrication and inspection tasks. This training program is a combination of classroom as well as onsite practical training (activity and accessory based). The main focus of the training program is to illustrate how to perform various lubrication related tasks effectively, effciently and safely.

Main contents of the course include:

- Basics of lubrication
- Contamination control
- Hands on training for handling lubricants
- Sampling
- Field inspection of lubricants

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Inspiring productive change through education & training