Machinery Lubrication

INDIA November-December 2017
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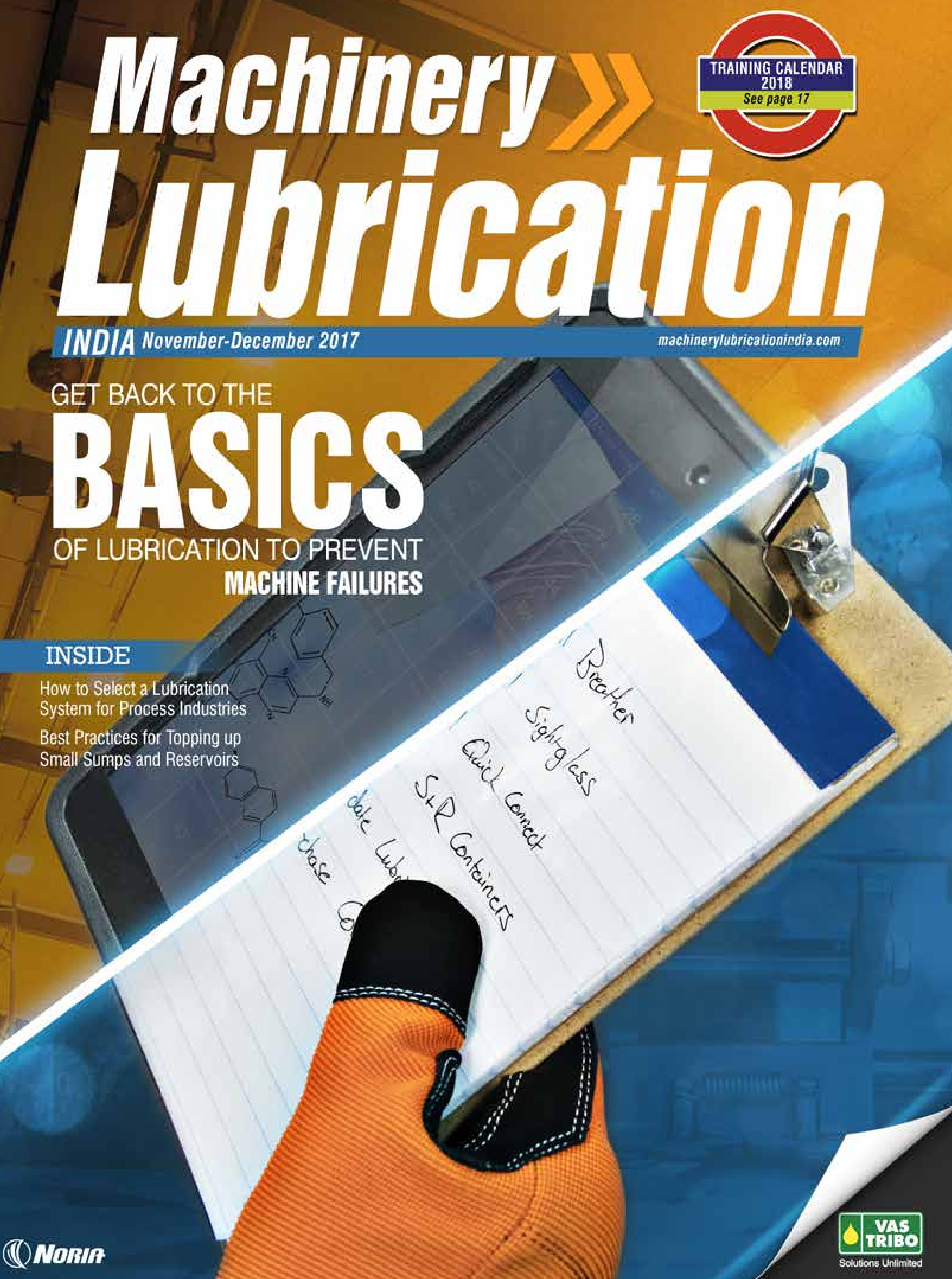
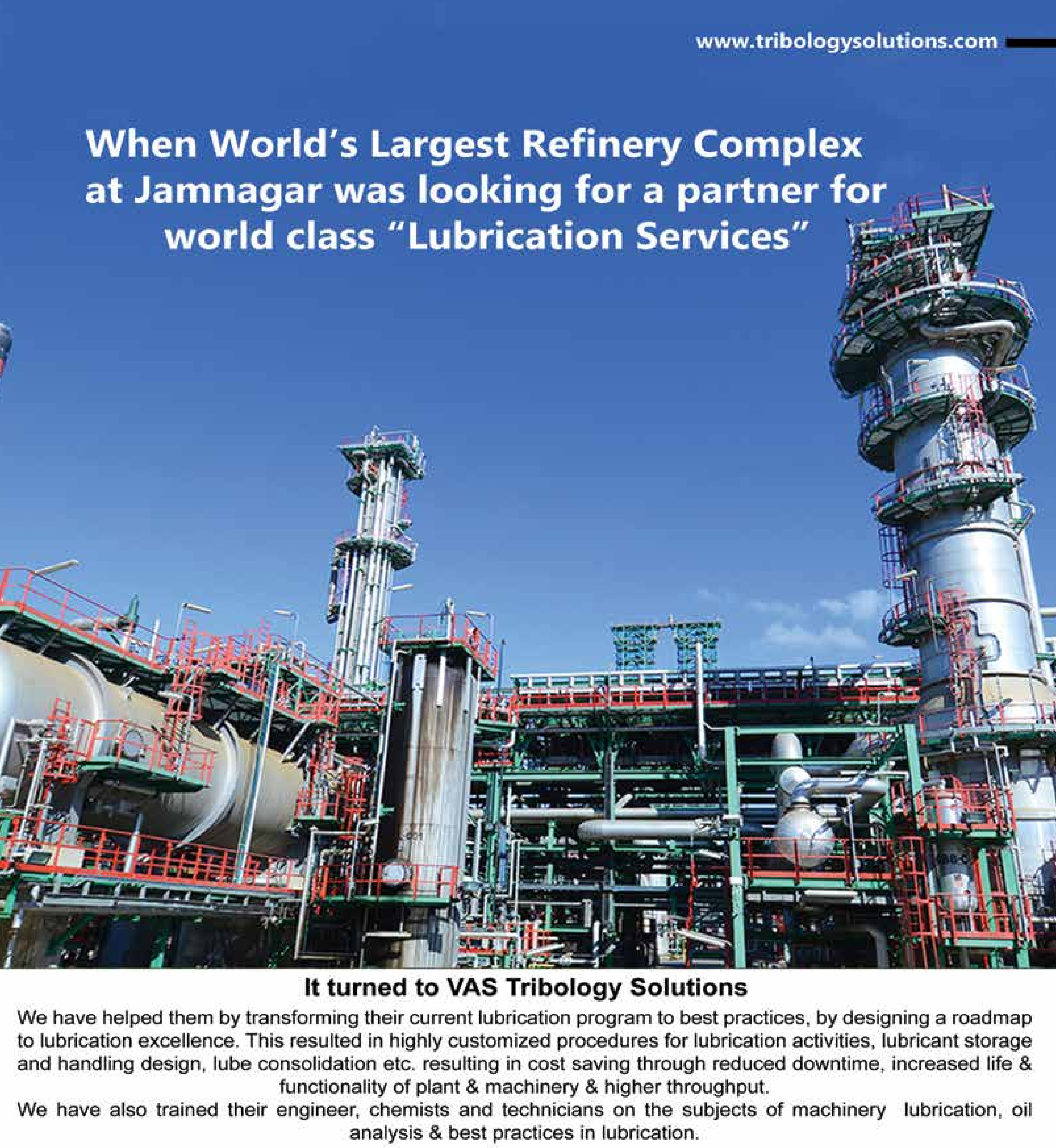
GET BACK TO THE BASICS OF LUBRICATION TO PREVENT MACHINE FAILURES



INSIDE



It turned to VAS Tribology Solutions

We have helped them by transforming their current lubrication program to best practices, by designing a roadmap to lubrication excellence. This resulted in highly customized procedures for lubrication activities, lubricant storage and handling design, lube consolidation etc. resulting in cost saving through reduced downtime, increased life & functionality of plant & machinery & higher throughput.

We have also trained their engineer, chemists and technicians on the subjects of machinery lubrication, oil analysis & best practices in lubrication.

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Contents

Machinery Lubrication India
November-December 2017

More

Editorial Features

Publisher's Note

Energy usage is a cornerstone of today's society. Economic development and better standards of living both rely upon the availability of energy. Better lubrication can lead to remarkable energy savings and an improved bottom line.

Each year Exxon Mobil analyzes and updates its long term view on energy supply and demand. As per Outlook for Energy 2017, energy demand is driven by developing countries as population and living standards increase. Oil will remain the world's primary energy source fulfilling 1/3 of all demand. In 2040, the projected energy mix will be: 32% Oil, 25% Nat Gas, 20% Coal, 7% nuclear, 4% wind, solar & bio fuels, 12% other.

Many of the world's governments are passing stricter laws regulating clean air and water, toxic waste, pesticides, endangered species and more. These factors – combined with a struggling economy – result in a challenge for plant operations managers, which is to reduce operating costs & discharge of effluents. Often, this means doing more with less. One way to reduce operating costs & effluents is to reduce energy consumption. Upgrading plant equipment to take advantage of newer, more energy-efficient technologies can reduce energy costs.

Unfortunately, in a challenging economic environment capital may not be available for plant upgrades. Simple changes in habits can also create substantial savings. One such change is improving the lubrication reliability program.

Energy-efficient lube oils and better lubrication practices are some of the strategic and niche measures to ensure the reduction in the energy bill of the industry. Various industry oriented studies have established that proper lubrication can reduce energy consumption by 5 to 8 percent compared to the baseline scenario.

The concept of energy efficiency with special lubricants is already bearing fruit in the steel industry, as illustrated by two recent studies made in large steelmaking groups, one in South Korea, the other in Brazil, showing significant gains in cooling tower fan gearboxes.

It should be known that usage of high performance and energy-efficient lube oils may protect and extend the life of your equipment & can also result in saving of other resources such as labour cost, lube oil consumption, downtime cost, cycle time reduction, productivity improvement etc. According to a survey, introduction of synthetic lube oil in several industrial units have observed that oil-drainage interval has extended from 3000-4000 hrs. to 20,000-25,000 hrs. in case of gearbox, while in compressor it is 4,000 hrs. to 10,000 hrs.

Thank you for the heartening response to our last edition's cover story – "Extending Equipment Life with Cleaner Oil". Our current cover story on "Get Back to the Basics of Lubrication to Prevent Machine Failures" will help you discover proactive maintenance measures using the combination of back-to-basics approach with breakthrough technologies.

We welcome your suggestions and feedback.

We wish our readers a merry Christmas & a happy and prosperous new year.

Warm regards,
Udey Dhir

JIM FITCH | NORIA CORPORATION

Be PROACTIVE to Avoid Root Cause FAULT BUBBLES

No warning or short-warning failures are the worst kind. Think of a tire. It can wear out slowly over thousands of driving miles or rupture suddenly, at full highway speed, from a random piece of road debris. You can monitor tread loss over time and conveniently schedule a tire change. Conversely, who could predict the sudden appearance of a sharp piece of iron?

Fault bubbles are sudden-death conditions in waiting. They haven't ruptured, but they are about to. Similar to a tire, fault bubbles can burst instantly. Unlike the tire, most fault bubbles in industrial machinery can be revealed by condition monitoring, which includes the careful examination by a skilled inspector. Once detected, the root cause can be arrested or at least mitigated.

In past columns, I've mentioned the P-F interval. As a review, "P" is the point at which a failure (in progress) is first detected, while "F" is the end point of functional inoperability. Although the P-F interval is a theoretical concept that has useful application, it is rarely applied in real-world machines. This is because the real world comes with many variable events. These events distort the predictability of the P-F interval.

Simply stated, the P-F interval is not well-behaved. It is a time interval that is influenced by detection skill and frequency. It is also influenced by multiple operational factors that determine the failure development period. These include:

- Multiple components on a single machine or drive train, each with its own P-F tendencies
- Multiple failure modes for any single component
- Variable duty cycle (speeds, loads, shock, temperature, etc.)
- Remaining useful life (RUL) varies with age. For any given fault mode, the P-F interval shrinks as the machine ages.
- Failure detection methodology and effectiveness vary (ability to detect faults early).

Following are a few examples of short P-F and sudden-death failure modes and fault bubbles. What intervention strategy focused on root causes would you apply to detect and neutralize these threatening conditions?

- Oil filter rupture
- Negligent introduction of a wrong oil
- Fish-bowl conditions (disturbed and mobilized bottom sediment)
- Sudden and severe shaft misalignment
- Stiction/silt lock of hydraulic valves (motion impediment)
- Grease “soap lock” starvation of an auto-lube system
- Impaired or complete loss of oil supply to a bearing or gear
- Heavy fuel dilution from defective fuel injectors or seal leakage
- Accidental introduction of chemical contamination
- Gross seawater contamination of a shipboard hydraulic fluid
- Shock loading of a large thrust bearing

When it comes to fault bubbles, the best defense is a good offense. Don’t be reactive ... after all, time is not on your side. Instead be proactive. How wise is it to wait until you’ve had your first heart attack to make needed lifestyle changes? Even if you become stricken with heart disease, there are so many ways for early detection and treatment. The following outlines a good proactive strategy to avoid or control fault bubbles.

Root Causes Relate to Reliability Culture and Education

Most fault bubble root causes can be traced to a human agency. This could relate to skill, attitude or the general reliability culture. As it is true that it’s never a good strategy to “inspect in” quality, likewise it is never sufficient to “condition monitor in” reliability. Don’t get me wrong, I’m a strong believer in condition monitoring and the value of measurement. However, the big bang-for-the-buck comes from building reliability teams flanked by education and culture.

Stop celebrating rapid repair and start celebrating the failure “non-event.” That is the failure or fault bubble that didn’t occur. A positive, nurturing maintenance culture is a critical plant asset. Consider that when people do good work, they feel good about themselves and their job. When people do bad work, they feel bad about themselves and their job. Feeling bad is a serious morale problem that multiplies and spreads. The simple solution is to enable people to do good work by culture and relentless education. And, good work should be recognized and celebrated.

This is both problem and solution. Culture drives behavior. Behavior influences quality of work. Quality work is fundamental to plant reliability and the cost of reliability. Good culture has inertia, too. It fuels a chain of reinforcing successes. Small successes beget larger and more sustainable successes. Creating a good culture starts and ends at the top, at the leadership level. When good leaders are in charge, everyone wins. When bad leaders are in charge, the culture becomes negative/hostile/

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stagnant, and everyone loses. Good culture also emerges from management's aspiration for improvement and the inherent desire to do good work. It relates to skills, tools, work plans and machine readiness.

Focus on Detecting Root Causes, Not Just Symptoms

Work backward from sudden-death failure to develop your condition monitoring game plan. This is illustrated in a simplified form for an imaginary pump bearing in the table below. Rank the main failure modes by likelihood/severity down the left side of the table. Make sure any critical fault bubbles are included. In this example, I have mechanical wear (abrasion, scuffing, etc.), corrosion, surface fatigue and oil seal failure (causing lubricant starvation).

Next, list root causes across the top of the table. I've included misalignment, particle contamination, water contamination and wrong/degraded oil. In the blue area of the table, put X marks under each root cause associated with each failure mode on the left. One X mark is for a root cause that has a minor contribution to a failure mode. Two marks are for a moderate contribution, and three are for a major one.

On the right side of the table, list the condition monitoring options. I have identified heat gun/thermography, inspection, vibration and oil analysis. In the pink area of the table, put O marks under each root cause that is detectable by the condition monitoring method. One O is for slightly effective, two are for moderate, and three are for highly effective.

Finally, tally up the number of X's and O's in the columns below the root causes. For instance, under water contamination, there are seven X's and six O's. Ideally, the number of O's should be more than the number of X's, or at least close. The number of O's should never be fewer than four for a given root cause. The purpose of this is to align the condition monitoring strategy with the ranked failure modes and their root causes.

Inspection and the Power Frequency

The best countermeasure for short P-F intervals is constant inspection and measurement. For many machines, real-time monitoring with imbedded sensors is justified, especially for high-speed, high-risk machines. This enables instant detection of certain root causes and symptoms. However, this is not a practical reality for the vast majority of common plant machines. Instead, a more realistic and simple solution for early detection must be achieved. There is no better option than skillful and motivated daily inspection aided by inspection windows and tools.

76%

of lubrication professionals say their organization has tried to change its culture, based on a recent survey at MachineryLubrication.com

Often the simplest solution is best. How do you get the optimum level of reliability at the lowest possible cost? Inspection presents some benefits and advantages that are difficult, if not impossible, to duplicate with other condition monitoring options. These include:

- Inexpensive, simple, lasting deployment
- Operator-driven

You can read more about how to create a strong and effective maintenance culture at:

machinerylubrication.com/Read/30275/maintenance-culture-remedies

CONDITION MONITORING STRATEGY TABLE: PUMP BEARING FAILURE

Ranked Failure Modes	ROOT CAUSES (OF FAILURE MODES): Misalignment or Mounting Error		Particle Contamination		Water Contamination		Wrong or Degraded Oil		Condition Monitoring Options*
1. Mechanical Wear	XXX	OO	XX		XX		XX		Heat Gun or Thermography
2. Corrosion		OO		O	XXX	OOO	X	OO	Inspection: Sight Glasses, Mag Plug, BS&W, etc.
3. Surface Fatigue or Fracture	XX	OO			X				Vibration Analysis
4. Premature Seal Failure/ Starvation	XXX	O	X	OOO	X	OOO	X	OOO	Oil Analysis
Totals	8	7	3	4	7	6	4	5	

- More emphasis on examination skills, less on technology
- Root-cause-oriented to avoid developing fault bubbles; more proactive, less reactive
- Early fault detection; more predictive; fewer misses and "just-in-time" saves
- The power of frequency and the one-minute daily inspection

We all seek more for less, and no one likes the pain and frustration that often come with exceedingly complex solutions to simple problems. KISS (keep it simple, stupid!) solutions should always be your first priority. Their application is at the core of inspection. No array of sensors and computer intelligence can outperform a human inspector at a large number of condition monitoring tasks.

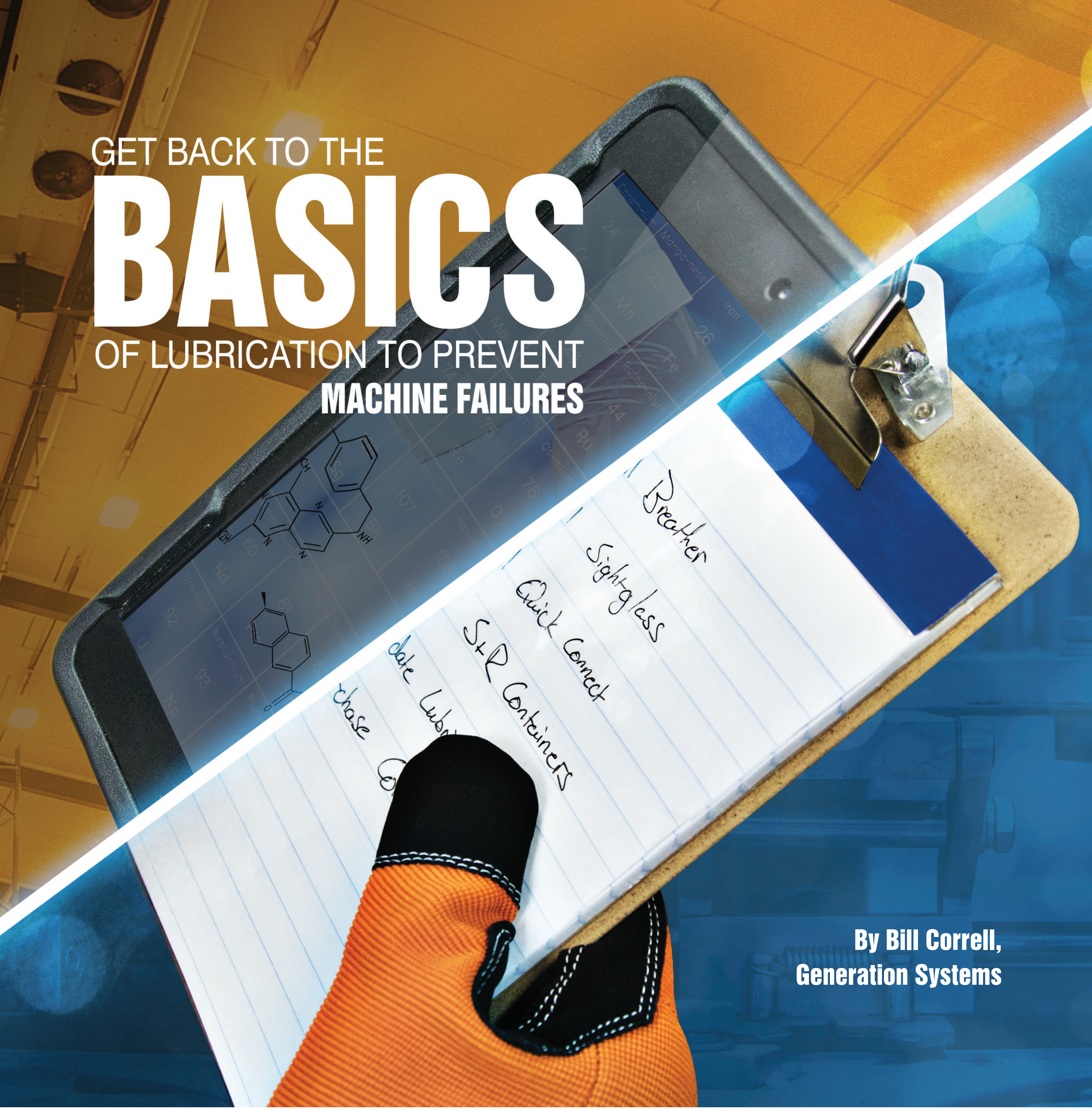
Ballooning and Escalating

The unique nature of fault bubbles cannot be misunderstood or understated. These are rapidly ballooning and escalating events. Many lie in the shadows and go unnoticed, and then suddenly burst and do their damage. The belief that all failures are like a tire's tread wear —slow and progressive — must be discarded. With the full understanding and respect that fault bubbles command must come a vigilant reliability culture of education, condition monitoring and frequent inspection. This is my main message.

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 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.

GET BACK TO THE BASICS OF LUBRICATION TO PREVENT MACHINE FAILURES



By Bill Correll,
Generation Systems

Lubrication-related equipment failure is a problem that plagues industrial facilities of all sizes and stripes. By some estimates, it causes as much as $1 trillion a year in reactive maintenance, unplanned downtime and lost productivity across the United States. These failure rates associated with lubrication also haven't budged in the past two decades. This is especially troubling for industrial operators who have sunk billions of dollars into sophisticated maintenance management systems and predictive maintenance tools designed specifically to reduce downtime. Still, the problem is not getting better. How can that be?

A small but growing number of reliability engineers think they have found an answer. They are rediscovering the value of returning to the basics and are applying innovative technology to old-school preventive maintenance. Yes, you read that right. It turns out that the newest weapon in the fight against machine failure isn't new at all, but it works. It is also generating substantial savings along the way.

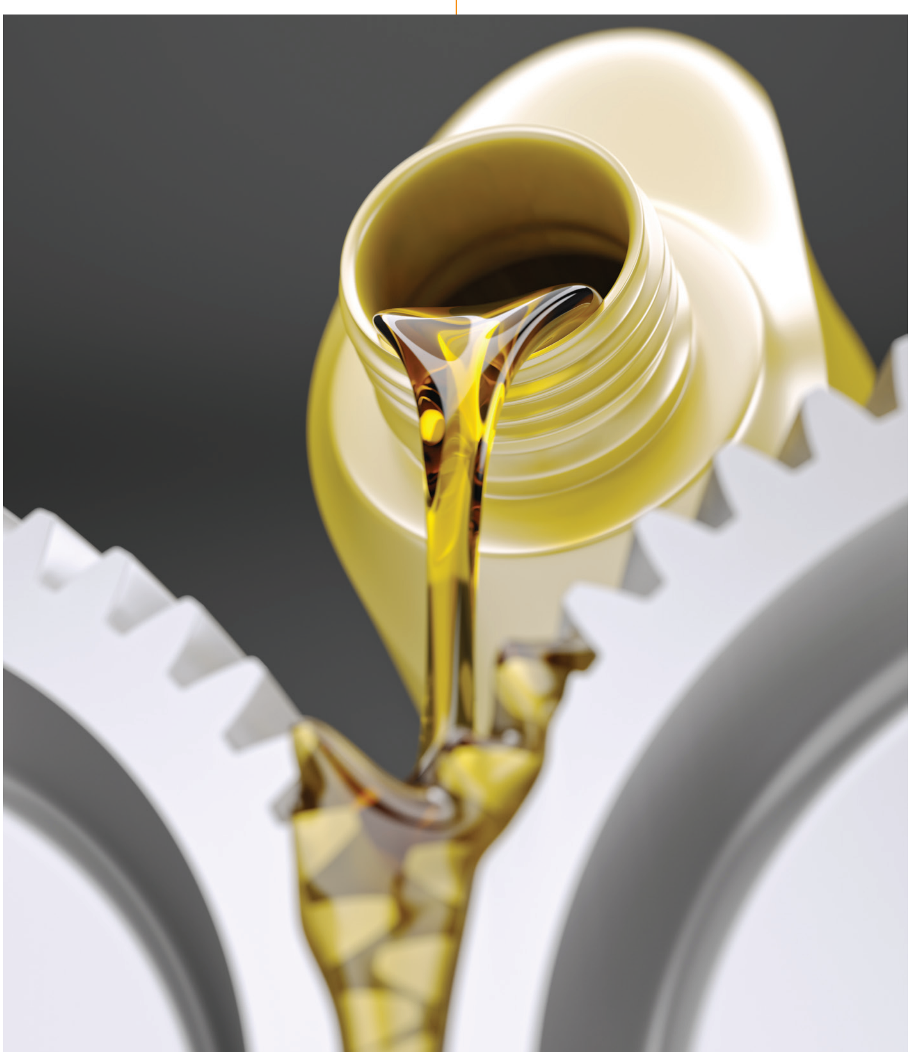
Lessons from the Medical Field

Benjamin Franklin had it right more than two centuries ago with his adage, "An ounce of prevention is worth a pound of cure." While this wisdom is indisputable, it's astonishing how often it is ignored. For instance, take the medical field. In Seattle during the 1970s, residents used to brag that it was the safest city in which to have a heart attack. Thanks to a program called Medic One, someone having a heart attack could expect to be in treatment within 15 minutes or less. The program indeed saved many lives. The problem was that it was reactive in nature. Doctors intervened only after someone had suffered a heart attack.

Since then, of course, the medical community has embraced the wisdom of taking preventive measures to reduce the risk of heart attacks in the first place. We now know to take precautionary steps such as exercising, eating right, not smoking, etc.

Predictive Maintenance: A Reactive Approach

In many ways, plant maintenance today is where medicine was in the 1970s. The tools are more advanced than ever, but they reflect a reactive mindset. Consider where advertising dollars have gone. For the past two decades, the focus in maintenance magazines, websites and trade shows has increasingly shifted from maintenance management solutions, such as computerized maintenance management systems (CMMS), to predictive maintenance and condition monitoring products.



Make no mistake, tools like vibration analysis, infrared thermography and other technologies play a vital role in diagnosing problems early to reduce the impact of downtime. Yet, much like Seattle's Medic One, they are truly useful only after the signs of failure have begun to appear. They are fundamentally reactive in nature.

With so much emphasis on the efforts to detect failure, it begs the question: What about preventing machine failure from occurring to begin with?

Addressing Machine Failure at the Source

To eliminate bearing failure, you must first identify the cause. On that score, most experts are already in agreement, and have been for decades, that poor or inadequate lubrication is the primary cause of industrial equipment wear and failure. In 1995, an assessment provided during an engineering conference placed the figure at 54 percent. In 2014, Ken Bannister's "State of the Lubrication Nation" revised the percentage to 70 percent. Bannister further calculated U.S. losses from lubrication-related issues to be an eye-opening $1 trillion annually. Estimates vary, but it's clear that the number of lube-related machine failures is far too high.

There are many reasons why lubrication problems are so persistent. A look at a few key statistics tells part of the story:

Only 12 percent of those assigned lubrication duties are certified to do so. Seventy-nine percent of companies do not have a professionally audited lubrication program. Sixty-one percent of companies do not track lubrication-related failures. Fifty-seven percent do not perform system checks on automated lubricant-delivery systems. Ninety-one percent do not have lubricant requirement sheets for bearings.

The Problem and the Answer

Increasingly, reliability engineers are beginning to recognize the role that inadequate lubrication plays in unplanned downtime and equipment failure. In an online survey by *Machinery Lubrication*, nearly 80 percent of reliability engineers indicated they experience lubricant starvation. In a live poll during a recent online maintenance conference, more than 85 percent of respondents made a correlation between lubrication issues and the level of reactive maintenance.

Lubrication shortcomings result in repeated equipment failures, production losses, subpar technician productivity, excessive energy usage, increased lube consumption, negative environmental impacts and a state of perpetual catching up.

Coming to Terms with Lubrication's Complexity

While a growing number of reliability engineers understand the importance of proper lubrication in a plant's efficiency, awareness at the management level is often lacking. In many organizations, management believes lubrication is just like any other maintenance task. However, as reliability engineers and lube technicians have known for years, lubrication is a highly specialized discipline. In fact, it is so complex that the International Council for Machinery Lubrication (ICML) offers numerous certifications for it.

To get an idea of the many intricacies that lubrication entails, consider all the factors just to determine lube requirements. This generally involves five core data elements: components, lubricants, task types, procedures and frequencies. It could take seven

different combinations of these elements to define lube requirements for a single conveyor and anywhere from 100-200 combinations across a plant.

In addition, it is not unusual for industrial plants to have many thousands of lube points. Depending on the number, they may require between 70,000 to 500,000 individual lubrication tasks each year, with each task incorporating specific combinations of data elements.

The logistical implications are overwhelming. A key reason lubrication problems remain so pervasive is that most industrial outfits attempt to manage lubrication using CMMS or enterprise asset management (EAM) solutions. Not only are these tools not designed to handle lubrication's formidable complexity, but they often involve the use of cumbersome preventive maintenance (PM) work orders that are difficult and time-consuming to create.

The Serious Flaw in Lubrication Work Orders

PM-based solutions are not capable of verifying that individual lube tasks are actually performed. Unlike corrective work orders, which can capture task completion more granularly, most lubrication work orders generated by CMMS and EAM systems are set up on an all or nothing basis. They can't be closed until 100 percent of the tasks are completed.

A typical lube work order may contain more than a hundred individual tasks. If lube techs are unable to complete a handful of work orders for whatever reason, there is no easy way to note that in the work order. Instead, the technicians have only two choices. They can choose to leave the entire work order open, even though most of the tasks have been completed, or they can check off everything as complete and hope the few missed tasks are covered next time. You can guess which option the vast majority of lube techs and maintenance managers prefer.

This is how lube tasks routinely fall through the cracks. It happens far

more often than most maintenance organizations realize. We know this to be true by the results companies have seen when using special software designed to track lube task completion and improve the efficiency of lube sequencing routes. Plants that rely on this type of software have achieved task completion rates of 80 to 95 percent. Keep in mind that to get such results, these organizations made a concerted effort to manage lubrication properly and still failed to complete 5 to 20 percent of their lube tasks. It is anyone's guess how much higher this rate might be for facilities not currently tracking their task completion. However, one thing is certain: Lube-related bearing failures continue unabated across industries.

A Shift to Preventive Measures

Against this backdrop of futility, a back-to-basics movement is beginning to take hold. Think of it as an old-school approach with a new technology twist. It is originating on plant floors, not in corner offices, and is driven by reliability engineers and lube techs who recognize that diagnostic systems and CMMS tools alone are not enough to make a real difference in reactive maintenance and lube-related failures.

Not surprisingly, you again find the first hints of this trend in advertising. Recently, more advertisements and trade-show displays have been featuring desiccant breathers, sight glasses, contamination control solutions, ultrasonic grease guns and lube room sanitation systems. Although these are technically advanced products, they are proactive at their core. They indicate a rising demand for preventive measures.

Establishing a Best-practice Lube Program

Proper lubrication is 100 percent proactive and preventive. Organizations that have instituted a best-practice lube program significantly reduce reactive maintenance and machine failure. Following are three key steps to help create such a program in your facility:

- Add lubrication-specific training to increase your staff's knowledge and establish best practices.
- Acquire lubrication-specific tools your staff may be lacking.
- Improve lubrication logistics and control.

Lubrication Case Study

The increased accuracy, effectiveness and efficiency of a best-practice lube program can improve uptime, reduce costs and lift the bottom line. For example, one plant that took the needed steps pocketed $680,000 in savings. In this case, lubrication best practices were first studied, and a plan designed. Buy-in was then obtained from management down to the lube tech. Key certifications were attained in lubrication maintenance, and not just for lube techs but for supervisors and managers as well.

The plant also conducted a lubrication survey in which every lube point was identified. This provided a critical baseline on which to build the program. Then the lube room was organized. Lubricants would now be filtered as they were received from suppliers and again before application to the equipment.

Next, an investment was made in color-coded containers to eliminate mistakes. Sealed oil containers were acquired to keep lubricants clean. Clear grease guns, sight glasses, breathers, filtration and contamination control were also incorporated.

Finally, lubrication software was added to help establish efficient routes, schedules, responsibilities and accountability. While the plant had only 1,350 lube points, it managed to save $200,000 the first year and more than $160,000 per year during the next three years for a total of $680,000.

If you were to extract this $200,000 savings over 1,350 lube points, it would equal a savings of $148 per lube point. Depending on the size of the plant, the savings would add up as follows: $740,000 for 5,000 lube points, $1.48 million for 10,000 lube points, and $2.2 million for 15,000 lube points.

Looking Ahead

Advanced CMMS, predictive maintenance and condition monitoring solutions are essential to modern plant health and efficiency, but when it comes to making significant inroads in eliminating equipment downtime and failure, they leave much to be desired. Moreover, CMMS tools lack the control needed for the complexities of effective lubrication management. The rise of advanced preventive maintenance tools and best practices is a response to a challenging problem decades in the making.

Sometimes the best way forward is to reach back. Today's proactive preventive measures combine the wisdom of a back-to-basics approach with breakthrough technologies. Organizations that incorporate them into their maintenance programs stand to make substantial gains in equipment uptime, productivity and cumulative cost savings across the board.

BY AL SMILEY, GPM HYDRAULIC CONSULTING

Understanding and Troubleshooting Hydraulic Proportional Valves

Since the mid-1980s, proportional valves have become increasingly popular and have replaced servo valves in many applications. The cost of a proportional valve can be as much as 50 percent of the cost of a servo valve of the same size. However, servo valves continue to be used where precise positioning or speed control is required in aircraft, aerospace and turbine generator applications.

Proportional valves can be used as flow and pressure controls, but the most common use is as a directional valve. While the design of proportional directional valves may vary from one manufacturer to another, they all essentially perform the same function: controlling the direction and speed of a hydraulic cylinder or motor. By using feedback devices like linear-displacement transducers or rotary encoders, the position of the actuator can be precisely controlled.

Direct-operated Proportional Valves

Direct-operated proportional valves are used when flow through the valve is approximately 25 gallons per minute (GPM) or less. Two-stage valves, which incorporate a pilot valve and main spool, are used when higher flow rates are required.

In order to troubleshoot the valve and system, you must be able to read hydraulic symbols. In Figure 1, the symbol for a direct-operated proportional valve is shown. Notice the four squares in the symbol. These represent the number of positions in which the valve spool can be shifted. When there is no power to the valve coil, the spring will shift the spool to the position shown on the far left. This is known as the "fail safe" position. In this condition, all flow is blocked through the valve. The symbol for the solenoid indicates that the valve operates off a variable electrical signal. This is usually 0-10 volts or in some cases 4-20 milliamps. The "S/U" symbol on the valve represents the linear variable differential transformer (LVDT), which is used to electrically specify the position of the valve spool. The feedback from the LVDT is normally a direct current (DC) voltage signal. The actual components of the proportional valve can be seen in the valve cutaway in Figure 2.

To operate the valve, an amplifier and power supply are required. The power supply is typically 24 volts and is used to power the amplifier. The command voltage is input from the programmable logic controller (PLC) and determines the position of the valve spool. The "enable" is a relay from the PLC that must be made to send a current signal to the proportional valve coil. In some

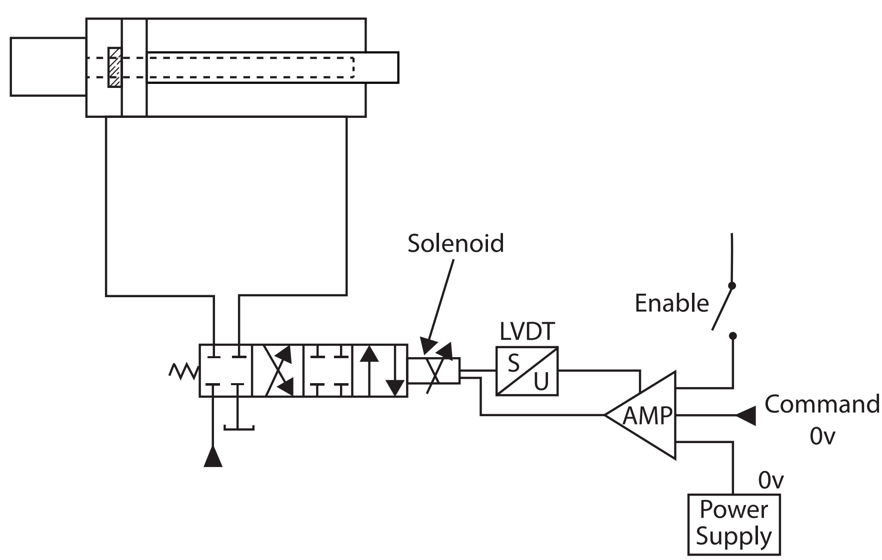


Figure 1. A direct-operated proportional valve

cases, the enable signal is not used.

When the power supply is turned on and the enable relay is not made, the LVDT will send approximately minus 12 volts back to the amplifier, signifying that the spool is in the "fail safe" position (Figure 3). Once the enable relay is closed, a current signal will be sent to the solenoid. The current creates magnetism in the coil, which pulls in a plunger to shift the spool. Since the command voltage is zero volts, the spool will continue to shift until the LVDT shows that zero volts is fed back. The spool will then be shifted into the "electrically closed" position (Figure 4). Approximately 1.35 amps of current are required to shift the spool into the "electrically closed" position.

To move the linear positioner 12 inches (Figure 5), a command voltage is input into the PLC. The amplifier converts the command voltage into a current signal, which is applied to the valve coil. A command voltage of 6 volts is input into the amplifier. The amplifier will then send a higher current (2.16 amps) to the valve coil. This shifts the valve spool into the straight arrows position. This position is commonly called the "A" position. The increased current causes the valve spool to shift until the LVDT feeds back minus 6 volts. The spool will then stop shifting and maintain its position. Oil is then directed through the valve spool and into the full piston side of the linear positioner. The speed in which the positioner moves is determined by the amount of spool shift. In this example, if the valve has a maximum flow rating of 10 GPM, then 6 gallons per minute will flow through the spool when shifted with a command voltage of 6 volts.

As the cylinder moves, the linear-displacement transducer sends an analog or digital signal back to the PLC. For example, if one digital pulse is sent back to the PLC for every 0.001 inch of movement, the positioner rod will move until 12,000 pulses are fed back, signaling that the positioner has moved 12 inches. The command voltage will then drop to zero, and the proportional valve spool will once again shift into the "electrically closed" position. The cylinder will hold its position until commanded to move to a different stroke.

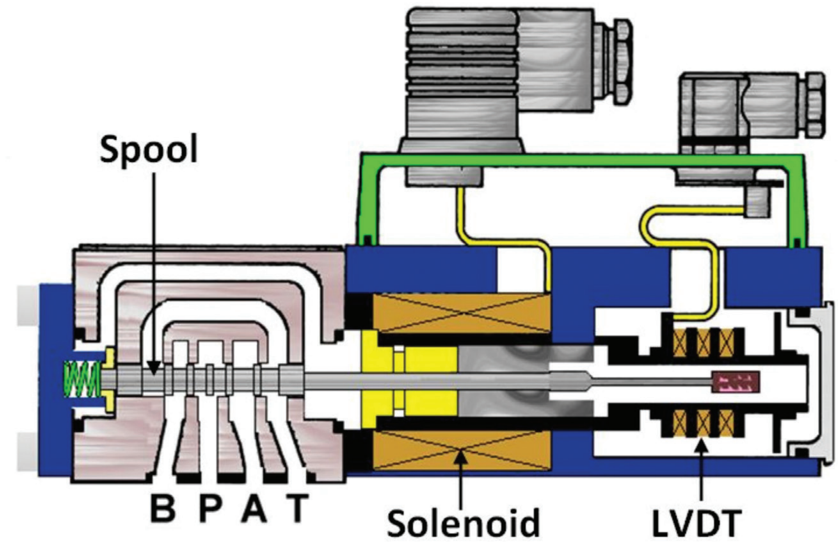


Figure 2. Components of a proportional valve

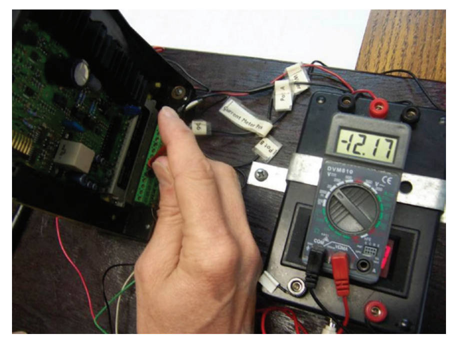


Figure 3. The valve spool in the "fail safe" position

Troubleshooting the System

If an externally mounted amplifier is used (Figure 6), lights on the front panel will denote a fault in the system. When the power supply is turned on and the enable signal is received, the "on" light will illuminate green. The enable voltage may range from 8.5-40 volts, although 10 volts is common. If

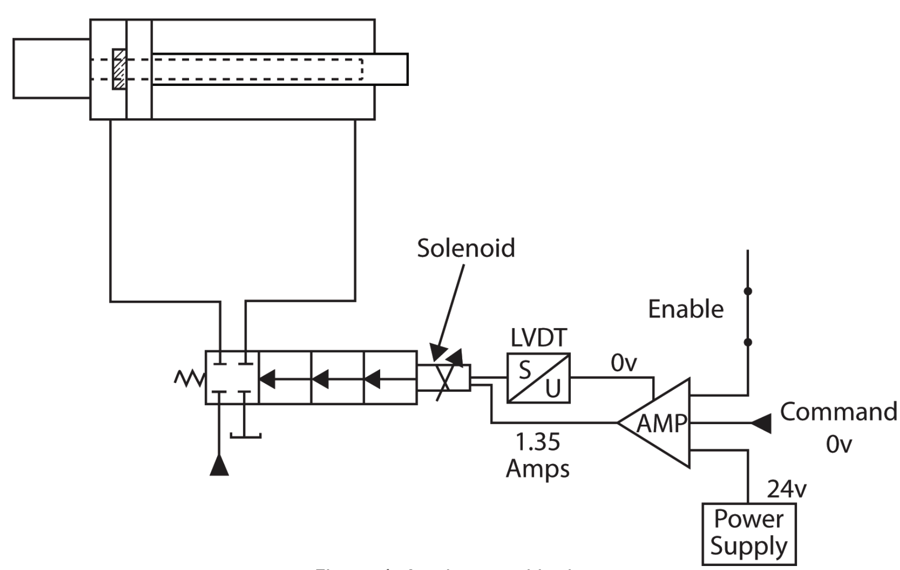


Figure 4. A valve spool in the "electrically closed" position

the light does not illuminate, the enable and power supply voltages should be checked at the amplifier connections. If no input enable voltage is present, the wiring and output signal should be checked from the PLC.

If the power supply drops below 21 volts, the red "UB" light will come on. This generally means the power supply or wiring is bad. When the power supply is good (Figure 7), 24 volts should be indicated at the amplifier.

The yellow light on the bottom of the amplifier face is used to show when the LVDT is bad or there is a problem with the connecting cables. The light will glow yellow when any of these elements fails. The easiest way to determine where the failure is occurring is to remove the LVDT cable from the existing valve and plug it into a new valve. It is not necessary to install the new valve for this test. If the yellow light goes out, the LVDT on the old valve has failed and a new valve should be installed on the machine. If the light stays on when plugged into the new valve, the problem is with the cable or connections. The continuity of the cable should be checked. If the light flickers as the machine operates, this normally indicates loose connections.

The zero adjustment is located on the amplifier's front face. This adjustment should be made in the event the cylinder is moving with a zero command signal coming into the valve amplifier. If the load is moving, the spool is not in the closed position. This is usually caused by the LVDT being out of position. Rotate the zero adjustment until the linear positioner stops drifting or oscillating.

If speed or positioning problems are occurring, the command and LVDT signals should be checked at the appropriate connections on the

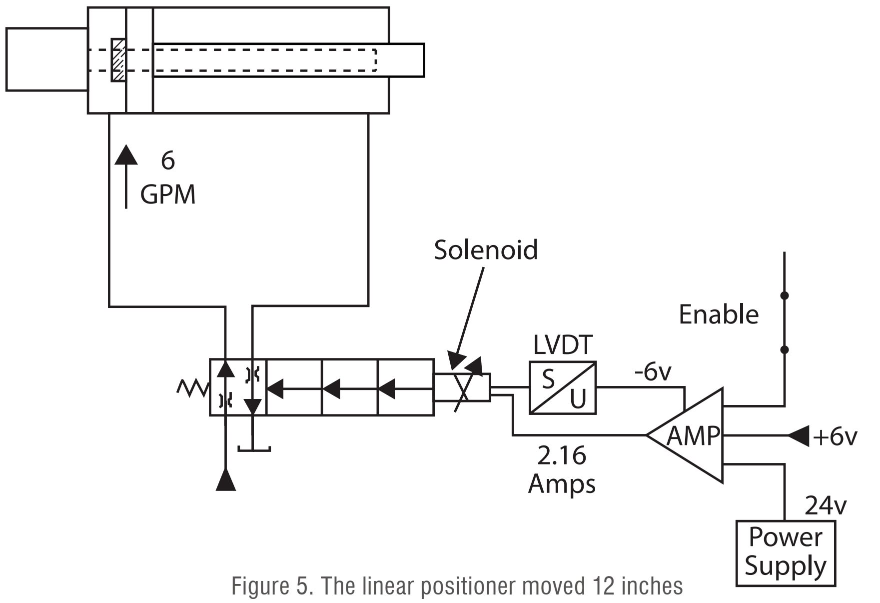


Figure 5. The linear positioner moved 12 inches

amplifier. If these are reading correctly, the problem is most likely in the hydraulic system or the linear positioner.

Valves with Onboard Electronics

A recent trend has been to mount the amplifier on the proportional valve. This is commonly referred to as onboard electronics (OBE). The valve operates the same as described with the external amplifier. The most common type of OBE valve uses a seven-pin connector. The power supply is input in the "A" and "B" pins on the valve. The command voltage comes into the amplifier via the "D" and "E" pins. To check these voltages, a multi-tester can be used by inserting the red and black leads into the appropriate connectors on the cable. To verify the power supply, insert the red lead into "A" and the black lead into "B." Twenty-four volts should be indicated. To check the command voltage from the PLC, insert the red lead into "D" and the black lead into "E." A 0-10 volt signal should be shown depending on the command signal from the PLC.

A test box (Figure 8) can also be used to verify that the valve is operating properly. The cable from the PLC

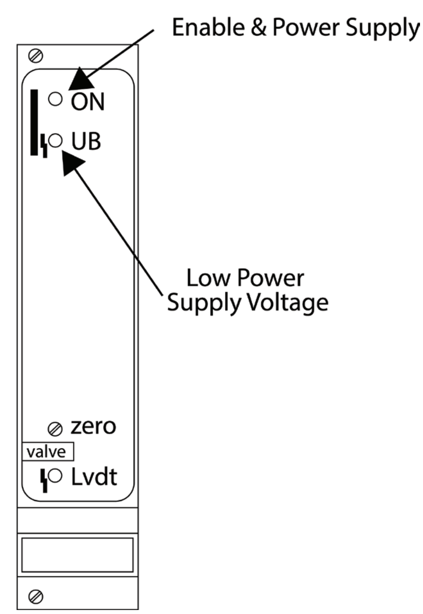


Figure 6. An externally mounted amplifier

should be plugged into the box, and the cable on the box into the proportional valve. When the system is turned on and operating, the power supply, command and LVDT voltages will be indicated. The valve can also be driven with the test box by moving the "command select" switch to internal. The valve can then be driven with the box's "drive" adjustment.

If the linear positioner is drifting, the LVDT may not be in the proper position. To null the valve, the LVDT access cover should be removed. The LVDT centering

Figure 7. A good power supply is indicated by 24 volts at the amplifier.

adjustment should then be slowly rotated until the drifting stops.

Oil Cleanliness

Proportional valves have extremely tight tolerances between the spool and housing. These tolerances are typically between 0.0001 and 0.0003 inch. It is essential that the oil entering the valve meet the standard set by the manufacturer. The cleanliness level is determined by the ISO 4406 code for the specific valve. For example, the ISO code for a particular valve may be 17/15/12. The three numbers correspond to the 4-, 6- and 14-micron particles in a 1-milliliter sample taken from the system. The "17" represents that the system has 640 to 1,300 particles that are 4 microns and larger. The "15" means there are between 160 and 320 particles that are 6 microns and larger. The "12" indicates that the sample contains 20 to 40 particles that are 14 microns and larger. It is necessary to use a 3-micron filter with a beta rating of 75 or higher to achieve this level. The oil should be sampled regularly to ensure the system meets this standard. A higher ISO code may mean the filters aren't being changed often enough, the filters don't have the proper micron and beta rating, or additional filters may need to be added to the system.

In conclusion, by troubleshooting systems that utilize proportional valves, you can avoid lost production time as well as the unnecessary expense of sending off good valves for repair. Changing out parts that do not need to be replaced can also introduce contaminants into the system, which can lead to even more serious problems. Be sure to follow the steps described in this article before removing any proportional valves from your hydraulic systems. ■

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.

Figure 8. A proportional valve tester

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BY RAY MELLOR, R.J. MELLOR & CO.,
AND PAR FUNCK, ASSALUB

How to Select a Lubrication System for Process Industries

Proper lubrication requires two main considerations: the correct choice of lubricant and the most efficient way of applying it. Failure with either selection can result in a major equipment malfunction. This article will describe how to select the right lubrication system for any process plant.

Manual Lubrication

The vast majority of greasing points are manually lubricated. During the last 15 years, several new products have been introduced to ease the lubrication technician's work, including grease meters, cordless grease guns and computer-monitored greasing systems that employ radio-frequency identification (RFID) technology to identify lube points. There are also systems that use acoustic aids to sense when the lubricant has reached the rolling edge of the bearing.

All of these products have made manual greasing more reliable. Today, no lube tech should be forced to perform his job with only a manual grease gun and count strokes to obtain the correct amount. At the very least, the technician should have a grease meter. If the plant has a large number of lube points, a cordless grease gun would also be of great help.

Automatic Lubrication Systems

Automatic lubrication systems are designed to eliminate manual labor costs while allowing the machine to be lubricated during normal production. These systems can also minimize the risk of lubricant contamination, avoid potential hazards associated with manual lubrication and provide better control of the amount of lubricant dispensed. A variety of system configurations are available, including dual-line, single-line volumetric, single-line progressive and single-point systems.

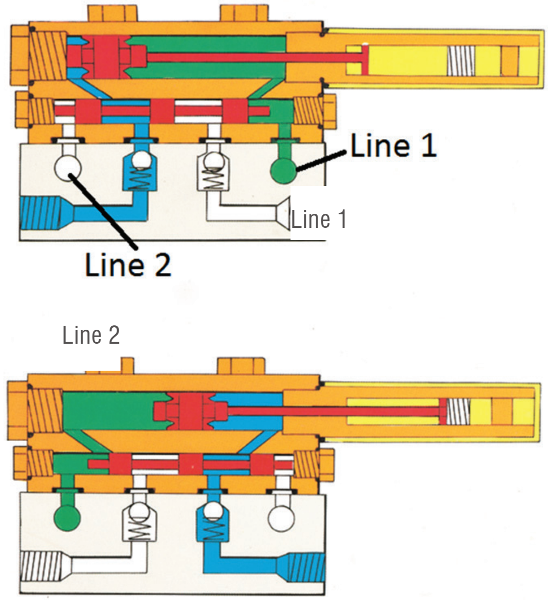
Dual-line Systems

The dual-line system is the predominant lubrication system in heavy process industries. These systems are very reliable, simple to understand and maintain, and allow you to easily expand or reduce the number of points. Their name comes from the fact that they have two main distribution lines.

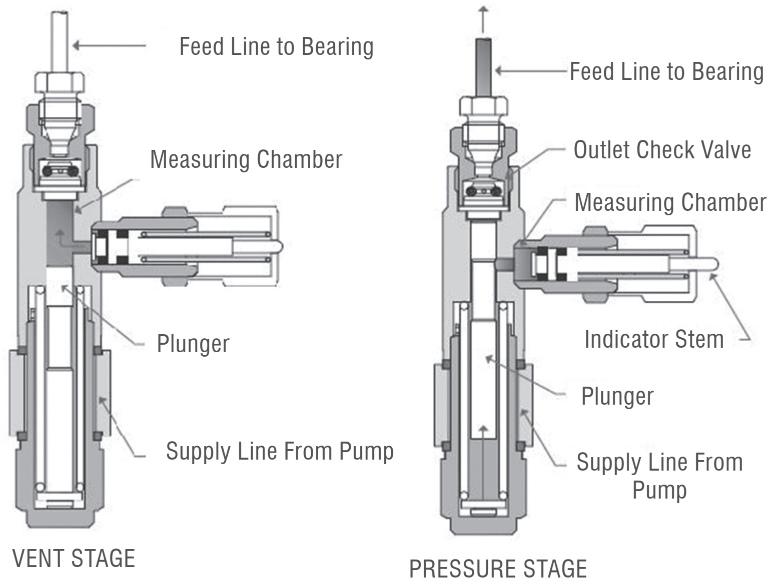
Pressurized lubricant entering the dispenser from line 1 forces the pilot piston (the lower one) to the left, allowing pressure to be applied to the right side of the main piston. The main piston then begins to move to the left. This dispenses the lubricant on the left side of the main piston through the pilot piston and the check valve to the bearing connected to the outlet.

Pressurized lubricant entering the valve from line 2 forces the pilot piston to the right, allowing pressure to be applied to the left side of the main piston, which begins to move to the

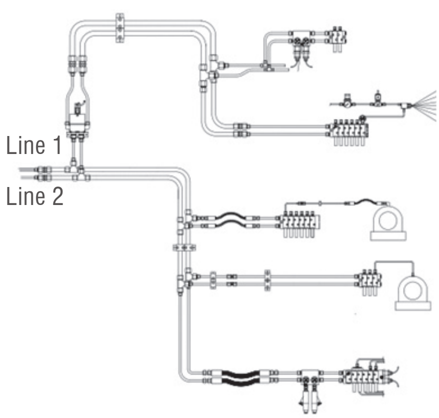
A manual grease gun with a grease meter



An example of a dual-line system



The vent and pressure stages of a single-line volumetric system



A dual-line system with a dispenser designed for both oil and grease

right. In the same manner as above, the main piston forces the lubricant on the right side to pass the pilot piston and the check valve, and then reach the bearing via the outlet.

The illustration above shows one version of a dispenser design used for both oil and grease. When pressurized, the plunger forces the lubricant in the measuring chamber out to the bearing. In the upper position, the measuring chamber loads with a preset volume.

Single-line Volumetric Systems

Single-line volumetric systems require only one header line. They are generally used for oil lubrication, but there are some models specifically designed for grease. Like dual-line systems, single-line volumetric systems are simple to maintain and understand, and the number of points can be easily expanded or reduced.

In these systems, the dispenser must reload after a lubricating cycle. This means the piston in the dispenser must overcome the lubricant pressure in the pump line. The models designed for grease are equipped with strong springs that allow reloading of the dispenser at relatively high venting pressures.

Single-line Progressive Systems

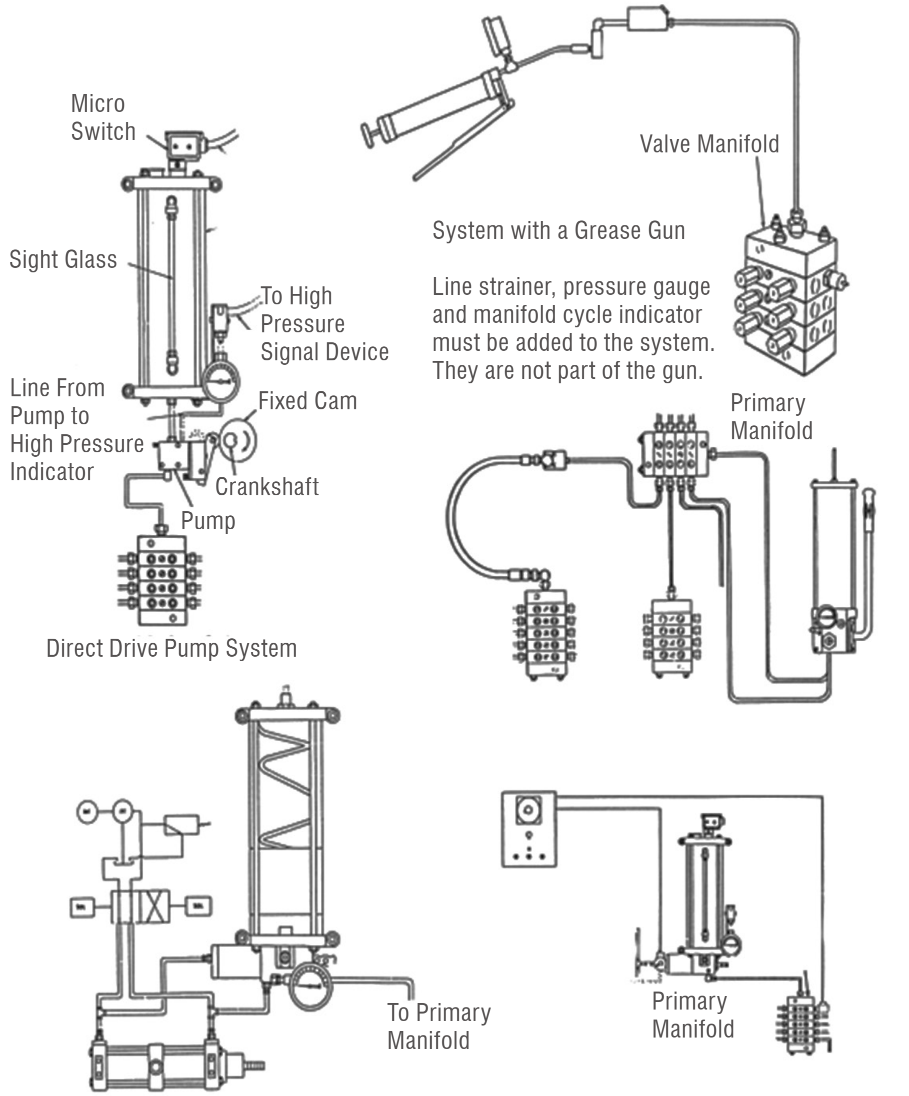
The heart of a single-line progressive system is the progressive divider. It has at least three dispensing elements, each with a hydraulically driven spool that feeds a fixed amount of grease during the stroke from one end to the other. The volume is defined by the diameter and length of the piston stroke, which cannot be adjusted. The spools are internally connected through a cross-porting arrangement that forces them to work in sequence, one after the other. If one spool is not able to fulfill its stroke, the divider will stop working.

These systems are often designed with one primary divider and a number of secondary dividers. Monitoring one spool in any of the dividers will give full control of the whole system, provided there is no leakage in the tubing from the divider to the wear surface.

Single-line progressive systems offer flexibility and can be used alone or in conjunction with other systems, such as direct-feed, dual-line and manual systems. They can handle both oil and grease, and are less expensive than dual-line systems. However, these are large systems with several secondary dispensers, so they can be more difficult to maintain and understand.

Single-point Systems

The first automatic single-point lubricators consisted of a spring-loaded piston that was charged with grease. The spring extruded the grease through an orifice, with flow dependent on the orifice, the spring force and the stiffness of the grease. These factors limited the spring-activated models, which have had only a limited impact on the market.



Examples of single-line progressive systems

Single-point Lubricators

During the last 20 years, new single-point lubricators (SPLs) have been introduced and have increased in popularity. The latest SPLs are easy to install and do not require a significant financial investment. Simply screw the unit onto the lube point, set the operation time and start it. The operation time generally can be set from one month to 12 months. While managing a single-point lubricator may sound simple, it is quite easy to ruin a bearing or the entire machine if you are not knowledgeable about these devices.

There are three basic models of SPLs: gas-activated, motor-driven and spring-activated. The gas-activated version involves a chemical reaction that expands a gas. This reaction is initiated by releasing a gas generator into the electrolyte fluid. The increased pressure of the gas is transformed onto the lubricant in the container, thus forcing the lubricant to flow out to the lube point. A typical maximum pressure of a gas-powered lubricator is 75 psi (5 bar), but in some models it may be as low as 15 psi (1.5 bar).

The second type of single-point lubricator consists of a piston on top of the container and an electric-motor-driven mechanism with a stem that forces the piston into the container and thus the lubricant to flow out. These models are usually able to reach somewhat higher pressures than the gas-driven versions, with normal pressure ranges from 72 to 145 psi (5 to 10 bar).

The third type of SPL contains a small piston pump that sucks from the container and feeds directly out. These models can reach pressures of 425 to 850 psi (30 to 60 bar).

Using a single-point lubricator of any type requires treating batteries or the used lubricator as waste. Disposal of this waste must be considered when choosing the type of equipment to be used.

Manual vs. Automatic Lubrication

It is important to strike a balance between manual and automatic lubrication. Manual lubrication with a high-quality lubricant may be best for lube points that require infrequent relubrication, such as monthly intervals or longer. However, avoid manual lubrication of points with short lubricating cycles whenever possible.

Although manual lubrication can be expensive, replacing it could be even more costly. While lubricating manually, technicians may also observe the machinery and can report or even fix irregularities. Pay special attention to manual points that are difficult to reach. If lubricant cannot be applied in a safe manner, an automatic lubrication system may be the only solution.

Converting manual points for automatic lubrication will require an investment estimated at approximately $650 per point. While this conversion cost may be discouraging for some, keep in mind that automatic lubrication can result in a more reliable system with fewer bearing failures. Any investment in an automatic system must also be compared with the expected return on investment from the elimination of labor costs, better control of lubricant dispensing, and the reduction of potential health and safety costs.

Which System Should You Choose?

Deciding how to lubricate equipment in a process plant is not an easy task. There is generally no accepted rule for how this can be accomplished. To develop a strategy for the relubrication of each lube point, you must consider several factors, such as the consequences of a bearing failure, the lubrication cycle, the ability to lubricate manually and the hazards of relubricating during a normal production run.

The consequences of a bearing failure can be classified for both automatic and manual lubrication. Although no common standard exists, you can create your own classification, which could be similar to the following:

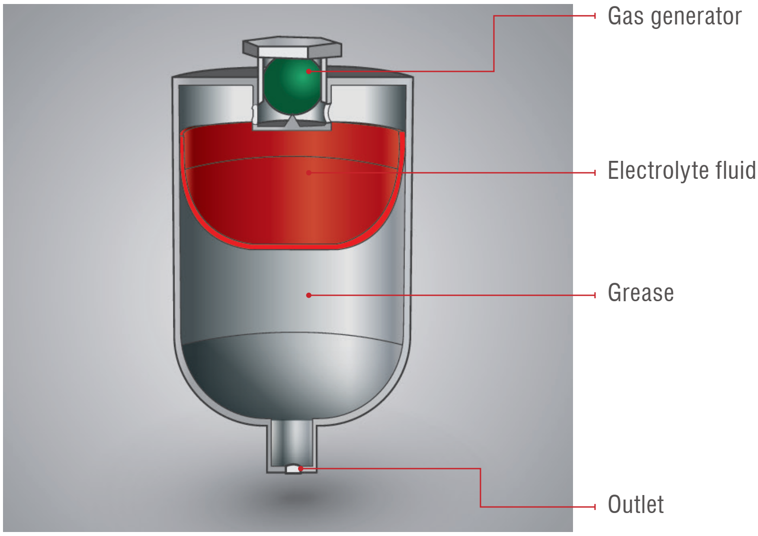
Class 1	Less important points that do not affect production and are easy to repair or replace
Class 2	More important points that affect production and/or are difficult or time-consuming to replace
Class 3	Important points that affect production and/or are expensive to repair or replace
Class 4	Critical bearings that directly affect production and must not fail

For each class, define which lubrication systems are acceptable and how performance is verified. Classes 3 and 4 are the most interesting. If the lubrication system does not work properly for these classes, sooner or later you will experience costly problems.

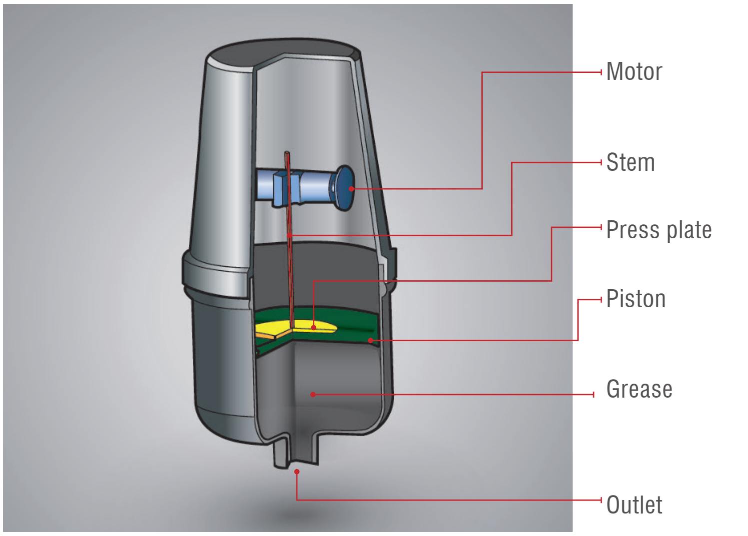
For class 3, only reliable lubrication systems with good control functions should be used. Note that most systems only monitor the pressure in the main distribution lines or that the piston has moved in the dispenser. None of the traditional systems can indicate whether the lubrication pipe between the dispenser and the lube point is broken.

For class 4, ensure that the amount of lubricant fed into the point is measured and compared with the set value, or that vibration measurements are collected on a regular basis and studied, with appropriate action taken when necessary.

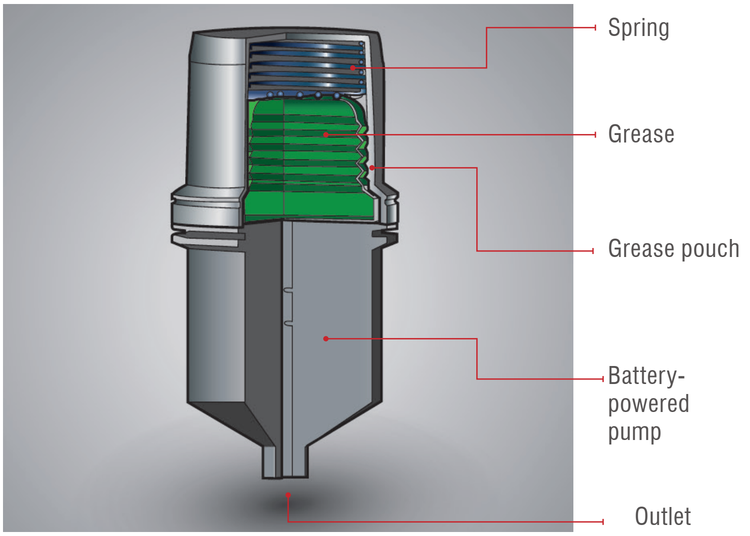
Finally, do not overlook the training of your team members. Maintenance personnel must be familiar with all types of systems in use. Lubrication systems can fail and need repairing. Therefore, it is wise not to mix many different system types and brands. This could result in choosing a dual-line system for just a few points when a single-line progressive system would be less expensive. ■



A gas-activated single-point lubricator



A motor-driven single-point lubricator



A spring-activated single-point lubricator

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.

Double Lubricant Life by Reducing the Temperature

The operating temperature of a static or circulated oil bath has a direct impact on the useful lifespan and effectiveness of the lubricant. For every increase of 18 degrees F above 130 degrees F, the rate of chemical reactivity doubles. In practical terms, if you are achieving a two-year life cycle on a charge of hydraulic oil in a tank operating at 136 degrees F and can find a way to decrease the temperature of the oil to 118 degrees F, then you can expect to double your hydraulic fluid life.

An easy way to check to see if you have room for improvement is to place your hand on the side of the tank. If it is hot enough that you cannot leave your hand on the tank for more than a couple seconds, then you are operating at roughly 145-150 degrees F. A fan-type heat exchanger can be installed for less than a thousand dollars and, with the right flow and ambient temperature, could reduce tank temperatures to the desired level.

How Oil Mist Can Protect Stored Machines

Oil mist is effective in protecting your stored machines. The Caltex Thailand Refinery added a new dimension to the capabilities of oil mist lubrication by using it to preserve its rotating machines while they were sitting in the construction storage yards. The machine manufacturers connected tubing from the oil mist connections on the machines to connectors on the sides of the shipping crates. A temporary system was connected to the crates upon their arrival to the yard. Typically upon startup, there are numerous bearing failures. In this case, there were virtually none.

Benefits of Polyurea Greases

Polyurea greases have very good oxidation resistance because they don't contain metal soaps such as calcium, lithium, etc., which are pro-oxidants to varying degrees. They are therefore widely used in lubed-for-life bearings.

Monitor Oil Filter Change Intervals

It is important to monitor your oil filter change intervals. Premature plugging is usually a sign of a problem that merits further investigation. This may be caused by airborne dust coming from nearby construction or a prolonged dry spell raising atmospheric dust levels. Whatever the source of dirt, the root cause should be investigated. Perhaps the seals or breathers need to be serviced or upgraded. In certain cases, the problem may be associated with a change in the performance of the filter from your supplier. Extremely long filter life is as much a concern as filter life that is too short.

Ensure Proper Lubricant with Color-coded Grease Caps

To ensure that the correct lubricant is being utilized, try using colored plastic grease caps. These fit right on the grease fitting and also help keep dirt and/or water off the fitting and hence out of the bearing. The color-coding can be used for the type of grease or the frequency. The caps cost only a few cents each.

Simple Tip for Faster, More Convenient Greasing

Create a lube panel located in a convenient location on or near the machine so hard-to-reach grease fittings can be centrally located using line extensions. This makes greasing the machine faster and more convenient for the operator or lube tech doing the PM. Remember, a PM that is made quick and easy is a PM that gets done.

Why You Should Combine Manual Inspections with Oil Analysis and Particle Counting

Oil analysis and particle counting are critical in unfiltered compartments such as heavy equipment final drives and differentials. However, if these compartments have magnetic plugs, occasionally the magnets will show a buildup of fuzz and you may have the beginnings of bearing failure while the oil sample remains relatively clean. This is an example of when manual inspection is very important along with oil analysis and particle counting.

Use Tape to Check Reservoir Cleanliness

To check the cleanliness of the inside of a new hydraulic reservoir, take a small strip of transparent adhesive tape and stick it to the surface (roof, side wall or bottom plate) of the reservoir. Firmly press the strip of tape with your thumb so it is in proper contact with the surface. Now peel off the tape and paste it on a white piece of paper. You will find that the strip has sampled large particulate contaminants. You can also use it with standard visual comparators, similar to common patch test comparators. With this method, you know whether your tank needs further cleaning. Also, keep in mind that the unaided eye can only see individual particles larger than about 50 microns.

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TRAINING Strategies to Control CONTAMINATION

Merriam-Webster defines a contaminant as "something that makes a place or substance (such as water, air or food) no longer suitable for use; something that contaminates a place or substance." Effective lubrication programs are centered on contamination control. However, one contaminant is often overlooked, and it has the potential to be the most destructive and costly of all contaminants, possibly costlier than all other contaminants combined. What is this critical contaminant? Believe it or not, it is your lubrication technicians and program managers. They are potentially your most expensive and damaging contaminant, and what can make them so destructive is a lack of training.

Who, What, When, Where, Why and How

In the development of a contamination control strategy for this unknown contaminant, you must seek to answer who, what, when, where, why and how. "Where" is your plant, "when" is always, and "what" is the contaminant. "Who" is everyone involved in the lubrication program, such as technicians, managers, purchasing, shipping/receiving, maintenance, operations/production, etc.

In the Navy, I learned that people don't do things for two basic reasons, which can be summed up as "can't" or "won't." The "won't" is usually easy to diagnose. It is a refusal to do what's asked and is quite simple to address. The "can't" is also easy to diagnose. The individual either doesn't have clear direction as to what the job is or doesn't have the proper tools or training. Often, this simply requires communication. Therefore, take the time to explain each task, outlining what the expectations are and what completion is. In this communication, you can identify what tools are needed and if you have the tools to complete the task.

You must also determine if the person has the necessary skills and knowledge for the task. It's possible to provide the required knowledge so the individual is ready to perform the task in relatively short order, but the necessary skills can be a bit more problematic. A job/skills mismatch may exist, and the individual may never be able to complete the task satisfactorily.

> "Even if you have invested large amounts of resources in your program, you may still need to invest in training for your team members in order for them to execute your procedures properly."

"Why" is a bit more complex, as is the "how." Numerous organizations invest in training for their team, sending personnel to public training courses, hosting private training events and undergoing certification testing afterward. While these methods are an excellent way to explain the "what" of lubrication, your program is destined to fail if all parties involved do not understand the "why." "Why are we engaging in this?" "Why is it important to the organization?" Answering these questions is essential to any change management process.

I've intentionally saved the "how" for last. In nearly every class I teach, I ask the following question: "How difficult is it to operate a grease gun?" Although the mechanics of this task are quite simple, are you aware of how much pressure a grease gun can generate? Do you know how much pressure it takes to blow a lip seal or push shields and seals into the element on a bearing? Are you able to look at an oil analysis report and tell whether the sample is the correct fluid just from the test data? Can you identify the chemical compounds that make up certain additives? How many of your lube techs can answer these questions?

I'm constantly amazed at how lubrication technicians are consistently at the bottom end of the scale in a maintenance organization. Properly trained and equipped lube techs are the eyes and ears of a maintenance group. They are the foundation of maintenance. It is not uncommon for a fully trained lube team to generate 70-80 percent of the work orders. They are the ones who

conduct most of the inspections and identify the majority of issues. However, to be effective, these individuals must be trained in the appropriate inspection techniques.

Let's go back to the question of how difficult it is to operate a grease gun. How does it feel when a seal blows out because of too much grease at too high a pressure? Explaining this is like trying to describe the color red to a blind person. If you haven't felt it, it is difficult to understand. Many aspects of lubrication are like this. Frequently, classroom training is inadequate for the task. A lot of people learn best by doing. Although much, if not all, of the "who," "what," "when," "where" and "why" of lubrication can be taught in the classroom, the "how" is best demonstrated in the field using the show-and-tell method. Instructors can "tell" you how, but the "show" requires you to be at the machine installing a breather, sight glass, quick connect, etc.

Filling the Knowledge Gap

The average age of skilled workers in the United States is reported to be between 53-57 years old. As these individuals retire, who is going to replace them? How will you fill the knowledge gap that exists at your plant? One answer is to have well-written and detailed procedures to ensure that technicians can perform the job regardless of how long they have held the position. Procedures can provide the basis for your training program, but sadly most are quite primitive with instructions such as: "Give machine A four shots of grease and machine B three shots of grease." Effective procedures define what a shot of grease is so you know precisely what quantity of lubricant should be put in the bearing or seal.

Many lube techs and program managers will require hands-on training for the "how" of lubrication. This should not be provided from a theoretical standpoint but through actual mentoring and guiding. During training, technicians should perform lubrication tasks under the guidance of a consultant, who then evaluates proficiency. At the end of the training, your lube team should be able to implement and execute your lubrication program just as if you had consultants onsite doing the jobs themselves.

Remember, even if you have invested large amounts of resources in your program, you may still need to invest in training for your team members in order for them to execute your procedures properly. By applying these strategies, you can develop a training program that will address, mitigate and possibly eliminate the most destructive contaminant in your plant. ■

About the Author

Loren Green is a senior technical consultant with Noria Corporation, focusing on machinery lubrication and maintenance in support of Noria's Lubrication Program Development (LPD). He is a mechanical engineer who holds a Machine Lubrication Technician (MLT) Level I certification and a Machine Lubricant Analyst (MLA) Level III certification through the International Council for Machinery Lubrication (ICML). Contact Loren at lgreen@noria.com to find out how Noria can help train your team for better contamination control.

73%

of lubrication professionals say knowing how to perform a task is not as important as knowing why, based on a recent survey at MachineryLubrication.com

MARUTI SUZUKI

Maruti Suzuki launches Lubes in India

A move that may heap on the competition among lube suppliers in the world's third-largest lubricant market could be the launch of Ecstar brand of lubricants and coolants in the country by India's largest car manufacturer, Maruti Suzuki. Maruti claims that Ecstar has passed rigorous tests that contribute to a superior performance by up to 2.8 per cent and fuel economy by up to 3.5 per cent.

Maruti will offer Ecstar to its customers at the Nexa Service workshops. It will also be available at authorized Suzuki dealerships.

Several lube suppliers have tie-ups with original equipment manufacturers, and the entry of the Ecstar brand could increase competition among players as they seek to grow their market share in the country.

Impact of GST :
GP Petroleums to Shift Daman Plant

The central sales tax exemption available for production and sales from Daman has been discontinued after implementation of GST. Moreover, the lease period of the Daman plant is getting expired on 15th Dec 2017. Thus, it has been decided by company management to discontinue production and sales from Daman plant and shift the same to Vasai plant where sufficient unutilized capacity is available.

The Company intend to set up new green field lubricant plant at 11 acre company owned freehold land situated at Valsad (Gujarat). The estimated capacity of plant will be 100,000 KL which will replace the combined production capacity of Daman Plant.

The logo & name of the Group (of which the Company is a part) has been changed, from Gulf Petrochem to GP Global.

HPCL LAUNCHES Lubes in Myanmar

HPCL has become the first Oil Marketing Company (OMC) from India to mark its presence in the lubricant market in Myanmar, and to lend more visibility and awareness to the brand, a well-designed product launch was scheduled in two major cities there. Having achieved the number one position in the domestic market, HP Lubricants sought to prove itself in foreign shore by venturing into Myanmar.

"Having achieved the number one position in the domestic market, HP Lubricants sought to prove itself on foreign shores by venturing into Myanmar," the company said in a statement. HPCL operates India's largest base oil refinery and produces over 300 lubricant products, specialty oils and greases. The company sells its lubricants through a network of 213 lube distributors and 14,412 retail outlets across India.

Gulf Oil Sets Sights on B2B SEGMENT

India's focus on infrastructure development offers opportunities for a strong fiscal year 2017-2018 in both consumer and business-to-business segments, Gulf Oil Lubricants India Ltd. noted in its annual report.

The government's Make in India initiative involves expansion, construction and modernization of roadways, metro networks and ports. The boost in infrastructure development will augur well for the company's future growth, Gulf Oil said.

Consumer automotive lubricants account for about 67 percent of the company's sales volumes. The rest are in the commercial, or B2B segment, which covers industrial oils; mining, construction and agricultural equipment lubricants; original equipment manufacturer tie-ups and government supply contracts; and commercial fleet deals. "We plan to increase exposure to the B2B segment for tapping the benefit from the reviving road construction, industrial and OEM activities," Gulf Oil Managing Director Ravi Chawla said in the report.

"BETTER LUBRICATION, BETTER PRODUCTION"

VAS Tribology Solutions organized the Seminar on "Better Lubrication, Better Production" held on 19th November 2017 at Dhaka to introduce various Noria services in the region.

Speakers had attracted great interest as Technical & Supply Chain executives from various industries like Steel, Cement, Polymer, Electrical Jute, Plastic, Piping and Textile participated in the seminar.

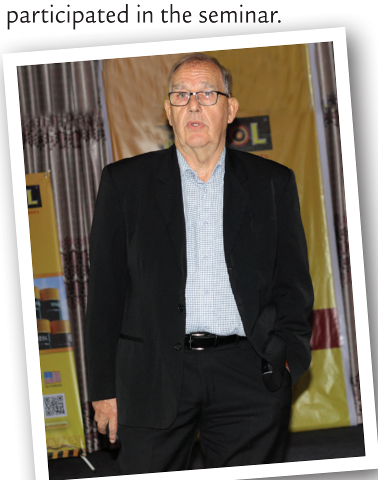
Mr. Rafiq Mujtaba, Director, Bangladesh Thai Aluminium (BTA) was the guest of honour.

Mr. Udey Dhir of VAS Tribology Solutions (regional partner of Noria Corporation, USA) addressed the gathering on "Optimum Lubrication through Lubrication Program Development".

Mr. Michael Hooper, Lead Trainer for Noria Corporation spoke on

"Listen to your Lubricants- Oil Analysis". Mr Mossadek Hossain, CEO of MEDCO also addressed the gathering on Lubricant Industry in Bangladesh. He spoke on expectation of customers and what industry can do to fulfil those.

The seminar was followed by a 3 day training program (20th-22nd Nov) on Practical Oil Analysis, a Noria Skill Development Training and ICML certification exam.



GARRETT BAPP | NORIA CORPORATION

Best Practices for TOPPING UP Small Sumps AND RESERVOIRS

After visiting and working in various plants across the nation, I've noticed that most small reservoirs just don't receive the attention they deserve. At one facility, we focused heavily on larger equipment that was deemed critical. Typically, these were also high-dollar items to replace or rebuild, so we made sure they were retrofitted with breathers, sight glasses, quick connects, inspections, etc. When smaller equipment failed, like a pump or gearbox, it usually was a firefighting situation because it was holding up one of our processes. At that point, we took the time to review the application and added preventive maintenance (PM) and inspections into the system. Eventually, everything was fed into our database, and some type of PM or inspection took place. All new equipment was also reviewed thoroughly to ensure past troubles were not repeated. The result was a huge increase in uptime, productivity and machine availability.

The ultimate goal with larger equipment is to predict and schedule when it will need to be replaced or repaired before a catastrophic failure and costly downtime occur. But what should be done with smaller pieces of equipment, those with reservoir capacities of only a few ounces to 10 gallons, or machines on which oil analysis is not conducted? How do you keep these systems in good condition? Regular inspections will make it easier to detect early warning signs of future problems. For example, a simple oil level check can be the difference between a piece of equipment failing prematurely and running five to 10 years or more. It doesn't end there. If the oil level is recorded as low, the reservoir must be topped up, but how is this top-up performed? Everyone has a slightly different way of completing this simple task, which can have negative effects on your machinery if not done correctly.

If handled correctly, a sealable and reusable container is great for topping up equipment. However, problems can occur if the container is left in the field next to equipment, not cleaned or has spouts that are not kept closed.

Bad Practices

Let's start by examining some of the wrong ways to top off your reservoirs. Please note that these practices also apply to changing out the oil in your equipment regardless of whether it is a gearbox, pump or other oiled component.

Funnels

I have seen funnels used everywhere and anywhere. Now I'm not saying that utilizing a funnel will kill your machinery, but how you treat the funnel and how the funnel is used may. Funnels often collect dust and debris while stored in lockers or the back of utility vehicles. Frequently after use, they are drip-dried and thrown into a storage location until needed again. Someone then pulls out the funnel to top off a reservoir and may or may not give it a quick wipe before pouring oil through it. You can imagine how much dirt is distributed into the reservoir just from the funnel alone.

Open and Galvanized Containers

I cannot count the number of times I have spotted open oil-transfer containers in a plant. In my first maintenance job, these types of containers were the only ones used to transfer oil. I've actually witnessed 5-gallon buckets with visible dirt and oil inside them just waiting to go into a machine. Keep in mind that large particles that enter a sump will eventually be made into smaller particles, which will have detrimental effects on the machine.

Galvanized pails have a coating of zinc to protect the steel. The problem with this zinc coating is that the additives in the oil formulation will attach themselves to it and get stripped from the oil before entering the reservoir, decreasing the percentage of beneficial additives in the oil.

Abuse of Sealable and Reusable Containers

If handled correctly, a sealable and reusable (S&R) container is great for transferring oil and topping up equipment. However, problems can occur if the containers are not labeled or cleaned, left in the field next to equipment, or have spouts that are not kept closed.

Cleaning Before Filling

This will largely depend on the individual who is adding the oil. With small reservoirs, it often is not economical to add quick connects as a means to fill and drain the system. Removing a fill plug or breather may be the only way to get oil back into the system. Unless you have an air-tight production facility with excellent filtration, debris will settle on and around fill ports and be ready to introduce itself once the ports are opened.

> It doesn't take much fluctuation of the oil level in most small reservoirs to start seeing a negative impact on the internal components.

Dirty Oil

There's a misconception that new oil is clean oil. This isn't always the case. Generally, oil that is received in drums, pails and bulk tanks should not go straight into your equipment. After sampling multiple drums of new oil deliveries over the years, I've found that a barrel of oil that meets the equipment's cleanliness targets is like finding a unicorn. Occasionally, a delivery may come in that meets the specifications, but you should always filter the oil before any top-up or fill is performed.

Fill It and Forget It

Too often I've seen a piece of equipment be put into operation and never be looked at or thought about again. Simple daily or weekly inspections should be performed on any valued asset. Over time, seals can begin to wear and leak. A plug may not have been tightened properly or has become loose. Small bath systems depend on the oil level being correct.

Good Practices

Now let's address the bad practices outlined previously by explaining how to correct them. Some are fairly straightforward, while others will require an investment of time, money and training.

Funnels

I don't think all funnels are bad. They have their place. I personally use a funnel every time I change the oil in my vehicles. But what are the best practices for using a funnel? First, make sure it's clean before using it. Clean the inside and outside with a lint-free cloth. After using the funnel, clean it again and store it in a new zip-lock bag, which should then be sealed and put in its permanent spot. This is important. I swear my wife and I play this game at our house where I take the scissors out of one drawer and place them in another drawer after I'm done using them. This causes her to search for them or ask me where I put the scissors. If you apply this to an industrial setting where multiple people have access to the tools, you would never be able to predict where the funnels would be. This typically leads to someone grabbing a funnel or something else that is unfit for use.

Open and Galvanized Containers

Quit using these containers. Do an inventory check and throw all of them away. Purchase enough S&R containers to get your team accustomed to using them. If the right tools are readily

> **58%**
>
> of lubrication professionals say they do not regularly inspect smaller pieces of equipment, based on a recent survey at MachineryLubrication.com

available, good practices will follow. Also, train the individuals who handle lubricants so they know not to use bad practices.

Abuse of Sealable and Reusable Containers

These containers should not be left lying around the plant. If a container is not where it's supposed to be, it will be of no use to the next person who needs it. Put a PM in place to thoroughly clean the inside and outside of the containers. This should be done inside a clean room to prevent contamination from entering the newly cleaned container. Just as with funnels, use a lint-free cloth to help with cleaning.

Cleaning Before Filling

Bring rags or wipes with you to the field to aid in cleaning fill ports before opening them. Even a little dirt entering the system can lead to catastrophic results. Having a supply of rags or wipes with you will help make those quick level inspections more reliable.

Dirty Oil

All oil entering the facility should go through a decontamination process before being allowed to enter a machine. Target cleanliness levels should be defined for all equipment, even if oil analysis isn't going to be performed. Optimum equipment reliability can be expected when new oil is at the target specification or cleaner.

Fill It and Forget It

All machinery should be examined at some point. A simple level inspection could mean life or death. It doesn't take much fluctuation of the oil level in most small reservoirs to start seeing a negative impact on the internal components. Put PMs and inspections in place so they become standard practice for servicing the "forgotten" equipment.

Purchase enough S&R containers to get your team accustomed to using them. If the right tools are readily available, good practices will follow.

Volume Control

Although this was not addressed directly in the bad practices, it is critical to maintain a precise oil level in small reservoirs. Underfilled units can lead to lubricant starvation and machine failure. Overfilled sumps can result in unnecessary seal leakage or foaming of the oil. Even a monthly inspection is better than nothing. Most manufacturers will specify how much oil the reservoir should take. The proper oil level should also be clearly identified on the sight glass.

Visual Inspection

A good sight glass will aid in maintaining a precise oil level. Before an inspection, the sight glass should be cleaned for an accurate reading. Newer sight glass styles allow a 360-degree view of the oil level, which can yield better inspection results.

A bottom sediment and water (BS&W) bowl may also be helpful. It can offer telltale signs of water contamination, sludge or wear. If oil analysis is not going to be performed, this simple device can provide an early detection of potential problems.

Contamination Control

Along with cleaning the oil before it goes into the machine, there must be a way to control the environmental elements. Proper headspace management will be key. In humid places, washdown applications or even outdoor equipment, a desiccant breather is an excellent option. While particle contamination is the No. 1 cause of lubricant-related equipment failure, moisture should not be overlooked. If moisture is not a threat to your machinery, a particle breather may be used. However, not all headspace management is created equal. Look for the micron rating to confirm that the breather you select will provide the needed protection.

Sampling

It's uncommon to sample smaller reservoirs simply because the cost may be comparable to or more than an oil change. Still, less periodic sampling can offer certain benefits. For example, I had a set of 20 gearboxes that required a synthetic lubricant. With all the gearboxes the same, I wanted to see if extending the oil change interval from one to two years would be possible. By collecting a few drain samples from the gearboxes, I was able to prove that the drain interval could be extended. At other times, the piece of equipment may be critical. If frequent sampling is to occur, hard sampling devices should be installed for more consistent results.

Quick Connects

Having the right tools for the job makes it that much easier. Sometimes a funnel and an S&R container just aren't enough. For harsh environments, a quick connect should be considered. Quick connects can be retrofitted to an S&R container for easy filling. This greatly reduces the number of contaminants that enter the system while filling.

Training

While all these tips can help any plant keep its smaller reservoirs topped up, it eventually boils down to the people performing the work. Without proper training, the same bad practices will continue because the individuals don't understand the impact they have on the equipment's reliability.

If your organization relates more to the bad practices than the good ones, it's time to step back and re-evaluate the way you manage lubrication. It's not a total loss. There is hope. Take a look around your plant and talk with the individuals on the floor doing the work. Develop a plan and address some of the bigger outlying issues. Remember, it's not always the critical equipment that holds up production. ■

About the Author

Garrett Bapp is a technical consultant with Noria Corporation, focusing on machinery lubrication and maintenance in support of Noria's Lubrication Program Development (LPD). He is a certified lubrication specialist through the Society of Tribologists and Lubrication Engineers (STLE) and holds a Machine Lubrication Technician (MLT) Level II certification through the International Council for Machinery Lubrication (ICML). Contact Garrett at gbapp@noria.com to learn how Noria can help you implement best practices for topping up equipment at your plant.

"If an oil with a viscosity grade (ISO VG) of 680 has an oil temperature of 60 degrees C but the journal bearing temperature is 88 degrees C, will it affect the oil condition or can the oil withstand this temperature?"

Temperature affects many things in the realm of machinery reliability. At this elevated temperature, you would expect the viscosity to decrease, the lubricant film to become thinner, an acceleration in abrasion and scuffing conditions, the oil to age sooner, the additives to deplete quicker, an acceleration of corrosion, and the formation of sludge and varnish. These are only a few of the side effects of running at a higher temperature, but they play a critical role in the overall health of the machine and the lubricant.

The relationship between temperature and chemical reaction rates (oxidation or the chemical aging of the oil) was theorized by Svante Arrhenius around the turn of the 19th century. According to Arrhenius' rate rule, lubricants will degrade twice as fast for every 10 degrees C the temperature is increased after their base activation temperature has been reached. The statement could also be made that if you were to reduce the temperature by 10 degrees C, you would expect to cut the oxidation rate in half, thus doubling the life of the lubricant.

Viscosity is the single most important property of a lubricant, and everyone knows that a change in temperature leads to a change in viscosity. However, few people realize just how much of an effect it has. In the question above, a temperature difference of 18 degrees C is mentioned. This temperature difference accounts for a drop in viscosity of 71 percent, assuming the lubricant in question is a mineral-based fluid with a viscosity index of 95. This drop in viscosity has a staggering effect on the film strength and the ability of the lubricant to keep the journal bearing from operating in a boundary (metal-on-metal) condition.

The selection and use of an ISO VG 680 oil in a journal bearing is outside the ordinary. This specific application would have to be very slow moving and/or very heavily loaded to warrant the use of such a high viscosity. For example, if the shaft were 12 inches in diameter and 12 inches in width, spinning at 900 revolutions per minute and at the proposed operating temperature of 88 degrees C, the required viscosity at this temperature would be 15.8 centistokes (cSt). The ISO VG 680 oil provides 59.38 cSt. This is extremely excessive, and the consequences can result in heat generation and energy consumption because of internal fluid friction.

So elevating the temperature to 88 degrees C will affect the oil condition, but the root cause of the heat may be an incorrect lubricant selection. If this is the case, it is easily addressable.

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. Which test is not practical to run onsite as an oil analysis field test?

A) Viscosity
B) Particle count
C) Acid number
D) Wear metals by atomic emission spectroscopy
E) Glycol determination

2. Lubricant refilling best practices should include which of the following:

A) Use a filter cart to charge (fill) the system with oil, if possible
B) Refill the equipment while it is operating and hot
C) A funnel
D) A funnel if it has been capped (or sealed)
E) A sealed container with a tube for siphoning

3. Greases have the advantage of functioning well in:

A) Very high-speed bearings
B) Frequent start-stop applications
C) The presence of other types of greases
D) Applications that require heat transfer and cooling
E) Very cold-temperature applications

Answers

1. D
This is because of the initial cost of the instrument.

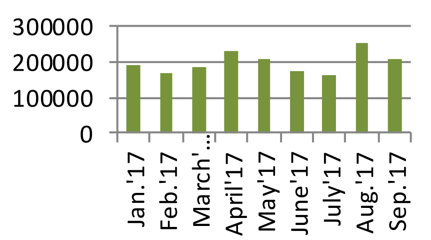
2. A
This is to ensure that clean oil is added to the system, as new oil is not necessarily clean oil.

3. B
Grease remains within the lubricated component, lowering the risk of a dry start. It is unlike oil, which drains away when the system is shut down.

BASE OIL REPORT

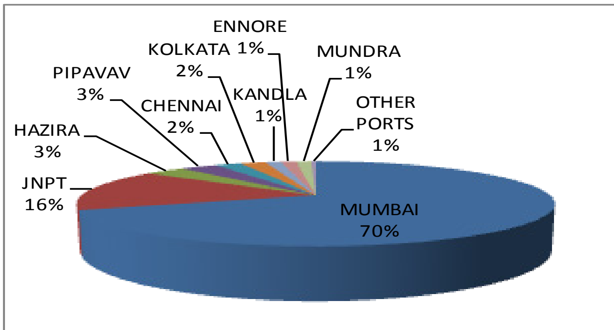
The price of crude oil has touched the $60/bbl mark, the highest since mid- 2015.

MONTH WISE IMPORT OF BASE OIL IN INDIA



Strong assurances from OPEC and Russia regarding the extension of the production cut deal has pushed oil prices above $60 per barrel, possibly bringing oil prices into a new higher range. OPEC, Russia and other oil exporting countries have pledged to hold back 1.8 million bpd in oil production in order to tighten markets until the end of March to drain a global supply glut, which is one of the key factors contributing to the oil price hike.

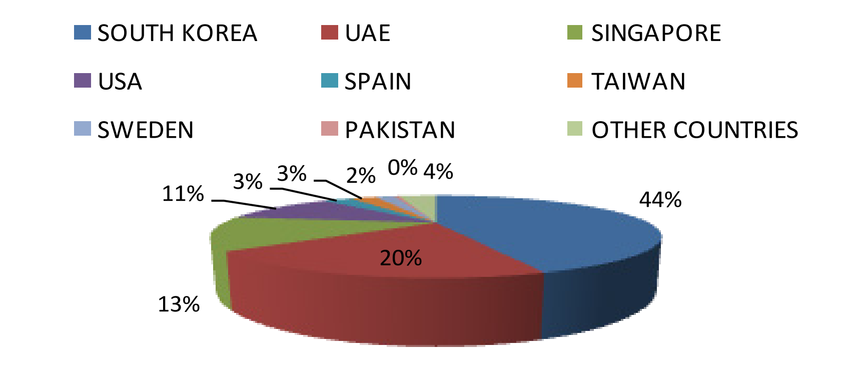
PORTS WISE IMPORT OF BASE OIL INTO INDIA (JAN-SEP 2017)



ORIGIN-WISE IMPORT OF BASE OIL INTO INDIA (JANUARY'17-SEPTEMBER'17)

The Indian base oil market remains steady with Inventories at optimum levels with surplus of imported grades. Compared to last month import of the country has decreased by 19% in the Month of September 2017.

ORIGIN-WISE IMPORT OF BASE OIL INTO INDIA (JANUARY'17-SEPTEMBER'17)



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.

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	Rubber Process Oil (Aromatic)
September 2017	USD 710 – 715 PMT	USD 685 - 695 PMT	USD 655 - 665 PMT	USD 380 - 395 PMT
October 2017	USD 725 – 730 PMT	USD 700 - 710 PMT	USD 670 - 680 PMT	USD 395 - 410 PMT
November 2017	USD 745 – 750 PMT	USD 720 - 730 PMT	USD 690 - 700 PMT	USD 415 - 430 PMT
	Since September 2017, prices have gone up by USD 35 PMT (5%) in November 2017.	Since September 2017, prices have gone up by USD 35 PMT (5%) in November 2017.	Since September 2017, prices have gone up by USD 35 PMT (5%) in November 2017.	Since September 2017, prices have hike up by USD 35 PMT (9%) in November 2017

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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GREY/MUM/06.17