Machinery Lubrication

India July - August 2014

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Secrets to BECOMING a WORLD-CLASS PM Facility

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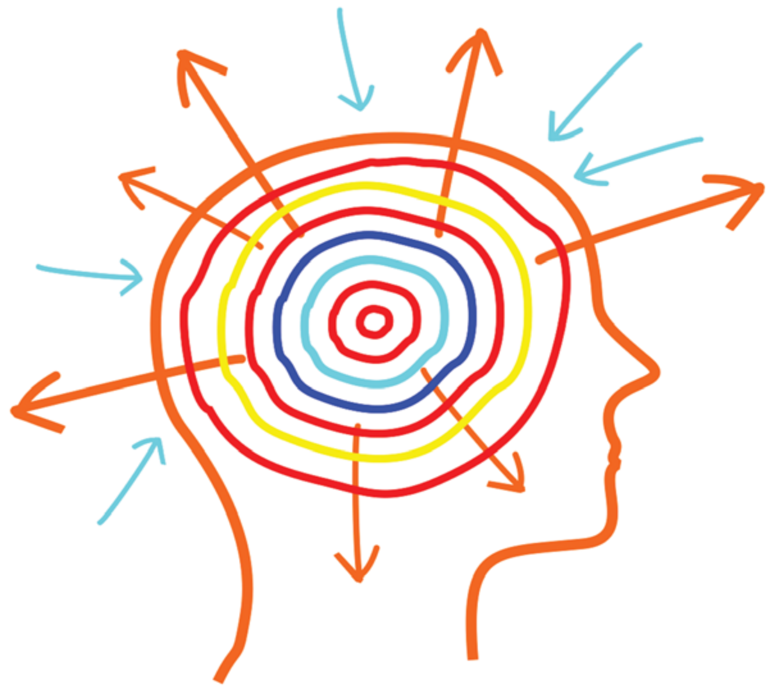

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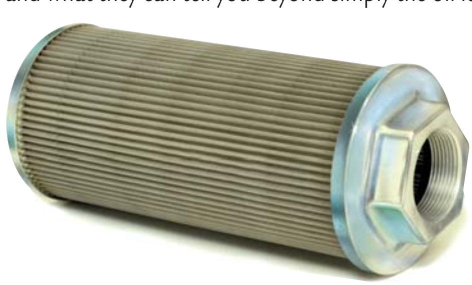

More Editorial Features

Publisher's Note

The past month has seen the much anticipated first budget by our new government. With a significant focus on development especially towards manufacturing and infrastructure, I feel this budget should set things in motion towards a speedy recovery of the economy as a whole.

In the last issue we gained an insight into how to purchase lubricants based on performance. It is becoming increasingly important to understand lubricants and what makes them work. As more and more research suggests that the conditions under which lubrication is performed is as important as the quality of the lubricant, it is important to probe deeper into whether one is getting the maximum out their lubrication program.

Finally by concentrating on performance specifications, total fluid management (TFM) will take a whole new dimension. If you choose to go this route, you will see tangible and intangible benefits of a scientifically designed program which are tailored to your requirements.

In the current issue we will share with you the secrets of becoming a world class PM facility. The primary goal in any industry is maintaining safe and reliable equipment. This involves getting the maximum uptime at the lowest cost of operation and extending the as-designed usable life. The fundamental cornerstone of this proposition is effective lubrication in concert with preventive and predictive maintenance tasks that are carried out in a quality manner.

Readers will also find an informative article by Jim Fitch on the hazards of changing lubricant brands and the strategy to implement to ensure a safe changeover.

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We also plan to have a readership survey with our next issue. This feedback will help us bringing articles and case studies of your interest.

Wishing all our readers and advertisers a very Happy Independence Day.

Warm Regards,

Udey Dhir

JIM FITCH NORIA CORPORATION

HAZARDS of Changing LUBRICANT BRANDS

It goes without saying that lubricants aren't indiscriminately interchangeable, even if they are in the same product class. This is especially true with industrial lubricants, and there are very few exceptions. From experience, we've learned that lubricant change is too often the precursor to sudden and unexpected machine failure.

Don't get me wrong. Noria is all about challenging the status quo and promoting change. While change brings the potential for considerable opportunity, it also can introduce considerable risk. This is probably where the adage "if it ain't broke, don't fix it" originated. The opportunity is what we seek, and fortunately when it comes to a lubricant changeover, we have considerable control over the risk.

Lubricant brand or type changes should always be viewed as machine and system disturbances. Never forget the lessons of Murphy's law: "Anything that can go wrong will go wrong." Therefore, make sure you have a compelling reason for a change, such as:

- Consolidation (reducing the total number of brands and products)
- Company-wide lubricant supplier change (sometimes due to a recent merger/acquisition event)
- Unsatisfactory historic performance (current lubricant fails to deliver performance needs relating to reliability, energy economy, etc.)
- Reduce lubricant cost (extended drains and/or lower price point)
- Current product has been discontinued by supplier

A lubricant brand change refers to switching product brands but not the product type, e.g., going from oil supplier A to oil supplier B for the same product (like a Group II turbine oil). A lubricant type change is typically the result of consolidation or performance enhancement initiatives. For instance, switching from an AW 46 mineral hydraulic fluid to an AW 46 synthetic hydraulic fluid would be a product type change. In this article, the term "changeover" will be used to represent one or the other.

> **57%**
> of lubrication professionals consider unsatisfactory historic performance to be the most compelling reason for a change in lubricant brand or type, based on a recent survey at machinerylubrication.com

What are the Risks?

If a change is highly desired or simply inevitable, then a good strategy is to get a firm grasp on the potential risks. Fortunately, the industry has considerable experience from which to draw understanding and plan risk management. Most changeover problems are associated with the following:

- The new lubricant was incompatible with the previous lubricant, and some mixing was unavoidable (or not properly avoided). The incompatibility resulted in lubricant performance defects and associated reliability consequences.
- The new lubricant was incompatible with internal sediment, sludge and/or varnish.
- The new lubricant was incompatible with machine internal surfaces (paint, surface treatments, filters, elastomers, caulking, adhesives, etc.). Some aggressive lubricant additives can leach sensitive metals (tin or copper, for instance).
- The new lubricant was incompatible with operating conditions and exposures (temperature extremes, contaminants, gases, process

chemicals, washdown sprays, coolants, etc.)

- The new lubricant had performance weaknesses or drawbacks that the previous lubricant did not. While some characteristics of the new lubricant may be superior to the previous lubricant, many others could exhibit substandard performance.

However, some lubricant changeovers offer much milder risk concerns. These include cases where:

- The viscosity is the only feature that is changed (not the brand or type).
- The lubricant changeover is within the same brand, and compatibility has been verified by extensive testing by the lubricant supplier.
- The changeover is scheduled for low-criticality equipment working in mild operating and exposure conditions.

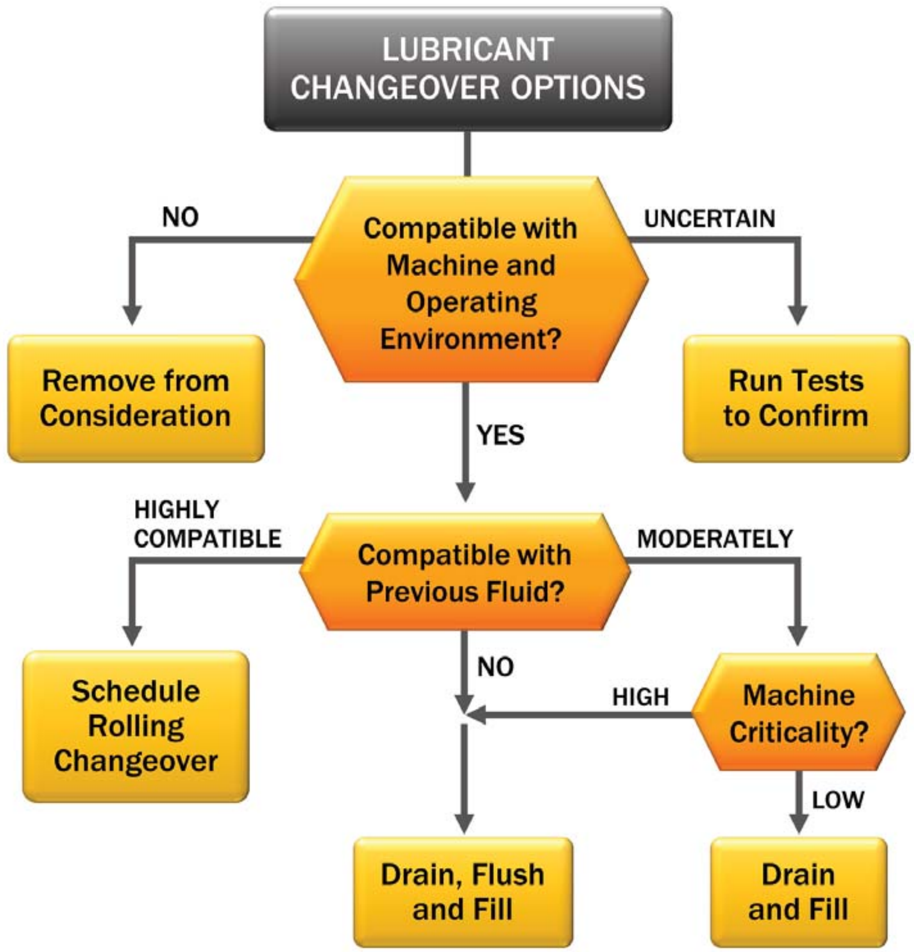
When the risk has been assessed to be low, then a rolling changeover is usually acceptable. This is nothing more than periodically using the new lubricant for top-ups (makeup fluid). The changeover can be accelerated by doing a bleed-and-feed. Even in relatively low-risk circumstances, it is important to implement post-changeover monitoring practices, which will be discussed later.

Conversely, the highest risk changeovers are frequently associated with:

- Old equipment (long service with the previous lubricant)
- Unknown additive chemistry and limited compatibility testing performed
- High machine duty and criticality
- Complex lubricant formulations

Testing Compatibility

There are numerous industry standards



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Greatest Changeover Dangers

PROBLEM	GREATEST DANGER	CONSEQUENCES	CONTROLLING THE RISK
Loss of oil clotting/packing (see www.machinerylubrication.com/Read/1394/)	Old machines; switching from mineral oil to formulations containing esters, detergents, dispersants and other polar additives	Oil leakage (both internal and external) and potential starvation	Perform a chemical flush and repair leakage before the machine is returned to service
Impaired seal performance (e.g., dimension change, structural change, deterioration, compression set issues, etc.)	Old machines; switching to a synthetic lubricant that has a sharply different aniline point than the previous lubricant	Oil leakage (both internal and external) and potential starvation	Run tests for compatibility to elastomer types used in the machine; repair/replace old and worn seals
Sludge mobility (sludge and deposits become mobilized by change in lubricant chemistry)	Old machines; switching from mineral oil to formulations containing esters, detergents, dispersants and other polar additives	Clogged oil flow through glands and orifices resulting in starvation and accelerated wear (see www.machinerylubrication.com/Read/29040/lubricant-starvation-dangers)	High-velocity flush, chemical flush and other flushing methods needed to purge system of sludge and deposits before new lubricant is introduced
Impaired lubricant performance due to clashing additives and base oils	Incompatible lubricant mixtures such as acid/base reactions	Possible reliability issues from: • Production of sludge and other insolubles • Loss of interfacial tension leading to chronic aeration problems, foam and/or oil-water emulsions • Impaired oxidation stability • Corrosion • Impaired film strength	Complete drain and flush of all remnants of the previous lubricant

that provide guidance on compatibility testing (ASTM, FTC, etc.). The typical protocol (e.g., ASTM D7155) involves preparing binary mixtures of the lubricants with questionable compatibility. Mixtures such as 50:50, 95:5 and 5:95 are often used, but this can be modified to better match the target application.

After a short bedding-in time at an elevated temperature, which allows the base oil and additives to chemically and physically interact, the mixtures are ready to be inspected and tested further. If floc, sediment, clouding or discoloration develops from the mixtures, the lubricants are confirmed to be incompatible (tier-one test) without further analysis. If this doesn't occur, then another tier of testing should be seriously considered.

Machine criticality plays a vital role in this decision, along with other factors (see sidebar on page 4). A lubricant specification can be used as the baseline for the tier-two tests, or the performance listed on the new lubricant from its product data sheet. Performance tests can include filterability, air-handling ability, water-handling ability, film strength, oxidation stability, corrosion suppression, etc.

The selection of these tier-two tests is largely driven by the critical performance needs in the target machine application. Again, standardized test methods can be employed, especially relating to elastomers and surface treatments. Risk relating to chemical exposures might include certain gases (refrigerants, ammonia, hydrogen sulfide, etc.), fuel, coolants, process chemicals, etc. Custom testing may also need to be performed to assess their compatibility.

Developing an Oil Drain and Flushing Strategy

For obvious reasons, a changeover is strongly discouraged if incompatibility is found between the new lubricant and the machine (seals, for instance) or the operating environment (e.g., process gases) (see Figure 1). If a changeover is still unavoidable, seek other lubricant options to mitigate the risks and consequences.

Should incompatibility only be found between the lubricant mixtures (not the machine or operating exposures), a changeover usually can be successfully performed if special precautions are taken. These relate to the complete removal of the previous lubricant and the decontamination of sediment, sludge and varnish.

The greater the danger, the more rigorous the drain and flushing should be. We can relate this to the definition of risk, which is the probability of a compatibility problem times the consequences. High lubricant incompatibility (determined from testing) relates to the probability of a problem occurring, and high machine criticality defines the consequences. Criticality includes such things as the cost of repair, lost production and safety risks.

Where the danger is high, drain the system completely of all remnants of the previous fluid. Look for trapped cavities of fluid in heaters, coolers, off-line loops, hoses, filters, low-point traps, line extensions, etc. Even after the drain is complete, oil will still occlude to the internal machine surfaces. These wet surfaces along with the presence of sludge and surface deposits (including varnish) are high risk.

Follow the drain with a displacement or chase fluid to carry away the remaining previous oil. The displacement fluid is sacrificial and as such needs to be completely compatible with the final fluid charge and relatively inexpensive. A low-viscosity base oil is sometimes used or perhaps even a transformer oil.

Heating the displacement fluid and passing it through all internal fluid zones at high velocity gives the best results. Many independent companies offer flushing services that are worth considering.

If machine surfaces fail to clean completely, a chemical flush may be required. This can be added to the displacement fluid at a concentration of 5 to 10 percent. One common product sold by DuBois Chemicals is Step-One cleaner (also branded and available from other lubricant suppliers). It is not a solvent but a calcium-sulfonate detergent product blended in a mineral base oil that has been found to be very effective. One drawback is that this cleaner must be completely removed from the system before the final lubricant is introduced. This is typically done with yet another displacement fluid.

Post-Changeover Monitoring

After the flush has been completed and the final oil charge added, combat Murphy's law by using a post-changeover monitoring strategy. Accelerate oil analysis and other machine inspections (foam, cloudy sight glasses, high temperature, discoloration, noisy operation, etc.). Test for foaming tendency and demulsibility characteristics.

Also, don't forget to change lubrication procedures to include the new lubricant for top-ups and oil changes. Be sure to re-label the machine with the correct new lubricant as well.

Note: Although this article addresses oil changeovers, grease changeovers present an equally high risk. For information on this topic, visit www.machinerylubrication.com/Read/882/mixing-greases.

JEREMY WRIGHT NORIA CORPORATION

MICRODIESELING and Its EFFECTS on OIL

Would you consider 2,000 degrees F to be hot? At this temperature, aluminum, copper, gold and iron have already melted; stainless and carbon steels are glowing red; and your Thanksgiving turkey would turn into a charred mess in less than a second. So what is so significant about 2,000 degrees? Did you know that many hydraulic systems can create temperatures in this range?

Have you ever walked by a hydraulic pump that was cavitating? Once you hear it, you will never forget the signature sound it makes. I describe it as a can of marbles being shaken. What is actually happening is that the pressure acting on the fluid is below the saturation pressure of the dissolved gas (normally air) in the fluid. If the gas bubbles pass through a higher pressure zone (like that found on the discharge side of the pump), they will violently collapse. This alone can cause serious reliability issues with the machine component in terms of vibration, noise, surface damage and potentially failure.

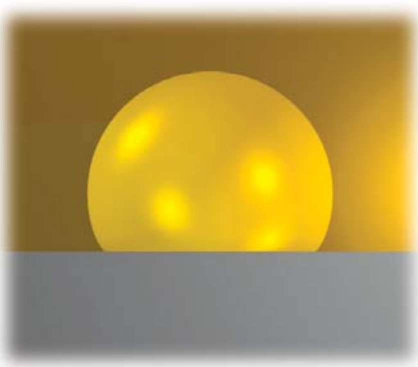
37% of lubrication professionals have seen the effects of microdieseling, based on a recent survey at machinerylubrication.com

The compression of these bubbles in that pressurized side of the pump is adiabatic (not much heat is exchanged between the fluid and the bubble during the nanoseconds of increasing pressure).

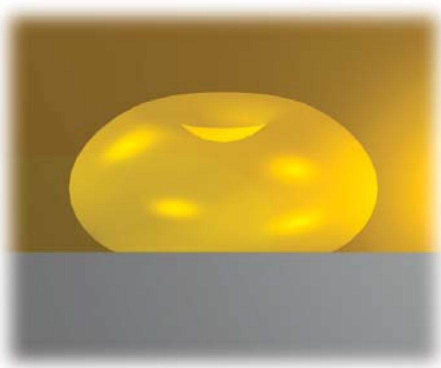
For example, consider a hydraulic system with a suction-side air leak that lets in bubbles at a little less than atmospheric pressure and 100 degrees F and then pressurizes the fluid to 1,800 pounds per square inch (psi). The temperature in this example, which is typical of a hydraulic system with an air leak, would be just more than 2,000 degrees F.

When an air-ignitable mixture is present inside the bubble, ignition is almost

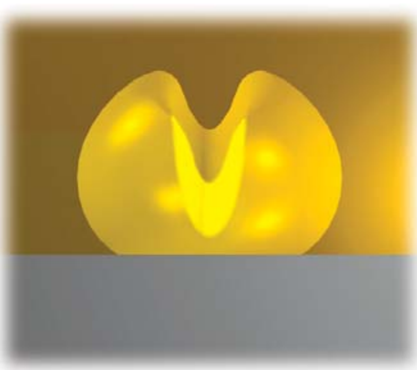
Cavitation



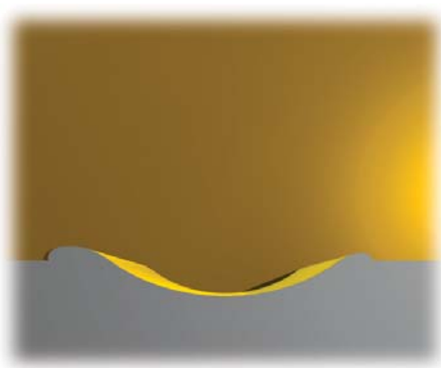
Initial Bubble



Initiation of Bubble Collapse



Forming of Liquid Jet



Impact and Metal Extrusion

4 States of Air-in-Oil Contamination

1. **Dissolved Air** — Air is completely dissolved in the oil and cannot be seen (no clouding).
2. **Entrained Air** — Unstable microscopic air bubbles in oil.
3. **Free Air** — Trapped pockets of air in dead zones, high regions and standpipes.
4. **Foam** — Highly aerated tank and sump fluid surfaces (more than 30 percent air).

inevitable at these incredible temperatures. This is the process known as microdieseling. It will lead to the oxidative degradation of the oil, higher operating temperatures, pressure spikes and the cavitational erosion of the hydraulic pump and other components.

The sources of the bubble formation within the system include but are not limited to:

- Pressure drop through an orifice
- Pressure drop through pipes and hoses
- Turbulence from valves opening and closing
- Shock waves due to sudden closing of valves and cessation of pump operation
- Pressure drop due to the sudden opening of a valve
- External force on a piston rod
- Suction resistance
- Plunging of fluid at the return to the tank
- Inadequate net positive suction head available (NPSHA) relative to the net positive suction head required (NPSHR) in centrifugal pumps
- Suction-side recirculation to sub-best efficiency point (BEP) operation of centrifugal pumps
- Nearly dry operation of a pump due to insufficient fluid volume

Problems that result from the formation or presence of these bubbles include:

- Oil temperature rise
- Deterioration of oil quality
- Degradation of lubrication due to viscosity loss or sludge and varnish formation
- Reduced thermal conductivity
- Cavitation and erosion
- Noise generation
- Reduced bulk modulus due to fluid aeration, leading to a spongy fluid and sluggish system control
- Decreased pump efficiency
- Reduced dielectric properties

In layman's terms, microdieseling is a pressure-induced thermal degradation. An air bubble will transition from a low or negative pressure area to a high-pressure zone and through adiabatic compression get heated to very high temperatures. These temperatures are high enough to carbonize oil at the bubble interface, resulting in carbon byproducts (sludge and varnish) as well as increased oil degradation (oxidation). In the best-case scenario, you would be able to stop the root cause of the problem — the bubbles. If you can control the bubble population, you can control microdieseling. ■

About the Author

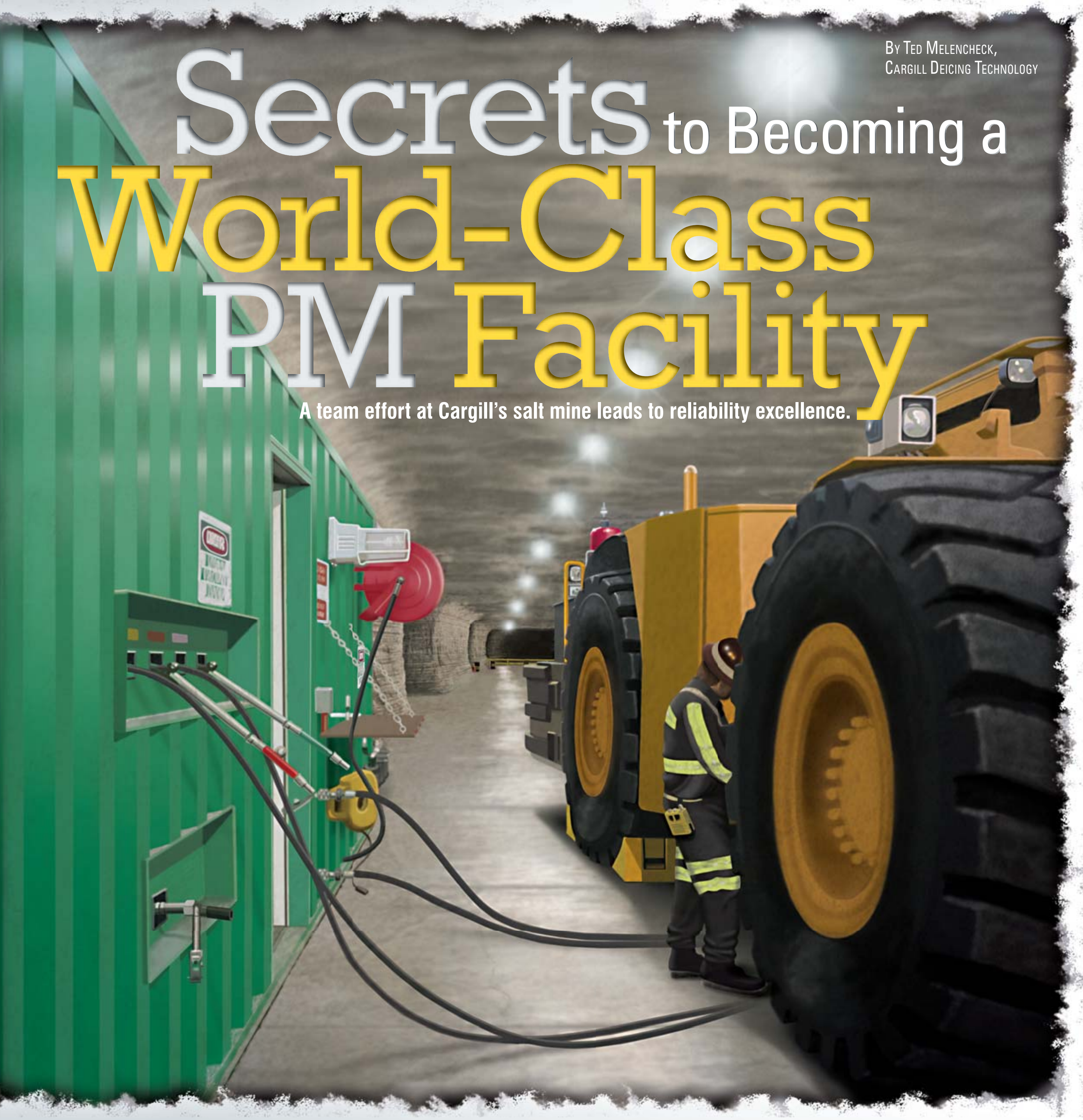
Jeremy Wright is vice president of technical services for Noria Corporation. He serves as a senior technical consultant for Lubrication Program Development projects and as a senior instructor for Noria's Fundamentals of Machinery Lubrication and Advanced Machinery Lubrication training. He is a certified maintenance reliability professional through the Society for Maintenance and Reliability Professionals, and holds Machine Lubricant Analyst Level III and Machine Lubrication Technician Level II certifications through the International Council for Machinery Lubrication. Contact Jeremy at jwright@noria.com.

Key Takeaway: *Microdieseling can lead to the oxidative degradation of oil, higher operating temperatures, pressure spikes and the cavitational erosion of the hydraulic pump and other components.*

By Ted Melencheck,
Cargill Deicing Technology

Secrets to Becoming a World-Class PM Facility

A team effort at Cargill's salt mine leads to reliability excellence.



The primary goal in any industry is maintaining safe, reliable equipment. This involves getting the maximum uptime at the lowest cost of operation and extending the as-designed usable life. The fundamental cornerstone of this proposition is effective lubrication in concert with preventive and predictive maintenance tasks that are carried out in a quality manner.

Performing required lubrication in a proper manner is challenging in even the best conditions, but at Cargill Deicing Technology's rock salt mine in Cleveland, Ohio, the obstacles were considerable. The mine is 1,800 feet deep and extends approximately 4 miles under Lake Erie. The underground mining operation utilizes a room-and-pillar style of mining, and its business is dependent on Mother Nature, since the primary product is deicing salt used for keeping roadways and sidewalks ice-free.

The mine maintains a fleet of specialized mobile equipment that extracts the salt, which is transported on a conveyor system to the milling operation and then hoisted to the surface for distribution. Diesel-powered mobile equipment is used for the extraction process. These machines are high oil consumers that require 250-hour operational oil changes.

underground mine. Considering all the challenges they had to overcome, the employees rose to meet and overcome those problems with very successful results, thanks in large part to having an engaged workforce and proper training.

Cargill Deicing Technology's rock salt mine in Cleveland, Ohio, is 1,800 feet deep and extends approximately 4 miles under Lake Erie.

The maintenance team made best-practice theories a reality by constructing a world-class, all-inclusive preventive maintenance (PM) facility, which is a unique installation for any

Old Practices

Approximately 10 years ago, the mining operation performed equipment servicing and PMs where the equipment was parked. All the material was

Previously, Cargill performed equipment servicing and preventive maintenance where the equipment was parked. Oil was transported in generic cans that were filled at a bulk station.

Cargill maintains a fleet of specialized mobile equipment that extracts salt from the mine.

brought to the machines, including filters, oils, drain pans, supplies, etc. Oil was transported in generic cans that were filled at a bulk station. The top of the can and equipment fill point were wiped off to keep dirt out when new oil was added to the machine. Waste oil was collected and poured back into the same cans to be dumped in the bulk waste-oil container, which was sent back to the surface for recycling.

Oil samples were taken, but maintenance personnel didn't understand the value, since they did not receive any feedback and no actions were generated as a result of the samples. Once the oils were drained, there was an ongoing question of what product should be used for refilling.

Beginning the Improvement Process

With so many issues at the mine needing improvement, the question was where to begin. It was determined that the best starting point would be to develop the knowledge base of the maintenance personnel. Part of this development was to have each mechanic attend a three-day lubrication course, which was conducted onsite. This helped provide the fundamental understanding that every component requiring lubrication needs the correct lubricant applied in the correct manner in the correct amount at the correct time. When these four principles are followed, equipment can last almost indefinitely.

Of course, acceptance is not always easy when conducting this type of training with long-time employees. About a week after the training, one veteran mechanic requested a lubricant specification book because he believed an incorrect lubricant was being used for an application. This was a major accomplishment. Having a highly seasoned employee requesting clarification meant he not only understood the class, but he also was applying what he had learned. This was a good first step.

Creating a New PM Bay

With a workforce that is engaged, employees execute what they learn when they understand why. Maintenance personnel soon began questioning current practices and believed they could make improvements, such as building a PM bay. Working with a maintenance supervisor, they decided what should be included in this area. They wanted to be able to perform PM inspections and kidney-loop filtration of systems, not just service equipment.

With a plan in mind, the team started assembling the necessary components. A location near the shop was designated as the PM bay area, and construction soon began. Once completed, the PM bay featured all the necessities for oil

Salt is loaded onto a conveyor system for transfer to the milling operation, which crushes and screens the salt into a usable product before transporting it to the surface.

Combined employee ideas culminated in the creation of a new PM facility, which featured all the necessities for oil storage, pumping and filtration.

A portable kidney-loop filtration unit was designed to meet the needs of the mining operation.

storage, pumping and filtration. Safety items were added such as an overhead fall-protection restraint system when accessing the top of the equipment.

As the PM bay was put into use, employees became proud of their accomplishment. Although it was not much to look at, it was a major upgrade from what they had been doing. Functionally, the PM bay achieved its intended design of supplying clean, filtered oil to the equipment. More importantly, the improvement came from the workforce wanting to be more proficient. This created a culture shift. Performing PMs where the equipment was located became a thing of the past. Everything now came back to the PM bay, and workers performed PMs with greater care, which translated into better equipment availability.

Continuing to Improve

Mining is an ever-moving operation. As the mineral is extracted, the distance from any permanent location increases. Soon, the PM bay became one of those locations getting farther away. Moving equipment to the bay took longer, leaving less actual PM time.

A suggestion was made to move the PM bay closer to the working face, which would mean more time with the equipment. This was a great idea, but it was a monumental task to disassemble the current PM bay and reassemble it in a new location while managing the required day-to-day maintenance activities.

Then a question was asked: "What if the PM bay was portable so it could continually advance with the faces?" This began a quest to find a supplier that could build a rugged, portable lubrication containment for an underground mine.

Employee involvement was critical. The site lubrication team, mechanics and maintenance apprentices who performed the equipment PMs were asked what they would like to see in this portable lubrication containment. Some of the suggestions were:

- Hose reels on all oil products
- Hose reels inside but nozzles outside the containment
- Everything pneumatically operated (no electric pumps)
- Waste-oil pump to be high volume and discharge into waste-oil container
- One waste-oil container outside each containment with easy change-out
- Kidney-loop filtration built in with quick disconnects
- Filters to include bypass indicators
- All filters and pumps the same
- 110-volt receptacles inside and outside
- Internal lighting
- A desktop area inside to complete paperwork
- A fold-down desk area outside for diesel particulate matter (DPM) testing
- Storage cabinet for additional filters, tools, test equipment, etc.
- High-volume compressor to clean out radiators
- Air hose reels in both containments with 100-foot air line
- An additional tank and pump in each containment for future expansion
- Runners underneath containment to facilitate easier moving over rough terrain

When the completed drawings were presented to the lubrication team, mechanics and apprentices, they were pleased everything was included and made only a few suggestions for improvements. This core group was truly engaged in the process. They made

It Takes Time

When attempting to become a world-class PM facility, it's important to understand that improvements will not be immediate. They cannot be measured on this month's metrics sheets or even in this quarter's results. There must be a vision where progress is compared by years.

Failures will not disappear overnight. Those failures are a direct function of current condition over time. Cleaner oil cannot compensate for a worn gear, bearing or pump but may decrease further damage.

Early on, oil analysis may show a multitude of issues where you lose faith in the process. When components are rebuilt or changed, slowly you will see a trend of improvement. This requires determination and discipline to stay on course, especially when it seems easier to abandon the initiative.

Reject the short-term view in favor of a long-term vision. For instance, if a new hydraulic pump with dirty oil can last six months, using clean oil and a long-term strategy may allow the new pump to continue efficient operation for five years, saving the cost and time of nine pump changes.

a difference, and their ideas were put into practice. They now not only had ownership of the lubrication containment but also enthusiasm in how they performed their work.

This enthusiasm was contagious, as others started making suggestions on how to improve the PM process. One idea was to have a level concrete pad on which to park the equipment when doing PMs. This would allow for proper oil fill levels and provide safer footing around the equipment.

Another suggestion was to wash the equipment close to the PM bay in order to eliminate travel time. This posed several challenges, since water dissolves salt and keeping the PM area clean was a priority. One individual's solution was to create a concrete-lined sump to catch all waste water from the washing process for recycling. This used water would be pumped into a containment tank to water roadways for dust control and improve ventilation.

These combined employee ideas culminated into making the PM facility. The entire 40-by-160-foot work area was made of concrete, creating a safer work environment and improving PM quality. However, this was a major undertaking and required a lot of hard work. The concrete had to be lowered underground, transported to the site as a dry mix, mixed onsite, poured and finished by a crew of volunteers from the maintenance team. This illustrated their belief in the project and their commitment to making their ideas become a reality.

When mobile equipment is scheduled for a PM, it is now brought to this new facility. The equipment is first washed and moved 80 feet for lubrication servicing. PM inspections are then conducted on the clean equipment. Predictive tasks like oil sampling are performed using proper procedures and sample ports, and exhaust emission testing is completed. All issues that are discovered in the inspections are noted with a follow-up work order to repair or investigate the problem.

New Practices

Two lubrication containments are used in the new PM facility, with one for general oil and one for equipment-specific oils. Dispensing nozzles are labeled and color-coded. Hose reels are used for all oil, grease and compressed air. There is a drop-down work area outside for completing paperwork or holding test equipment. Tanks are identified by name with color-coded labels. This minimizes the chance of filling a tank or dispensing the incorrect product where it does not belong. Each tank also has its own desiccant breather attached. There's even a flat surface for completing paperwork.

Two lubrication containments are used in the new PM facility, with one for general oil and one for equipment-specific oils.

Dispensing nozzles are now labeled and color-coded.

In addition to oil analysis, Cargill also conducts diesel exhaust emission testing to determine engine health.

New oil is filtered with 10-micron, Beta-1,000 filters when it is transferred into the storage tanks from sealed 5-gallon cans. The oil is again filtered upon dispensing to ensure the cleanest oil goes into the equipment. All filters are equipped with a go/no-go filter bypass indicator. When the needle is in the green area, the filter is operating. When filters are in the red section, it's time to stop and change the filter. This condition-based strategy of filter replacement maintains oil cleanliness while maximizing filter life to reduce cost.

Each unit has a waste-oil pump that is plumbed to a 300-gallon waste-oil tank, which is behind the containment for easy replacement. One unit is equipped with a kidney-loop filtration system using the 10-micron, Beta-1,000 filters set up in a series with quick disconnects. Both units have pneumatic grease guns and fire-suppression systems that are sensor-activated.

Lubricant Consolidation

After examining its underground lubrication inventory, which was in excess of 60 different lubricants with several very similar products, the mining operation initiated a consolidation effort. With the assistance of the lubricant provider, the team evaluated each application for correct product specifications and was able to consolidate down to 10 oil products and two grease products for mobile equipment plus an additional six oil products and one grease product to cover all rotating stationary equipment.

A product application sheet for mobile and rotating stationary equipment was then developed. This color-coded, one-page sheet listed all mobile or stationary equipment and identified the product to use in each application. This significantly reduced inventory and cross-contamination while providing a quick reference for application. Without this consolidation effort, it would have been nearly impossible to build a lubrication containment with enough capacity to house all the different oils.

The Importance of Training

Although the mine's maintenance personnel generally filled the equipment and gearcases, operators would top-off equipment when they performed a preoperational inspection and found a low oil level. Therefore, to make sure anyone adding oil to the equipment understood the consequences of their actions, lubrication training for some equipment operators and storeroom personnel was implemented.

New oil is filtered when it is transferred into the storage tanks and then again upon dispensing to ensure the cleanest oil goes into the equipment.

Upon completing the training, one operator said he didn't know oil was that important. He had been adding the wrong oil to his transmission. This showed he wanted to do the right thing but just did not understand why.

Storeroom personnel were trained in lubrication practices because they were the first line of defense in ensuring the correct oil was being put into a machine. Before the training, when someone requested oil, storeroom personnel would fill the request. After the training, an oil request was met with the question of where was the oil going to be used. If the oil requested did not match the application, storeroom personnel would explain that was the wrong oil and then provide the correct oil. This was a great start to control cross-contamination and educate employees.

The lubrication training also taught personnel the value of oil analysis and how to take proper samples. The goal was to make the oil analysis information meaningful. Each sample result would be reviewed when the lab report was received by email. Follow-up work orders would be written to address any anomalies. The results would be posted for all personnel to review. The lab would maintain a database on its Website of all current and historical analysis reports by machine number. Every maintenance employee would have the Web address, username and password with access from any work or home computer. This has made a significant improvement.

Measuring Progress

The Cleveland mining operation has invested a considerable amount of time, money and manpower into improving its lubrication standards and developing a world-class PM facility. Was it worth it? The team is effectively

When mobile equipment is scheduled for a PM, it is brought to the new PM facility, where it is first washed and then moved 80 feet for lubrication servicing. PM inspections are then conducted on the clean equipment.

trying to measure the impact by determining how many issues were prevented. Within the first month of operation, the identification and documentation of potential problems by craftsmen completing PMs increased 30 percent.

Many of these described initiatives have reduced cost, improved equipment availability and increased productivity. However, while some things can be measured mathematically, others are not as obvious. For example, consider the direct effect an engaged workforce has on the results. Having the most technologically advanced systems will not necessarily gain improvements without a workforce taking ownership and pride in their accomplishments. This highly skilled and engaged workforce knew how to work as a cohesive team to foster successful results.

The old adage that grease is grease and oil is oil may have worked 50 years ago but no longer applies. Personnel must develop a healthy respect for the complexities involved with proper lubrication practices. The basics of workforce development can be achieved through education and training, while the willingness to execute will be anchored in engagement.

The Cleveland mine has taken a significant step in maintaining its mobile equipment fleet in the safest, most reliable condition with the development, construction and implementation of a world-class PM facility. This was a tremendous team effort in the quest for reliability excellence. ■

By the Numbers:

This past year, approximately 27,000 gallons of oil were used by Cargill's mining operation, which was a 42-percent decrease in consumption from six years ago, with a 25-percent increase in production for the same period.

PETE OVIEDO NORIA CORPORATION

CONSIDER CONSISTENCY When Selecting GREASE

When instructing Noria's Fundamentals of Machinery Lubrication course, I usually ask my students to tell me the type of grease that they currently use at their facility and not to give me a color. Most technicians understand that color doesn't reveal much about a grease's properties, but they don't always answer correctly with the base oil viscosity, thickener and consistency.

Of course, greases are formulated with oil, thickener and additives. While you may be familiar with the formulation of grease, do you know what grease consistency means and how it should influence your grease selection?

Base Oil

Grease is formulated with up to 95 percent base oil. Most greases today use mineral oil as their fluid components. These mineral oil-based greases typically provide satisfactory performance in most industrial applications. In temperature extremes (low or high), a grease that utilizes a synthetic base oil will offer better stability.

Thickener

The thickener is a material that will produce the solid to semifluid structure in combination with the selected lubricant. The primary types of thickeners used in grease are metallic soaps. These soaps include lithium, aluminum, clay, polyurea, sodium and calcium. Lately, complex thickener-type greases are gaining popularity. They are being selected because of their high dropping points and excellent load-carrying abilities.

Complex greases are made by combining the conventional metallic soap with a complexing agent. The most widely used complex grease is lithium-based. These greases are made with a combination of conventional lithium soap and a low-molecular-weight organic acid as the complexing agent.

Nonsoap thickeners are also gaining in popularity for special applications, including high - temperature environments. Bentonite and silica aerogel are two examples of thickeners that do not melt at high temperatures. However, there is a misconception that even though the thickener may be able to withstand the high temperatures, the base oil will oxidize quickly at elevated temperatures, thus requiring a frequent relube interval.

NLGI CONSISTENCY CLASSIFICATIONS

NLGI #	ASTM* WORKED PENETRATION	FOOD ANALOGY	APPROX. % THICKENER
000	445 - 475	Ketchup	
00	400 - 430	Applesauce	
0	355 - 385	Brown Mustard	9
1	310 - 340	Tomato Paste	11
2	265 - 295	Peanut Butter	14
3	220 - 250	Vegetable Shortening	23
4	175 - 205	Frozen Yogurt	27
5	130 - 160	Smooth Paté	32
6	85 - 115	Cheddar Cheese Spread	40

Semi Fluid → 000; Increasing Consistency; Firm Block → 6

*D217

Notice in the table below how much the thickener percentage affects grease consistency. Keep in mind that there is a substantial amount of oil in the grease and that field conditions can also influence grease consistency.

Consistency

Grease consistency depends on the type

Cone Penetrometer

and amount of thickener used along with the viscosity of its base oil. A grease's consistency is its ability to resist deformation by an applied force. The measure of consistency is called penetration, which is contingent on whether the consistency has been altered by handling or working.

ASTM D217 and D1403 methods are used to determine the penetration of unworked and worked greases. To measure penetration, a cone of a specific weight is allowed to sink into a grease for five seconds at a standard temperature of 25 degrees C (77 degrees F). The depth, in tenths of a millimeter, to which the cone sinks into the grease is its penetration.

A penetration of 100 would represent a solid grease, while a penetration of 450 would be semifluid. The National Lubricating Grease Institute (NLGI) has established consistency numbers or grade numbers from 000 to 6 that correspond to specified ranges of penetration numbers.

Certain conditions will affect the consistency required for a grease. The table below can help you select the correct consistency for an application.

Additives

Additives can play several roles in a lubricating grease. These primarily include enhancing the existing desirable properties, suppressing the existing undesirable properties and imparting new properties. The most common additives are oxidation and rust inhibitors, extreme pressure, anti-wear and friction-reducing agents.

In addition to these additives, boundary lubricants such as molybdenum disulfide (moly) or graphite may be suspended in grease to reduce friction and wear without adverse chemical reactions to the metal surfaces during heavy loading and slow speeds.

It's important to note that speed and load help determine the proper viscosity required for an application. Remember, viscosity is the most important property of a lubricant. Whenever you are selecting grease, you must also take into consideration the application and match the required consistency to ensure that you provide the equipment with the best choice to improve equipment reliability.

5 Categories of Penetration

1. **Undisturbed** — Grease that is in its original container.
2. **Unworked** — A sample that has received only minimal disturbance in being transferred from the sample can to the test cup.
3. **Worked** — A grease that has been subjected to 60 double strokes in a standard grease worker. NLGI classification is based on worked penetration.
4. **Prolonged Worked** — Grease that has been worked the specified number of strokes (more than 60), brought back to 77 degrees F and then subjected to an additional 60 double strokes in the grease worker.
5. **Block** — This is the penetration of a block grease, which is hard enough to hold its shape without a container.

Selecting the Correct Consistency for an Application

High Consistency (Higher NLGI Numbers)

- Journal bearings, slow speed, such as locomotive block grease
- High-speed ball/roller bearings (with low-viscosity base oil)
- To avoid water washout
- To avoid bleed
- To avoid excessive leakage problems
- High ambient or operating temperatures
- To seal out environmental dust (very dusty conditions)

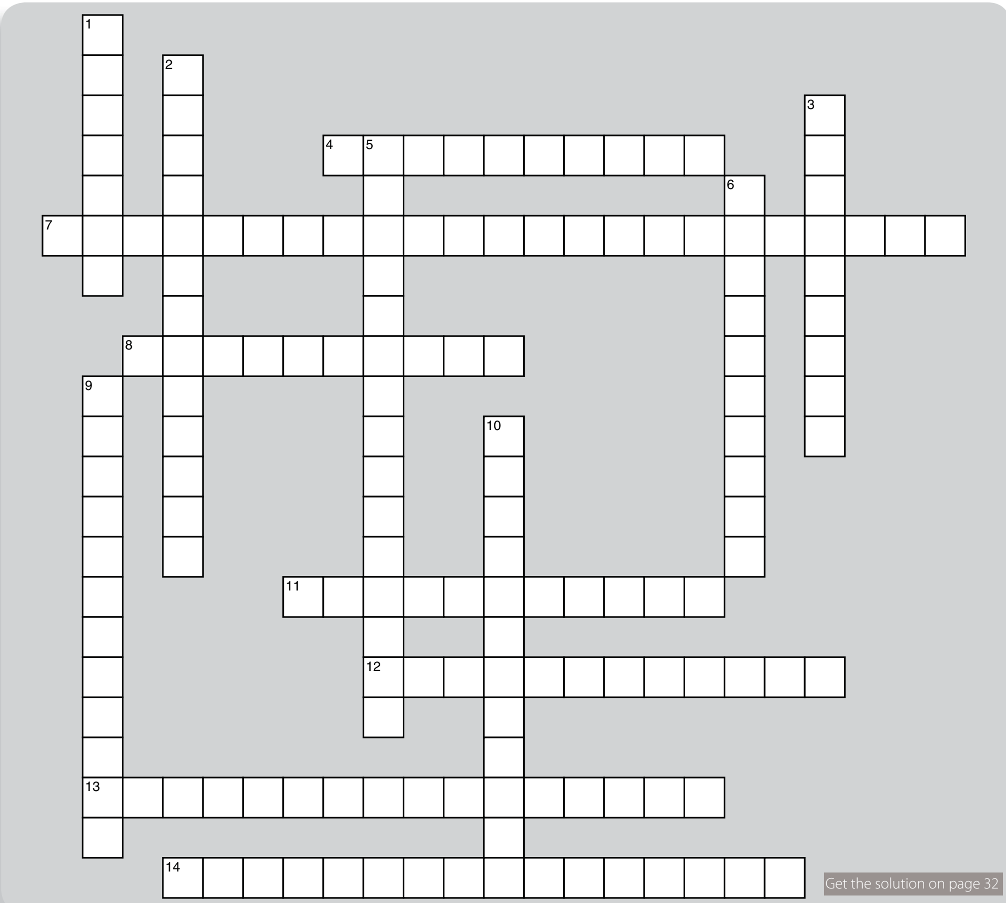
Low Consistency (Lower NLGI Numbers)

- Low-speed rolling element bearings (with high viscosity)
- Cold temperature operation
- Pumpability requirements
- Gearbox – lubed for life

About the Author

Pete Oviedo Jr. is a senior technical consultant with Noria Corporation, focusing on machinery lubrication and training. He has more than 20 years of experience with machinery and rotating equipment, as well as an understanding of laser alignment, balancing rotating equipment, thermography, magnetic particle and ultrasonic flaw detectors. Need help with your lubrication program? Contact Pete at poviedo@noria.com.

Crossword Puzzler»



Get the solution on page 32

Across

4 The distinction between paraffinic, naphthenic and aromatic molecules.

7 A publication containing health and safety information on a hazardous product (including petroleum)

8 An engine that uses the energy of expanding gases passing through a multi-stage turbine to create rotating power.

11 The routine activity of analyzing lubricant properties and suspended contaminants for the purpose of monitoring and reporting timely, meaningful and accurate information on lubricant and machine condition.

12 The ability of a non-water-soluble fluid to form an emulsion with water.

13 A complex wear process where a machine surface is peeled away or otherwise removed by forces of another surface acting on it in a sliding motion.

14 Normal particles between 20 and 40 microns found in gearbox and rolling element bearing oil samples observed by analytical ferrography.

Down

1 The part of a shaft or axle that rotates or angularly oscillates in or aganst a bearing or about which a bearing rotates or angularly oscillates.

2 A sophisticated microscopic system involving a microscope, a television camera, a dedicated computer and a viewing monitor similar to a television screen.

3 Low-boiling volatile materials in a petroleum fraction.

5 A filter medium primarily intended to hold soluble and insoluble contaminants on its surface by molecular adhesion.

6 The amount of acid, expressed in terms of the equivalent number of milligrams of potassium hydroxide, required to neutralize all basic constituents present in 1 gram of sample.

9 A chemical compound made up of nitrogen and oxygen.

10 An oil specially suited for use as either the specific gravity or the API gravity of a liquid.

BRENDAN CASEY

DECIDING Whether to Install SUCTION STRAINRS on Hydraulic Pump INLET LINES

A hungry donkey enters a barn in search of hay. Much to his delight, he discovers two identical haystacks, each on the opposite side of the barn. The donkey stands in the middle of the barn between the two piles of hay, not knowing which one to choose. Hours go by and then days, but he still can't make up his mind. Unable to decide, the donkey starves to death.

This short parable comes from the French philosopher and logician Jean Buridan's commentaries on Aristotle's *Theory of Action*, and so the story is known as "Buridan's ass."

When he constructed this story, Buridan presumably chose a donkey because it is not renowned for intelligence. But having grown up on a farm, I can't imagine any hungry animal dithering in such a way — not even a donkey.

68%

of machinerylubrication.com visitors have suction strainers installed on hydraulic pump inlet lines at their plant

Regardless, how smart donkeys really are is unimportant to the moral of the story, which is: not deciding has consequences, and options can be a blessing as well as a curse. Had the donkey found only one haystack inside the barn, there would have been no decision to make, and he wouldn't have starved to death. But life is not that simple.

Back in 1941, philosopher Eric Fromm wrote a book called *Escape from Freedom*. In it he said that people in a modern democracy are beset not by a lack of options but by a dizzying abundance of them. This is even more so today. Figuratively speaking, we're all Buridan's ass, completely surrounded by haystacks. The options may be nice to have, but not deciding has consequences.

This of course applies on all levels of life, both personal and professional. In the maintenance and reliability game, there are always decisions waiting to be made, such as what type of oil to use, a planned change-out to call, which proactive maintenance tasks to do (on what machines and when), a component to be declared faulty, and so on.

Often such decisions must be made in the absence of perfect information, or worse, in the presence of conflicting information. An example that comes to mind is the installation of suction strainers on hydraulic pump inlet lines.

As you may be aware, I'm an advocate of not installing suction strainers and, in the majority of applications, removing and discarding them when they are installed. As a result, I'm always

Making Tough Decisions

In his book, *Predictably Irrational*, Dan Ariely describes the inefficiency of having too many options as well as the problems posed by having to choose between two appealing possibilities.

"In fact, choosing between two things that are similarly attractive is one of the most difficult decisions we can make," Ariely writes. "This is a situation not just of keeping options open for too long, but of being indecisive to the point of paying for our indecision in the end."

interested in any new information on this issue, especially if it's anything official from a pump manufacturer.

On this note, the data sheet for Nachi PVS series variable volume piston pumps was recently brought to my attention. In the document, Nachi recommends the installation of a suction strainer: "Provide a suction strainer with a filtering grade of about 100 microns (150 mesh)."

To the best of my knowledge, Nachi is in a small minority of pump manufacturers that actually recommend the use of a suction strainer. Contrast Nachi's recommendation with Bosch Rexroth's. The data sheet for its SV-20 and SV-25 series variable vane pumps states: "Bosch Rexroth does not recommend the use of inlet suction strainers."

That's one pump manufacturer for and one against. Another manufacturer, Eaton-Vickers, appears to be sitting on the fence based on its *Mobile Hydraulics Manual*:

"(Reservoir) outlet line strainers, also called (pump) inlet filters or inlet screens are very common. This may be more traditional than functional. They are intended to keep larger solid contaminants from entering the hydraulic system. A drawback is that they are quite inaccessible for service and cleaning. If they become restricted due to excess contamination, they can cause cavitation and damage to system pumps. A more current approach is to ensure clean fluid is maintained in the reservoir, precluding the need for an outlet line strainer."

This piece of prose may well have been written by one of the company's in-house attorneys. It seems this pump manufacturer wants you to make up your own mind. At least it acknowledges that the tradition of always installing a suction strainer is outdated.

Then there's this from the *Contamination Control Program Manual* by Stauff, a company that does not manufacture pumps but does make suction strainers:

"It is advisable to check with the pump manufacturer before any type of filter is fitted to the pump inlet line ... In general, suction strainers do not contribute to system cleanliness. The difficulty associated with changing strainers, and knowing if and when they are clogged (may result in pump damage)."

So if you take Stauff's advice and check with the pump manufacturer, one says "yes," another says "no" and a third says "you decide." As is the case with a myriad of other equipment maintenance decisions, this one is your call, and it's a call you have to make — one way or the other. As Buridan's ass discovered, not deciding can result in the very same consequences you wish to avoid.

The Importance of Protecting the Pump

What is the "heart" of the hydraulic system? Or, asked another way, which component would shut down the system if it suddenly failed? The answer is the pump. Without the pump, the entire system is dead. As in the human body, if the heart stops working, all functions cease. Thus, it makes sense to protect the pump in order to keep the system operating smoothly and efficiently.

Sump strainers or suction strainers are effective types of filtration for this purpose. They can be installed in two locations. A simple strainer can be placed on the end of the inlet line submersed in the bottom of the reservoir, while a strainer within a housing can be installed in the suction line outside the reservoir.

One thing to guard against is having too much restriction in the suction line. Too fine a level of filtration could cause the pump to cavitate, which might cause additional problems. Therefore, the suction line must always flow freely. To prevent cavitation, it is sometimes necessary to install a bypass valve along with the suction strainer to allow flow when the strainer is indexed. Suction strainers are commonly available with a built-in bypass valve.

How do you know what level of filtration is needed for any given system? To answer this, consider the following:

- The type of pump being used (gear, vane or piston pump)
- The viscosity of the fluid
- The flow rate
- The system pressure

Because the level of filtration has an indirect effect on the suction strength, strainers range anywhere from 30 mesh (595 microns) to 200 mesh (74 microns). A filtration specialist can help determine the right mesh for your system. It generally is not recommended to use filtration any finer than 74 microns in the suction line.

To protect the system as a whole, proper filtration should be placed throughout the system as required by the application. Some manufacturers require the pump be protected to keep the warranty in effect.

Take a proactive approach to ensure your hydraulic system's proper operation and longevity. This includes careful system design, regular monitoring, fluid analysis and preventive maintenance.

Keep in mind that a suction strainer serves one job and one job only: to protect the pump. Suction strainers are an inexpensive and effective investment that will safeguard the "heart" of your hydraulic system and, in so doing, prolong its life.

— Donald C. Krause, Flow Ezy Filters

About the Author

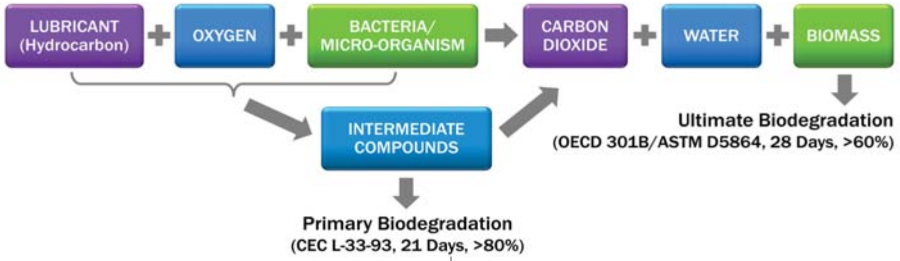
Brendan Casey is the founder of HydraulicSupermarket.com and the author of *Insider Secrets to Hydraulics, Preventing Hydraulic Failures, Hydraulics Made Easy, Advanced Hydraulic Control* and *The Definitive Guide to Hydraulic Troubleshooting*. A fluid power specialist with an MBA, he has more than 20 years of experience in the design, maintenance and repair of mobile and industrial hydraulic equipment. Visit his Website at www.HydraulicSupermarket.com.

DR. ANOOP KUMAR, ROYAL MANUFACTURING

What You Should Know About Environmentally Friendly Lubricants

Buzzwords like biodegradable, bio-based, eco-friendly, renewable, non-toxic, green, etc., are often heard echoing throughout industry. Over time, these words have become powerful tools and selling points for lubricant manufacturers and marketers. However, they can also be misleading.

Along with legislative compliance, one of the reasons for this recent green initiative is the growing awareness and demand to use more environmentally safe products. The fact that petroleum-derived mineral stocks have finite resources has also created a pressing need to find alternative/renewable sources.



While there is no universally accepted definition for environmental safety, factors like biodegradability, eco-toxicity, bio-accumulations and renewability must be taken into consideration when accounting for the safety of the environment. Lubricants, by virtue of being petroleum based, have been classified as being of environmental concern. In the past, large quantities of industrial lubricants have been irresponsibly disposed of into the environment as used oils and spills or accidentally, which is a matter of grave environmental concern requiring immediate attention.

There are two basic approaches for dealing with environmental safety with regards to lubricants. The first is to find ways to eliminate the disposal of lubricants into the environment. The second is to use environmentally safe products in environment-sensitive applications such as agriculture, forestry, municipalities, mining, marine, etc.

In addition, the different terms floating across industry to measure/evaluate environmentally safe products are not well-defined and need better understanding.

Biodegradable

In simple terms, biodegradable refers to the chemical degradation of a substance (lubricant) in the presence of micro-organisms/bacteria. Although there are different definitions of biodegradability across industry, perhaps one of the most reasonable is found in ASTM D6064, which describes biodegradability as "a function of degree of degradation, time and test methodology."

There are two generally used measurements for biodegradability. The first is primary degradation, which is measured as the reduction of the carbon-hydrogen bond. This is determined with infrared spectroscopy (IR), which corresponds to the direct measure of the percentage of lubricant breakdown. The most widely used way to measure this degradation is by the Coordinating European Council (CEC) L-33-93 test method run for 21 days.

The other type of biodegradability measurement is secondary degradation, which is better known as ultimate biodegradability. This measures the evolution of carbon dioxide through the degradation process over a period of 28 days. The most common method used to determine ultimate biodegradability is by the Organization for Economic Cooperation and Development (OECD) 301B/ASTM D5864.

The benchmark for qualifying a lubricant as biodegradable is if its biodegradability is more than 80 percent by the CEC L-33-93 method or more than 60 percent by the OECD 301B method.

Bio-Based

Bio-based is a term that was mainly coined in the United States and based on the necessity to derive renewable products from vegetable/plant/animal-based materials. The industry or regulatory authority (USDA) did not intend for bio-based to imply a 100-percent vegetable oil-based formula, as other non-bio-based ingredients might be necessary to meet industry performance standards. The USDA and other regulatory/industry organizations have established that the use of 50 percent or more bio-based material in a formulation could allow a product to be considered bio-based. Thus, the more accepted definition of bio-based lubricants would be those products formulated with a majority of renewable and biodegradable base stocks.

For example, fatty acids used in making grease thickener components qualify as bio-based even though they are not biodegradable. Therefore, bio-based products may not necessarily be 100-percent biodegradable, but they must be agro-based and renewable.

Green

A synonym for being environmentally

friendly, green is probably one of the most attractive terms in industry, yet it often can be misleading. Some products that are not even based on vegetable oil may still be marketed as environmentally friendly lubricants. While these types of lubricants may be free of heavy metals and other potential toxic ingredients, they are not biodegradable. Consequently, it's important to be careful when selecting such products and to be aware that green does not necessarily mean biodegradable. Just being a green color or free from heavy metals does not make a product environmentally friendly in the real sense. This requires being biodegradable or derived from renewable sources.

Theoretically, environmentally safe products are those that degrade quickly and naturally with non-toxic decomposed fractions and that are based on renewable sources. These lubricants must be formulated with renewable/vegetable oils in majority, readily biodegradable and free from heavy metals and other toxic ingredients/byproducts.

Performance Comparison

Environmentally safe products offer certain performance advantages. When formulated with vegetable oils, these lubricants exhibit better lubricity, which means reduced friction and wear, a high viscosity index and high flash points for improved safety.

The inherent drawbacks associated with these types of products include their limited high-temperature capabilities as a result of inferior oxidation and thermal stability, restricted low-temperature applicability due to higher pour points, and poor pumpability at sub-zero temperatures. As these lubricants are expected to degrade over the course of time in the presence of oxygen, their shelf life also is limited and does not compare with that of mineral/synthetic oils.

Another aspect that should be considered when switching to vegetable oil-based greases is their compatibility with mineral oil or synthetic oil-based greases. Recent studies indicate that some vegetable oil-based greases have been found to be incompatible with mineral oil-based greases due to the chemistry differences between vegetable and petroleum oils.

While our knowledge of environmental safety is still in its early stages, more concerted efforts are needed to clearly define the related terms. If choosing vegetable oil-based environmentally friendly lubricants, keep in mind that there are dual objectives to fulfill, with one being environmental safety and the other the quest for alternatives to petroleum base stocks. The future of these classes of lubricants will greatly depend on how these disadvantages are overcome while still being competitive in price.

About the Author

Dr. Anoop Kumar is the director of research and business development at Royal Manufacturing. He has more than 20 years of experience in the field of lubricants and greases, along with a doctorate in chemistry from the Indian Institute of Technology. Dr. Kumar can be contacted via email at anoopk@royalmfg.com.

JOSH PICKLE NORIA CORPORATION

Advantages of PROPER LUBRICANT Storage

Oil storage is a very important aspect of a lubrication program that is often overlooked. Most plants receive new oil and automatically assume it is clean. Then, they may put it to use right away, keep it in a dirty environment, store it outside or leave it open and exposed to contaminants after the initial use. Hopefully, after reading this article, you will have a better understanding of the value of proper lubricant storage.

Bulk Storage

When practical, bulk storage is best if the lubricant supply can be hard-piped to a number of stationary machines that use the same lubricant or for machines with high oil consumption. In comparison to drums, which have much greater handling demands, bulk storage offers low labor costs to store and handle the lubricant. In addition, online filtration and oil analysis can be easily added to the system.

Buying in bulk also provides cost savings. When purchasing large quantities, the price per gallon of lubricant can be much less when compared to totes or drums. Furthermore, by utilizing hard piping to machines, you reduce the risk of using the wrong oil in those pieces of equipment. Of course, if the wrong lubricant is delivered to the bulk supply and then used, it could be disastrous. This is why it's critical to always make sure the right lubricant has been delivered before adding it to your bulk supply.

Among the disadvantages of bulk storage include the upfront costs of installing the piping, pumps, etc. There is also an increased risk for high-volume leakage.

Totes

Totes are the preferred method of lubricant storage for many plants. They offer lots of advantages, especially those with a filtration system. With totes, you can get the lubricant supply in bulk, or if you currently have drums, you can transfer and filter the lubricant from the drums into the totes and eliminate the unwanted empty drums.

Totes that have filtration systems provide the ability to clean the oil upon transferring in, while it is in the tote and when transferring out into sealable and refillable containers before being transported to the equipment when needed.

Drums

Drums are my least favorite method of lubricant storage. This is because I have yet to see proper drum storage when visiting a plant. They always seem to be left open or kept outside where they have been rained on and faded from the sun.

Correct drum storage can be easily accomplished with just a little effort. The first step is to ensure that all drums are stored inside and away from the sun and rain.

66% of Lube-Tips subscribers list drums as the lubricant storage method used most frequently at their plant

Outside storage can result in water ingression and cooking of the oil, which can degrade the lubricant before it even enters your equipment. Unused drums should be stored indoors and horizontally with the bungs at the 3 o'clock and 9 o'clock positions.

For open drums that are in use, be sure that the bungs are not left open, exposing the oil to the environment. If hand pumps are employed, they should be threaded tightly onto the drums. A proper filter should also be used. A drum-adapter kit with quick-connects and an attached desiccant breather will allow you to filter the oil in the drum as well as into equipment or top-up containers.

Remember, whether you use bulk storage, totes or drums, it is important to learn the most effective ways to store and handle lubricants in order to get the most from whatever storage method you choose. ■

About the Author

Josh Pickle 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 mechanical engineer who holds a Machine Lubrication Technician (MLT) Level II certification and a Machine Lubricant Analyst (MLA) Level I certification through the International Council for Machinery Lubrication (ICML). Contact Josh at jpickle@noria.com.

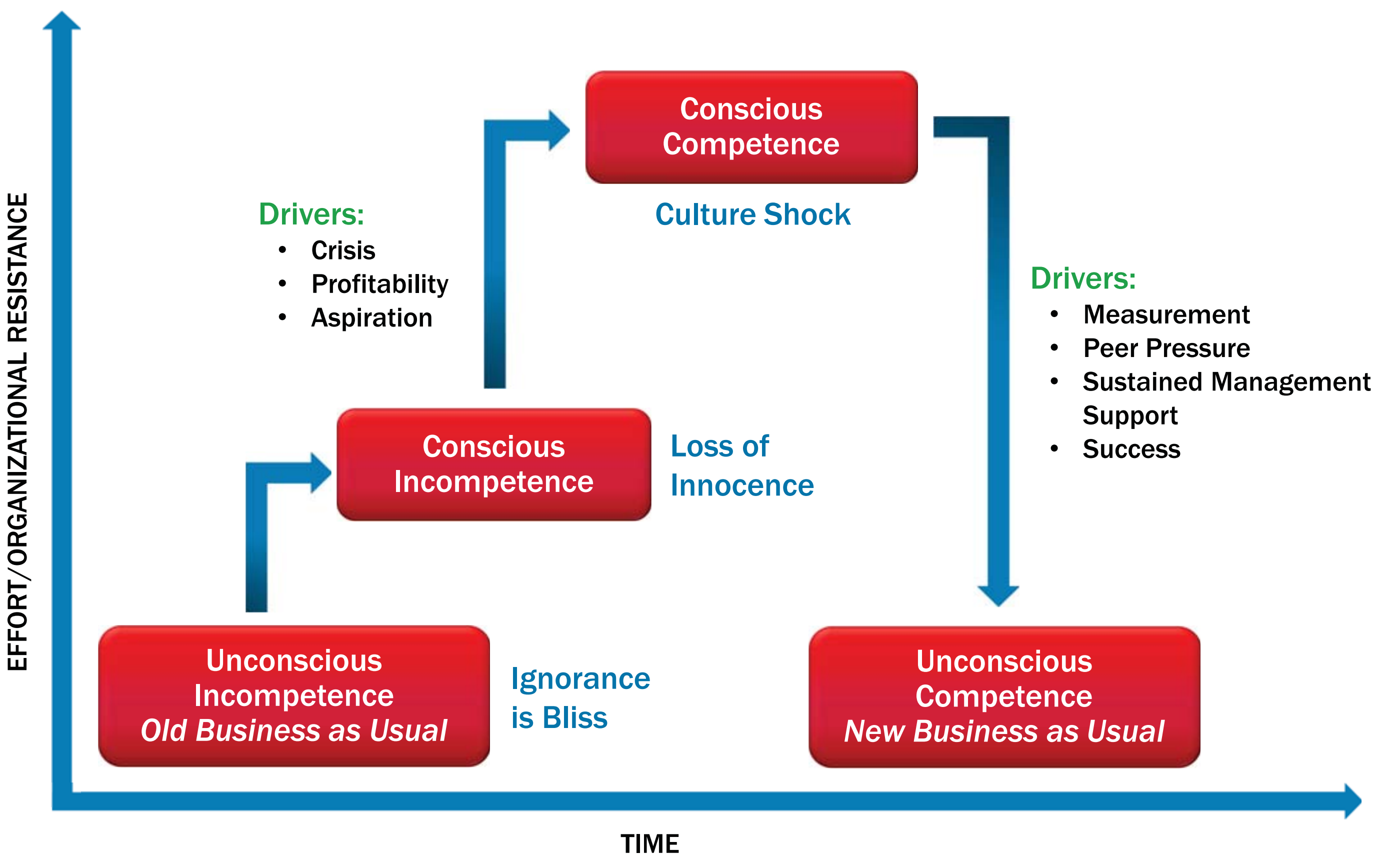
LOREN GREEN | NORIA CORPORATION

How to CHANGE YOUR Lubrication CULTURE

In many of the training courses Noria provides, we discuss how a culture change is required in most cases to achieve a world-class lubrication program. This is by far the most difficult part of the process. The assessment is easy. A technical consultant walks through your plant or facility and looks for opportunities. Most often the low-hanging fruit is obvious and simply overlooked by plant personnel because it has become part of the standard scenery. With a fresh set of eyes specifically looking for these opportunities, they are generally not too difficult to find.

Frequently, the facilities being assessed are operating in an "unconscious incompetence" stage, as shown in the diagram below. This simply means that the workforce is doing the wrong things and isn't even aware that they are wrong. After training or an assessment is conducted, the facility moves to the second stage. Personnel at the plant are no longer ignorant of the right way to do business. Eyes have been opened, and innocence has been lost. Now they can pursue the optimum reference state (ORS) of lubrication excellence.

This is where things get difficult. Knowing the right things to do and actually doing them are obviously not the same thing. This is known as the



knowing-doing gap. So now that you know what is right and wrong, how do you get that "culture shock" to take place?

During my career in the U.S. Navy, I was told repeatedly that an organization takes on the traits of its leadership. In other words, what the boss wants, generally the boss gets. If it is important to the boss, it is going to be important to the rest of the organization as well. Therefore, the easiest way to achieve a culture change is to get the boss onboard. Sometimes it is not always easy. You may have to be the champion of change and fight in the trenches alone. The following tips can help you affect the change you are seeking.

First, use the Pareto principle or the 80/20 rule. You may have been taught the 80/20 rule in terms of 20 percent of the workers do 80 percent of the work, but at Noria we apply it to contamination. Twenty percent of the causes of failure are responsible for 80 percent of the occurrences of failure. By and large the greatest percentage of damage to equipment is due to particulate contamination. So if particles are the largest source of contamination, this prioritizes how you should invest your time and efforts.

Particles can get into machines in a few ways. They may be built in, ingressed or generated. The cost of excluding contaminants is less than 10 percent of what it will cost you once they are allowed to ingress into your fluid (see http://www.machinerylubrication.com/Read/28574/justifying-cost-of-excluding-a-gram-of-dirt-). If you want to get your boss onboard, you will need to put this in terms of cost savings. There are several case studies that show the cost benefits of filtration, breathers, keeping shaft seals in good shape, etc. These studies address the savings in lubricants, bearings, downtime and many other areas that you can use to form a sound argument.

Secondly, you must get other team members onboard. In my experience, explaining the "why" is the most effective method to accomplish this. Why are we doing this? Talking about saving the organization money may or may not be your best approach. Detailing the benefits of keeping the oil clean, cool and dry in terms of reduced downtime and workload may help.

67% of lubrication professionals say their facility has attempted to change its lubrication culture, based on a recent poll at MachineryLubrication.com

I recently conducted a training course where one of the students was skeptical of the advantages of oil analysis. He was a fan of vibration analysis and thermography but questioned the benefits of oil analysis. I explained that in order for vibration and thermography technologies to be used, you must either have vibration or a higher than normal temperature condition. On the other hand, with a good oil analysis program, you can detect potential issues before they get to the point of registering on either vibration or thermography equipment. The ideal situation is to match all of these technologies. After taking the time to explain the "why" of oil analysis, he began to come around and see the benefits.

This leads us from the "conscious incompetence" stage to the "conscious competence" stage. Now you know the proper procedures, quantities, frequencies, etc., and are putting this information to use. This is when the magic happens and the organization begins to change. You as the champion have made an impression, and the staff is following your example. When you start seeing evidence of this transformation taking place, you should take a moment to congratulate yourself and your team. Many organizations don't make it this far.

Keep striving to make improvements and eventually you will reach the fourth and final stage, "unconscious competence." In this stage, personnel perform procedures correctly and aren't even sure why. When asked why things are done a certain way, they might answer, "I don't know; we've always done it that way." Better yet, perhaps they can explain why everything is done the way it is. If so, you are well on your way to having a world-class lubrication program. ■

About the Author

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WES CASH, RICK JAMES NORIA CORPORATION

Using a Grind Gage for In-Service Grease Analysis

Oil analysis is commonly used across industry not only to analyze oil health but also machine health. Recently, advances have been made in grease analysis. With the increasing demand for machines to operate fault-free, it has become even more critical to understand what is occurring inside of them. Although technologies such as vibration, thermography and motor-current analysis can offer early signs of machine failure, analyzing in-service oil and grease can help refine your detection ability.

Freshly purged grease should be collected and analyzed for wear debris and contaminants.

By periodically sampling the oil in a machine, you can obtain information about its health. The same is true for grease-lubricated components. With 90 percent of bearing applications being grease lubricated, it makes sense to apply the same methodology for analyzing the lubricant in these cases.

The value of grease sampling has been recognized and is now even an ASTM standard (D7718-11). This standard describes a method for taking a representative grease sample from an in-service bearing. While this is the first step in grease sampling, the second phase involves conducting tests on the sample.

Several laboratories can perform grease analysis and check for contamination, changes in viscosity or consistency, as well as test other properties of the grease and its constituents. Some of these tests can be expensive and may take several days before results are received. This has created a need to analyze in-service grease in the field and obtain instant feedback on condition, contamination and wear debris content.

A study published by SKF indicates that roughly 70 percent of bearing failures are due to contamination. Another study by NSF found that contamination caused nearly 50 percent of bearings to fail. By applying the Pareto principle (the 80/20 rule), you can see that addressing contamination in bearings should prevent some if not most failures. Accessories such as shields and bearing isolators can be added to make bearings last longer, but you must be able to analyze the amount of contaminants in the lubricant to know how clean or dirty they are.

Field tests for oil analysis are readily available for almost any property you want to test, including acid number, viscosity, water content, etc. While there are some field tests for greases, they are primarily limited to rough estimations of consistency and oil content. Whether in the field or lab, few practical methods of analyzing particle concentration exist for in-service grease. In fact, there are only three methods available: microscopic analysis (FTM 3005.4), scratched acrylic plates (ASTM D1404) and fineness-of-grind gages (Hegman gages). This article will discuss the fineness-of-grind gage as a practical tool for both lab and field applications.

Gage Design

The gage's design features a large block of steel (typically stainless or chromium plated) and tapered grooves or "raceways" machined into the surface. One groove may range from a depth of 0 to 250 microns, with a second groove from 0 to 50 microns.

A wiper blade is fabricated from the same material as the block. It draws the sample across the block's surface for analysis. The wiper blade and the surface of the block are milled as smooth as possible to allow for zero clearance between them during the testing process. After many uses, the wiper may lose its profile and may need to be retooled.


The grease sample is deposited at the deep end of the gage block.

Applications

Early applications of these gages were seen in the pharmaceutical and paint industries, which had issues determining the fineness of particles in suspension. For example, in the paint industry, the earliest method for inspecting dispersion quality involved obtaining a small sample of the product to test for particle fineness. Testing in this manner had its drawbacks because it required considerable experience and agreement between testers to predict the final product quality. To assist testers in determining dispersion quality, the North Standards were developed. These were actual pigment dispersions covering a broad range of grind quality. A sample was checked by comparing it to the selected standard on a glass plate.

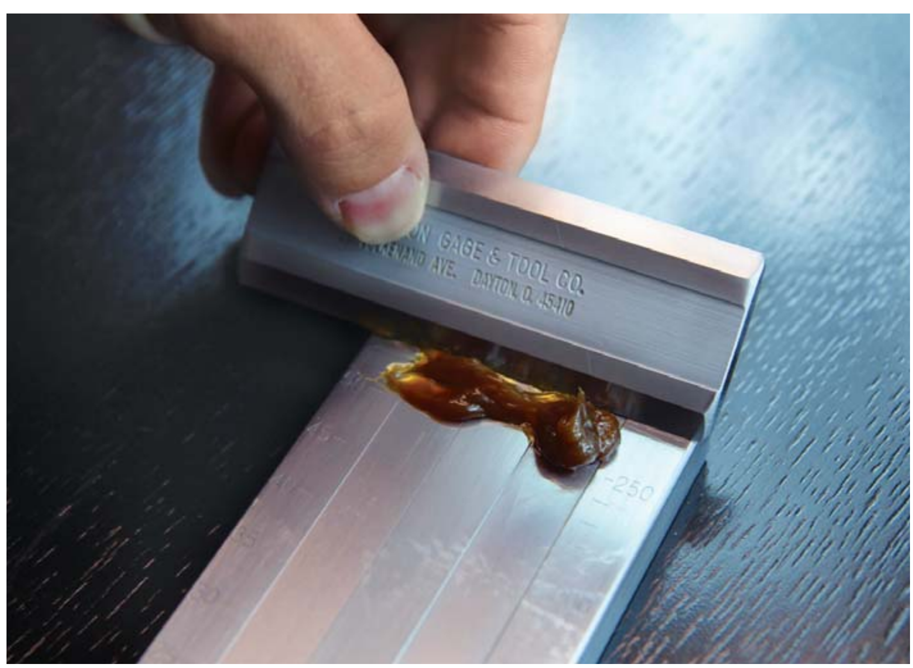
In order to eliminate the dependence on standard samples, the Hegman grind gage was developed in 1938. It is now used in a variety of fields, including the food, pharmaceutical, pigments, plastics and paint industries. In all of these applications, Hegman gages (sometimes referred to as grind gages or grindometers) are utilized to produce, store and apply dispersion products.

Using the Gage

To use the gage, start by placing the device on a flat surface. This will allow even pressure to be applied on the wiper blade during the testing process. Spread the grease to be tested on the deep end of the channel and be sure to use enough grease so that it can be distributed evenly over the length of the block. Hold the wiper blade perpendicular to the block and pull the blade down the length of the channels with a smooth, even stroke. Once the grease has been spread down the channels, hold the block at an angle to a light source to check for particle concentration and type.

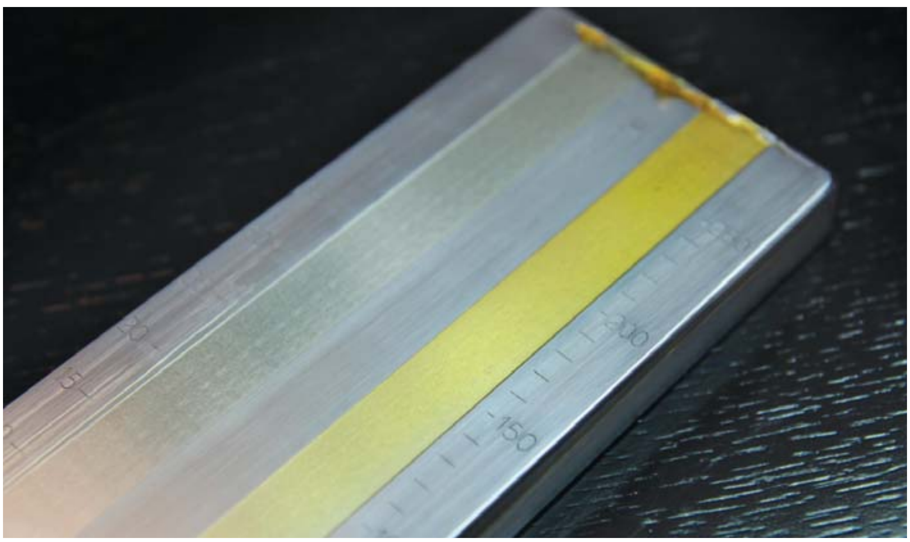
Not only does this field test provide a way to quantify particle concentration in grease, but it also offers a crude indication of particle size. When the test has been completed, inspect the channels for streaks left behind. Where the streaks begin relative to the depth of the channel will give you an estimation of the particle size.

In a recent experiment, two tests were conducted: one with new grease applied directly from a grease gun and another test with in-service grease taken from a wheel bearing. When the results were



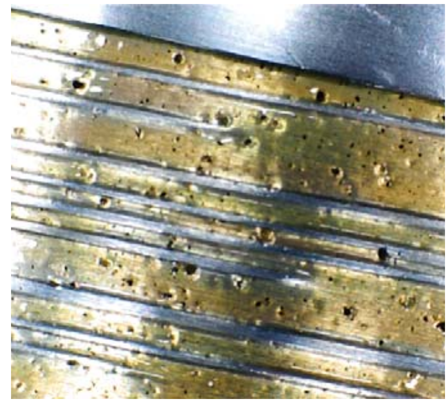
The wiper blade is used to wipe the sample down the block.

The wiper is pulled down the length of the block with even pressure.



The raceways are examined for evidence of contamination.

Skid marks left in used grease indicate hard contaminants.

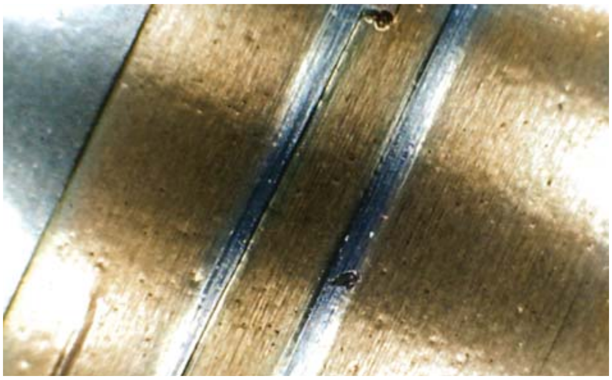


Hard particles will leave behind streaks in the grease and can be given a rough size estimation based upon where they appear on the scale.

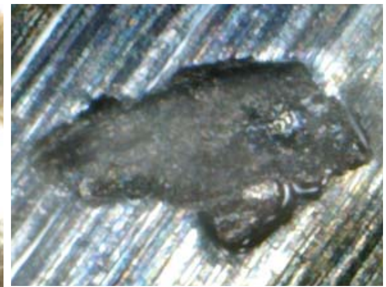
compared, a few differences were observed, including the amount of streaks found in the samples. The new grease spread evenly down both channels with little to no streaks, indicating no hard particles in the grease. On the other hand, the used grease sample showed obvious signs of hard contaminants.

Although knowing the size and concentration of particles suspended in grease is beneficial, this test can be taken a step further to analyze the particles and identify the contaminants. By looking at the particles under a microscope, you can begin to distinguish environmental contaminants from wear debris originating in the bearing/race/cage assembly. These findings can then be used to determine wear patterns and modes as well as give feedback on any contamination control devices being utilized.

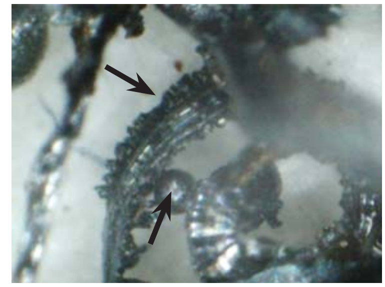
This test offers the most information on grease that has been directly purged from the bearing's core. If the grease can be sampled, either through a grease purge trap or a grease sampling device, it will provide direct information on the current state of the grease in the bearing. However, dry, old grease that is simply scraped from the shaft/seal interface will have more ambient contamination (airborne particles), making it harder to obtain any current information about the state of the bearing. This type of grease is historical data from the bearing and doesn't



This is an example of a hard particle found in a grease sample.



This magnified sample particle appears to be a metal chunk possibly caused by overloading and poor lubrication.



Cutting wear particles (top) are generally indicative of hard, solid contaminants. A spherical wear particle is typically seen from fatigue cracks in rolling-element bearings.

represent what is happening currently.

Be sure to conduct this test on new grease to find out what its "streak" profile looks like in the raceways. Keep in mind that some solid additives such as graphite, moly, etc., may appear in both new and used grease samples and should be accounted for when evaluating a sample's total contamination.

As the demand increases for machines to operate without failure for longer and longer periods, the need for accurate information on the operating condition of these machine parts will continue to become more important. This simple test should not be used to replace laboratory testing but rather to supplement it and provide more immediate information.

References

Doubleday, D. & Barkman, A. (1950). Reading the Hegman Grind Gage. *Paint, Oil and Chemical Review*.

Lafferty, G.J. & Gross, H.M. Application of the Hegman Gage to Medicinal Particle Fineness in Ointments. *Journal of the American Pharmaceutical Association*, Vol. XLIV, No. 4.

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TEST your KNOWLEDGE

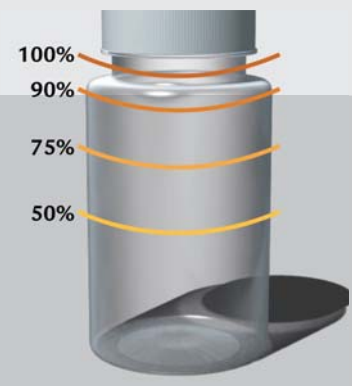
This month, *Machinery Lubrication* continues its "Test Your Knowledge" section in which we focus on a group of questions from Noria's Practice Exam for Level I Machine Lubrication Technician and Machine Lubricant Analyst. The answers are located at the bottom of this page. The complete 126-question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

1. The blotter spot test is primarily used to detect:

A) Silicone sealant
B) Viscosity increase
C) Particles, soot and organic insolubles
D) Air entrainment
E) Spent additives

2. High soot loading is managed by what additive?

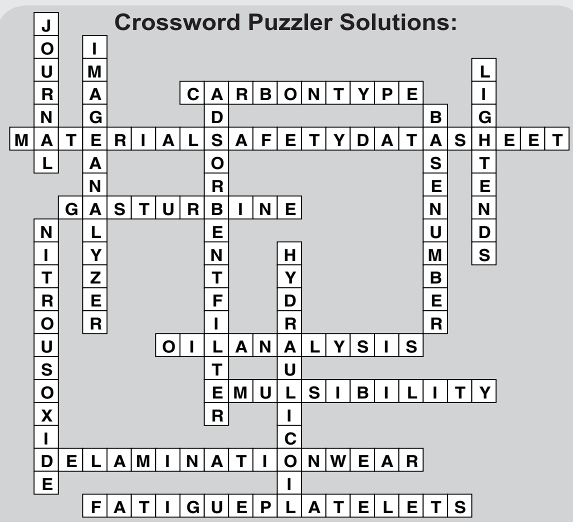
A) ZDDP
B) Dispersant
C) Over-base detergent
D) AW/EP
E) Demulsifier



3. For a typical hydraulic fluid, how full should a sample bottle be filled with hydraulic fluid?

A) 50 percent
B) 75 percent
C) 90 percent
D) 100 percent
E) It doesn't matter

Crossword Puzzler Solutions:



From Page 19

Answers:

1. C

This test is extremely simple and inexpensive. It involves placing two drops of used oil on chromatography paper. When the oil makes contact with the absorbent blotter paper, it will wick out into the paper. Once all the oil has moved into the pores of the paper, the blotter is ready to be examined. This test is primarily used to detect the accumulation of particles, soot and organic insolubles such as sludge and other oxidation byproducts. It is also a good tool to assess the condition of oil dispersants.

2. B

High soot loading is controlled by dispersant additives. This type of additive is polar and is used to disperse soot particles in order to prevent agglomeration. Dispersant additives envelop particles and keep them divided.

3. B

A sample bottle should be filled to enable enough agitation by lab personnel to assess the contaminants and wear metal contents. Otherwise, contaminants and wear metal will stay in the bottom of the sample bottle and will not be measured, making the sample unrepresentative. In addition, a sample bottle that is filled less than 75 percent may be insufficient to perform all the required tests.

WES CASH NORIA CORPORATION

Using Sight GLASSES and LEVEL GAUGES

When I go to a plant to examine its current lubrication practices, among the first things I look for are sight glasses. These devices provide a wealth of information in the time it takes to walk up to a component and check it. More than just simple additions to a machine to indicate there is enough oil in the sump for proper lubrication, sight glasses offer an opportunity to monitor the oil.

Generally, sight glasses come in two styles. Columnar sight glasses attach to an oil-bathed component, typically at the drain port. They have cylinders made of a transparent material (glass, acrylic, some plastics, etc.) in which oil is free to fluctuate up and down with the change of the oil level within the machine. The second style is known as the "bull's-eye" sight glass. It also is made of a transparent material but is threaded into a port where the oil level should be maintained during operation.

Each sight glass has its own strengths and weaknesses. Columnar sight glasses are great for reading the oil volume. Since it is piped into the machine at a low oil level, the level in a sight glass can usually be seen even when the oil volume is low. The appropriate oil level must be marked on the sight glass so you can tell if it is correct.

When plumbing in this device, you must make sure there aren't any "goosenecks" or traps in the piping that would enable the oil level shown in the sight glass not to be representative of the volume in the sump. There are more hardware requirements with these types of gauges due to the fact that they are externally mounted. They also need to be able to "breathe." Some manufacturers actually put small breathers on top of their products. If

SIGHT GLASS COMPARISONS

P=Poor F=Fair G=Good	BULL'S EYE	COLUMNAR
Oil Volume Detection (e.g. gallons of oil)	F	G
Oil Level Confirmation	G	F
Oil Color Detection	F	G
Water Emulsion Detection	G	F
Aerated Oil Detection	G	F
Foam Detection	G	P

Other Types of Oil Level Indicators

There are other oil level indicators that should be mentioned but that don't necessarily represent best practice for a lubrication program. Dipsticks have been utilized since someone had the great idea to put a metal rod into a volume of oil to check its depth. These devices are easy to use and can tell you where the oil level sits. They also allow you to perform a blotter test with the oil that comes off them.

The problem with dipsticks is that you have to open the machine component to the outside atmosphere to check the oil volume. This gives airborne particles a direct source for ingression. Not only can airborne particles fall in and contaminate the system but also any dirt or debris that may be on the cap when you remove it to pull out the dipstick.

Level plugs are common for machines that hold a smaller amount of oil. These are threaded plugs that are unthreaded from the machine case when the oil is being refilled. Once the oil begins to drip from the oil plug, it has the proper amount of oil in the sump. These are great for refilling purposes, but once again the machine is open to the atmosphere and at risk for particle ingression when these devices are used.

The same goes for systems in which you must open a hatch or cap to visually check the oil volume. Any time you open machine components to the outside, you have to be aware that you are giving dirt and contaminants a chance to enter them. Devices like these should be avoided whenever possible, and equipment modifications should be made to accept either a columnar or bull's-eye sight glass.

Sight glasses are windows into what is happening with your oil and can provide a first-hand account of any problems that are occurring.

possible, it is best to pipe the top of the sight glass either back to the headspace of the reservoir or to a desiccant breather. This allows the sight glass to "breathe" if necessary without ingressing any contaminants.

Another disadvantage of the columnar sight glass is that it doesn't clearly show whether there is a foam or air entrainment problem on the inside of the reservoir. Since the oil filling the level gauge is coming from the bottom of the sump, air has a chance to detrain, preventing you from being able to see any indication of foam in the column.

On the other hand, a bull's-eye sight glass sits directly on top of the inside oil level so any foam can be seen more easily. Bull's-eye sight glasses are great for confirming that the oil level is correct. Since there is no piping or potential to create a trap, whatever level is seen in the bull's eye is what the oil level actually is.

One drawback to these gauges is that it's hard to see the true oil color when looking through them. If by chance you have a very clean, unstained sight glass, then you can see the color and be on the lookout for any darkening or changes in turbidity (e.g., from oil/water emulsions).

It's not enough just to put a sight glass on a machine and walk away. These devices should be monitored. They are windows into what is happening with your oil and can give you a first-hand

account of any problems that are occurring. Things like water contamination, oxidation and low oil levels can all be diagnosed quickly when

56%

of lubrication professionals use columnar sight glasses most frequently in their plant, according to a recent poll at machinerylubrication.com

these accessories are used properly. Being proactive and properly equipping components with a sight glass can provide peace of mind that both the oil and machines are healthy.

Sight glasses generally come in two styles: columnar and bull's eye.

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DHIREN SHAH

BASE OIL REPORT

Crude oil prices have detoriated to around pre-Iraq crisis level. Indian basket crude oil price was at $104.22 on July 15, However, crude oil prices rose a bit on July 16 due to good economic number emerging from China.US crude prices gained a dollar to over $100.50 a barrel. Before, Iraq crisis the average crude oil price of Indian basket was hovering around $105 a barrel. During peak of Iraq crisis price of Indian basket of crude oil had risen to around $112 a barrel raising concerns of its impact on economic revival of the country. India imported approximately 10.13 million MT of Crude Oil during May 2014 of different grades,

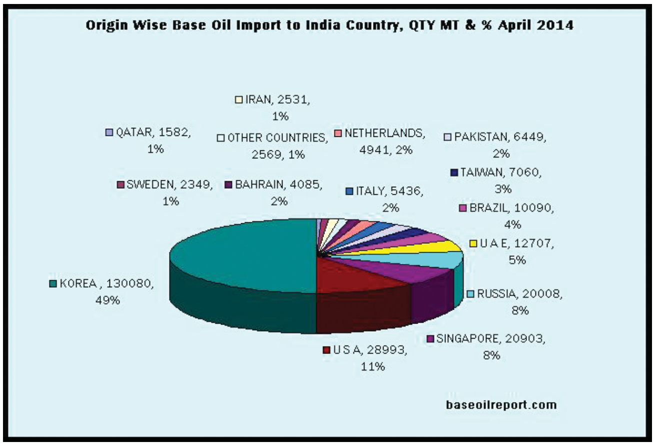
India's Import of Crude Oil in May 2014		
Crude Oil	Import	Percentage
Arab Crude Oil,	2.73 million MT	27%
Basrah Light Crude Oil,	2.17 million MT	21%
Murban Crude Oil,	947862 MT	9%
Kuwait Export Crude Oil,	940208 MT	9%
Iranian Heavy/Light Crude Oil,	776714 MT	8%
Other Crude Oil,	907652 MT	9%
Bonny Light Crude Oil,	515936 MT	5%
Azeri Crude Oil,	355423 MT	4%
Girassol Crude Oil,	278316 MT	3%
Quaiboe Crude Oil	253284 MT	2%
Amenam blend Crude Oil.	250534 MT	2%

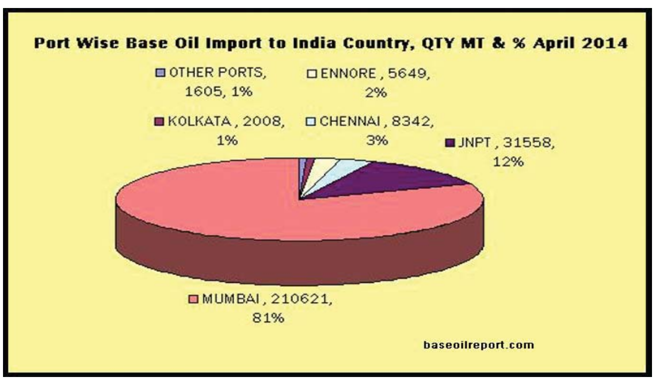
The Indian base oil market remains steady with inventories at optimum levels with surplus of imported grades. During the month of May 2014, approximately 212237 MT which is 18% marked down as compared to April 2014, have been procured at Indian Ports of all the grades. Indian State Oil PSU's IOC/HPCL/BPCL basic prices for SN – 70/N – 70/N-65/SN – 150/N -150/N – 150 marked up by Rs. 1.20 per liter on its basic prices, While SN - 500/N - 500/MakBase - 500 were up by Rs. 0.40 per liter. Bright stock prices were also up by Rs. 2.00 per Liter effective July 01, 2014. Hefty Discounts are offered by refiners which are in the range of Rs. 10.00 – 13.00 per liter for buyers who commit to lift above 1500 MT. Group I Base Oil prices for neutrals SN -150/500 (Russian and Iranian origin) are offered in the domestic market at Rs. 61.25 – 61.50/61.60 – 62.10 per liter, excise duty and VAT as applicable Ex Silvassa in bulk for one tanker load. At current level availability is not a concern.

The Indian domestic market Korean origin Group II plus N-60–70/150/500 prices at the current; level is steady. As per conversation with domestic importers and traders prices have inched up for N – 60/ N- 150/ N - 500 grades and at the current level are quoted in the range of Rs. 60.75 – 60.85/62.15 – 61.50/65.00 - 65.10 per liter in bulk respectively with an additional 14 percent excise duty and

Month	Group I - SN 500 Iran Origin Base Oil CFR India Prices	N-70 Korean Origin Base Oil CFR India Prices	J-150 Singapore Origin Base Oil CFR India Prices	Naphthenic Base Oil HYGOLD L 2000
April 2014	USD 975 – 985 PMT	USD 1025 – 1035 PMT	USD 1050 – 1060 PMT	USD 1020 - 1030 PMT
May 2014	USD 995 – 1010 PMT	USD 1035 – 1050 PMT	USD 1060 – 1070 PMT	USD 1035 - 1045 PMT
June 2014	USD 1030 – 1045 PMT	USD 1050 – 1065 PMT	USD 1090 – 1105 PMT	USD 1075 – 1085 PMT
April	USD 960 - 970	USD 1025 - 1035	USD 1060 - 1070	USD 1130 - 1150
	Since April 2014, prices jumped up by USD 70 PMT (7%) in June 2014	**Since April 2014, prices has marked up by USD 40 PMT (4%) in June 2014**	**Since April 2014, prices has gone up by USD 55 PMT (5%) in June 2014**	**Since April 2014, prices has increased by USD 65 PMT (6%) in June 2014**

Countries from Where Base Oil is Imported					
Korea	Singapore	USA	UAE	Iran	Taiwan
France	UK	Netherlands	Japan	Italy	Belgium





VAT as applicable, no Sales tax/Vat if products are offered Ex-Silvassa a tax free zone. The above mentioned prices are offered by a manufacturer who also offers the grades in the domestic market, while another importer trader is offering the grades cheaper by Rs.0.25 – 0.35 per liter on basic prices. Light Liquid Paraffin (IP) is priced at Rs. 61.90 – 62.10 per liter in bulk and Heavy Liquid paraffin (IP) is Rs. 66.30 – 66.60 per liter in bulk respectively plus taxes extra.

During the month of April 2014, India imported 259783 MT of Base Oil. The country imported 130080 MT (50%) from Korea, 28993 MT (11%) from USA, 20903 MT (8%) from Singapore, 12707 MT (5%) from UAE, 20008 MT (8%) from Russia, 10090 MT (4%) from Brazil, 7060 MT (3%) from Taiwan, 6449 MT (2%) from Pakistan, 5436 MT (2%) from Italy, 4941 MT (2%) from Netherlands, 4085 MT (2%) from Bahrain, 2569 MT (1%) from Other countries, 2349 MT (1%) from Sweden, 2531 MT (1%) from Iran and 1582 MT (1%) from Qatar. While in the month of April 2014, India imported 259783 MT of Base Oil, India imported the huge quantum in small shipments on different ports like 210621 MT (81%) into Mumbai, 31558 MT (12%) into JNPT, 8342 MT (3%) into Chennai, 5649 MT (2%) into Ennore, 2008 MT (1%) into Kolkata and 1605 MT (1%) into Other Ports.

Approximately 10947 MT of Light & Heavy White Oil has been exported in the month of April 2014 from JNPT, Mundra, Raxaul LCS, and Chennai port. Compared to last month i.e. March 2014, exports of the country have increased by 17% in the month of April 2014.

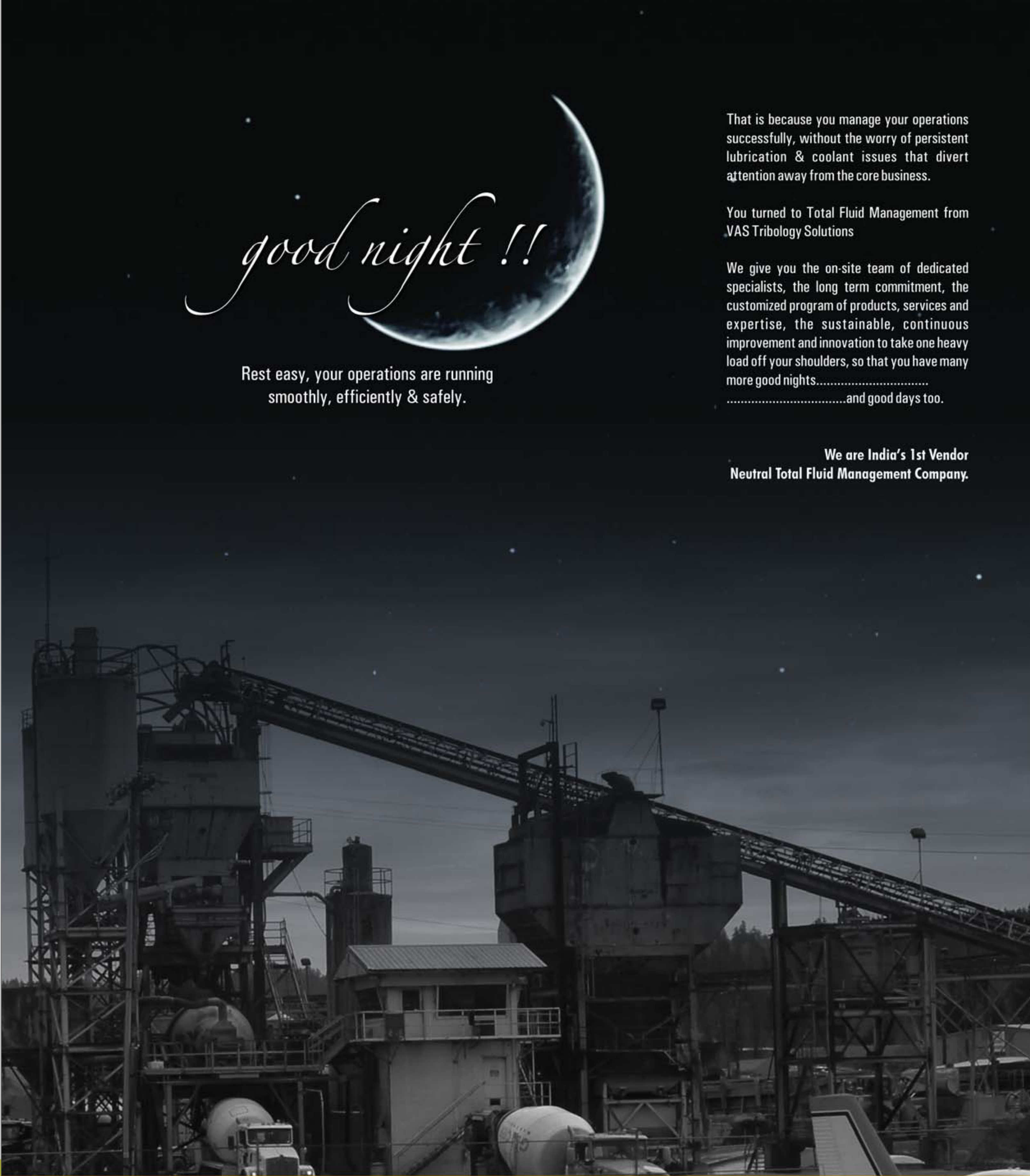
Approximately 3443 MT of Transformer Oil has been exported in the month of April 2014 from JNPT and Chennai port. It has been exported to Bangladesh, Brazil, Malaysia, Iran, New Zealand, Oman, Paraguay, Morocco, Indonesia, South Africa, Sri Lanka, Saudi, Philippines, Thailand, Vietnam, and UAE.

India, UAE discuss strategic oil storage lease. India is in talks to lease part of its planned strategic storage to United Arab Emirates' state oil company ADNOC, two government sources said, as New Delhi moves to protect its economy against crude price shocks and supply disruptions. India, the world's fourth largest oil consumer, imports about 80 percent of its oil needs and is building emergency storage capacity to hedge against energy security risks. India had initially planned to fill the oil storage without overseas participation, but it is now drawn to deals similar to those that the Abu Dhabi National Oil Company (ADNOC) struck earlier with Japan and South Korea. Such a deal would take into account India's growing role as a regional refining hub. The South Asian nation imports around 16 million tonnes of crude a month - more than it consumes - and exports about a third of that as refined products. "Final details of the plan are yet to be worked out but they (ADNOC) have said they can take up to 2 million tonnes capacity.

About the Author

Dhiren Shah is a Chemical Engineer and Editor – In – Chief of Petrosil Group

Countries Where Light & Heavy White Oil Has Been Exported									
Argentina	Australia	Bangladesh	Bulgaria	Brazil	Cambodia	Chile	Canada	Dominican Re	Djibouti
Ecuador	Egypt	Germany	Ghana	Greece	Indonesia	Ivory Coast	Israel	Italy	Jordan
Kenya	Malaysia	Mauritius	Myanmar	Nepal	New Zealand	Nigeria	Pakistan	Peru	Philippines
Poland	Russia	S. Africa	Senegal	Spain	Sri Lanka	Sudan	Taiwan	Tanzania	Thailand
Turkey	UAE	UK	Ukraine	Vietnam	Yemen	Zaire			


good night !!
Rest easy, your operations are running smoothly, efficiently & safely.
That is because you manage your operations successfully, without the worry of persistent lubrication & coolant issues that divert attention away from the core business.
You turned to Total Fluid Management from VAS Tribology Solutions
We give you the on-site team of dedicated specialists, the long term commitment, the customized program of products, services and expertise, the sustainable, continuous improvement and innovation to take one heavy load off your shoulders, so that you have many more good nights.................................
..................................and good days too.
We are India's 1st Vendor Neutral Total Fluid Management Company.