Machinery Lubrication

India March - April 2017

INSIDE

Determining Grease Compatibility and Why It's Important

Art and Science of Belt Conveyor Lubrication

30 YEARS WITHOUT AN OIL CHANGE

A CASE STUDY ON EXTENDING LUBRICANT LIFE

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Contents

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March - April 2017

More

Publisher's Note

The global market for Lubricating Oils and Greases is projected to reach 47 billion litres by 2020, driven both by an increase in the vehicle ownership in the developing countries and also increased consumption in the industrial sector due to increased demand of finished manufactured goods.

Automotive industry is one of the major markets for lubricating oils and greases. Automotive lubricants are used in the crankcase of a vehicle engine and transmission to ensure smooth operation.

Strict standards for controlling exhaust gas emissions from vehicles are necessitating production of advanced lubricants produced out of better base oils and additives. This scenario creates lucrative opportunities for lubricant manufacturers. India like the rest of the world is committed to comply with BS IV norms in the next couple of years. With this in mind oil companies are investing heavily into research and production of compliant fuels and lubes.

Industrial machinery also represents a major end-use market for Lubrication Oils & Greases. The health of manufacturing sector therefore influences demand dynamics in the market. Improving global manufacturing PMI indices and the resulting expansion in production capacities will help drive growth in the industrial lube market. The increase in manufacturing activity will spur investments in production machinery, thus creating a strong business case for the use of industrial lubes.

Asia-Pacific represents the greatest & fastest growing market, with volume sales projected to grow at a CAGR of 5% over the period. Four of the top ten major players in lubricants are from Asia (Idemitsu Kosan Co Ltd. (Japan), Indian Oil Corporation Ltd (India), JX Nippon Oil & Energy Corporation (Japan) & Sinopec Corporation (China).

Mankind always wanted to use its resources indefinitely. The current issue has a cover story on a case study where an organisation has given its experience on their using oil for 30 years and the challenges faced by them.

Your publication was the "Media Partner" for the NLGI –India Chapter conference cum exhibition hosted in Varanasi (India) from 2-4th Feb 2017. It was heartening to see the participation through presentation of papers on the new developments in grease technology and also display of newer and advanced testing equipments.

We thank our readers the valuable feedback and suggestions, which we regularly receive and look forward to your continuing inputs on the quality of content and presentation. We would also like to thank our advertisers for their continued support.

Warm regards,

Udey Dhir

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How to Visually INSPECT THE HEALTH and STATE OF OIL

The well-known KISS principle (keep it simple stupid) was first coined in the 1960s and began widespread use in the U.S. Navy shortly thereafter. While it started as a design principle for engineers, it has since been applied to any activity or creative endeavor that has had the propensity to become unnecessarily complicated. What becomes overly complicated also becomes, by default, poorly understood and sparsely used. Conversely, the greater genius in design and engineering lies in achieving the design objective through simplicity and pureness of form.

This can be applied to the world of oil analysis in many ways. Increasingly, oil analysis has become engulfed by complex analytical chemistry and mathematical algorithms. This science is successful when it takes the complicated, such as an array of particles of varying shapes, sizes, textures, colors and compositions, and puts their formation into plain English (e.g., cutting wear on cylinder walls). It is less successful when it does the opposite, i.e., overanalyzes and overdetails. If someone asks you for the time, there is no need to give an explanation on how a watch works.

Don't get me wrong, I'm very proud of the technical progress of the oil analysis field and the tremendous value it has brought to the world of machinery reliability. That said, oil analysis should always be viewed in terms of its many forms. These are not competitive but rather should form a focused and unified activity, each with inherent strengths and weaknesses. Collectively, they enable oil analysis to function at its best. Like all reliability initiatives, this should deliver reliability at the lowest possible cost. It optimizes reliability, not maximizes it. It's about making the right choices.

For instance, for a given machine, how frequently should you conduct laboratory analysis? How frequently should you perform wear particle characterization? These are necessary questions needed to achieve the desired optimum reference state (ORS). The four principle forms of oil analysis are identified and described in Figure 1.

In recent issues of *Machinery Lubrication* magazine, I've introduced Inspection 2.0 as an important reinvention of conventional inspection practices. I see so many low-hanging fruit opportunities for simple, daily, penetrating machine inspections that often go unnoticed and certainly unexploited. It's far better to do 100 frequent "screening" inspections

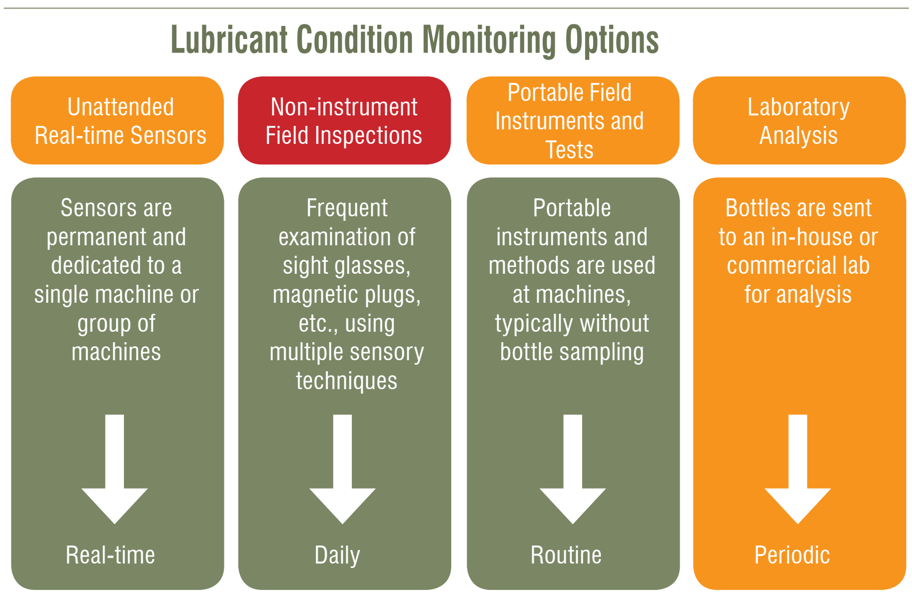

Figure 1. The four principle forms of oil analysis

It's far better to do 100 frequent "screening" inspections than one monthly or quarterly laboratory analysis.

than one monthly or quarterly laboratory analysis. Laboratory analysis should still be performed, but it is not a substitute for frequent quality inspections. When this happens, reliability is marginalized and maintenance budgets are wasted.

As a review, Inspection 2.0 can be summarized by the following tenets:

- Culture of reliability by inspection (RBI)
- Advanced, tactical inspector skills
- Machine inspection readiness with inspection windows
- Advanced inspection tools and aids
- Inspection protocol that is aligned to failure modes
- Early fault and root cause emphasis
- Origin of more than 90 percent of unscheduled work orders

Tactical Inspections Are Purposeful Inspections

With the exception of taste, our four other senses can be effectively used, individually or collectively, for frequent tactical inspections. The concept of tactical inspections is inspection with a purpose. It is not just going through the motions down a checklist. For instance, you don't just look at oil but rather examine it for specific reasons. The inspectors must know the reasons.

This examination seeks to answer several questions about the health of the oil, the health of the machine and the state of the oil to protect the machine from premature failure. Inspectors should be hunting for something that often is inherently hard to find or notice. The machine, through the oil, will telegraph a signal. The strength of that signal increases as functional failure approaches. Early fault detection is the objective and is best achieved by tactical inspections. I'll talk about how this can be done visually.

There are no scientific instruments, sensors, algorithms or computers that can outperform the eyes and mind of a human inspector. To get the most out of your sense of sight, you need to know what you're looking for. Start by constructing a list of root causes and symptoms.

Inspection seeks to find critical states of the oil that cause failure (roots of failure) or reveals active failure in progress (symptoms). As an example, for a diesel engine oil this might be the oil level, soot dispersancy, fuel dilution, coolant contamination and sludge. For an industrial gearbox, you might want to look for a wrong oil level, dirty oil, water contamination, excessive wear debris, aerated oil and an overextended oil drain.

By knowing the questions, you can work backward to define the tactical inspection protocol that provides the answers. This is a two-step process:

1. **Causes and Symptoms (C&S)** — For every machine or system component, list what is important to find (ranked by importance).
2. **Critical Occurrence States (COS)** — For each item on this list, create an inspection protocol that would reveal the state of occurrence (the earlier the better).

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A Well-trained Eye

Using the industrial gearbox example, let's rank the causes and symptoms guided by past experience and help from technical advisors. After each item on the following list are one or more ways to enable earlier alerts by visual inspection.

1. **Wrong Oil Level**: Level gauge inspections
2. **Dirty Oil:** Exposed headspace (vents, breather, hatch, etc.), filter in bypass, rapid rise in the filter pressure differential, entrained air problems, sediment in bottom sediment and water (BS&W) bowls, blotter test sediment
3. **Water Contamination:** Cloudy oil, free water in BS&W bowls, rust on the corrosion gauge, hydrated desiccant breather, entrained air problems, positive result from a crackle test
4. **Excessive Wear Debris**: Metallic sediment in BS&W bowls, laser pointer inspection, loaded magnetic plug, metallic debris on the filter's surface, magnet inspection of oil sample
5. **Aerated Oil (Entrained and/or Foam):** Sight glass inspection (cloudy or frothy oil), sudden rise in the oil level, hatch inspection, rise in the oil temperature, emulsified water
6. **Overextended Oil Drain:** Sight glass inspection (dark, sludgy oil), dirty oil (see No. 2), excessive wear debris (see No. 4), soft insolubles on blotter, air-handling problems

After each inspection (that passes), the inspector should have a high level of confidence that there are no active or abnormal C&S conditions related to the oil or machine. This is done by skillful inspection in search of the COS. If you engineered your inspection protocol properly, it would be extremely difficult for there to be an active C&S in progress without a positive alert from an inspection of each of the COS. These critical occurrence states are designed to effectively reveal C&S events.

Routine Inspections

A routine inspection consists of quick and frequent inspection events not generally requiring the use of tools, pulling a sample or special inspection aids. The following are examples of routine visual inspections related to lubricating oil:

- **Oil Level** — Visually inspect the dipstick, level gauge or sight glass.
- **Oil Color and Clarity** — This involves a sight glass inspection aided by a strong light. Usually a comparator image is used.
- **Foam Presence and Stability** — This can be determined by some sight glasses or headspace inspections, or both.
- **Entrained Air Presence and Stability** — Also generally assessed by sight glasses and headspace inspections.
- **Free Water** — Inspect water traps or BS&W bowls for a free water phase.
- **Emulsified Water** — Inspect sight glasses for turbidity.
- **Oil Sediment and Floc** — Inspect sight glasses and BS&W bowls for stratified solids and soft insolubles.
- **Gauge and Sensor Inspections** — These inspections utilize various digital and analog gauges, including temperature, pressure and flow. Some machines have sensors that report oil properties, such as particle count, wear particle density, water contamination and viscosity.
- **Heat Gun Inspection** — This provides a quick, quantitative assessment of the oil temperature on critical machine surfaces.
- **Magnetic Plug Inspections** — Some sight glasses have integrated magnetic plugs for quick and effective observation.
- **Headspace Inspection** — Hinged hatch access aided by a strong light can enable observation of bathtub

rings, varnish and foam.
- **Corrosion Gauge Inspection** — Similar to magnetic plugs, these gauges can be quickly inspected to reveal corrosive conditions associated with corrosion agents, impaired rust inhibitors, etc.
- **Leakage Inspection** — Failed seals and radial shaft movement can cause leakage, but this can also be due to a sudden drop in oil viscosity, change in oil chemistry or ingression of certain liquid contaminants.

Exception Inspections

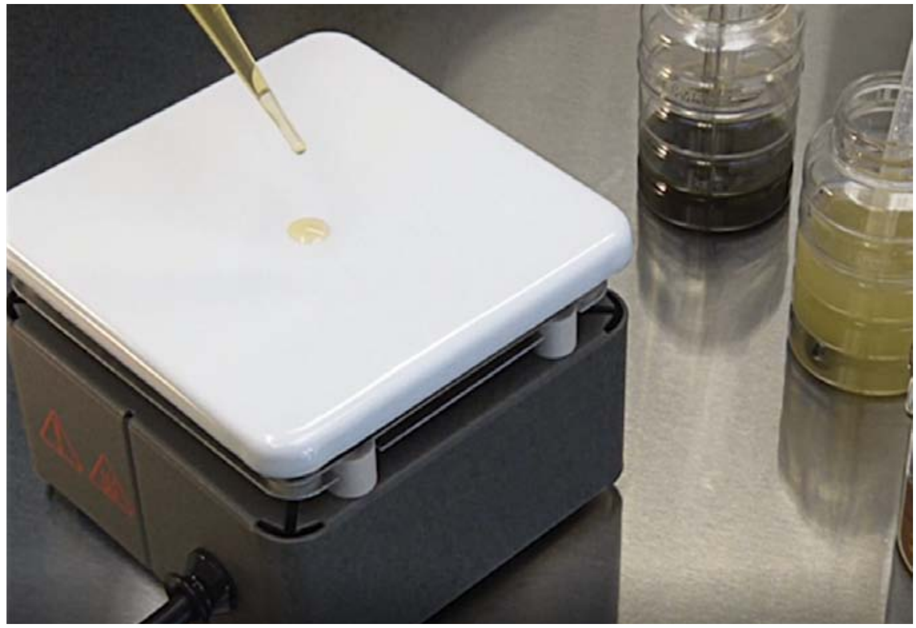
Exception inspections are conducted either because of a reportable or questionable routine oil inspection or as the result of an abnormal operating condition. Most exception inspections require the extraction of an oil sample and a simple test that can be performed at the machine or on a benchtop. The following are examples of visual exception inspections related to lubricating oil:

- **Blotter Spot Test** — This simple test can be extremely helpful for detecting a range of contaminants and abnormal oil conditions.
- **Blender Test** — This test can be performed with a blender or

70%

of lubrication professionals perform daily visual inspections of the oil at their plant, based on a recent survey at machinerylubricationindia.com graduated cylinder. It is useful for revealing certain contaminants, degraded oil chemistry, impaired air-handling ability and other abnormal conditions.

- **Inverted Test Tube** — This is an old method that uses the rate of rising air bubbles to roughly estimate oil viscosity. Graduated cylinders or sample bottles can be utilized as well.
- **Oil Drop on the Surface of Water** — Certain additives and chemical contaminants influence the interfacial tension of lubricants. Placing a couple drops of oil on the surface of water can quickly exhibit this. Compare the results to that of new oil.
- **Cold Oil Turbidity** — Oil with trace amounts of water can be assessed by placing a sample of the oil in a refrigerator for an hour. Dissolved water will saturate in oil at cold temperatures and become visibly noticeable by a cloudy appearance.
- **Hot Oil Clarity** — The presence of soft oil insolubles (oxides, organic materials, dead additives, insoluble additives, varnish potential, etc.) and some emulsified water will often quickly dissolve in the oil when heated. This is visibly noticed by the oil becoming markedly clearer (less turbid).



- **Crackle Test** — This well-known test for water contamination can be performed with a hot plate or soldering iron.
- **Bottle and Magnet Test** — The presence of ferromagnetic wear debris particles can be separated and concentrated for quick inspection by placing a strong rare-earth magnet against the outside surface of an oil sample bottle and then agitating. For high-viscosity oils, dilute the oil first with kerosene or another solvent to lower the viscosity.
- **Laser Pointer Test** — Shining, reflective particles can be easily observed in many oils by passing a laser through the oil. The particles will scatter the light. It sometimes is best to allow the particles to settle to the bottom of the bottle first and then pass the laser light up from below.

For more information on these test methods, refer to the *Daily One-Minute Lubrication Inspections and Field Tests* booklet in the Noria bookstore at store.noria.com.

About the Author

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

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A CASE STUDY 30 YEARS WITHOUT AN OIL CHANGE

By Brian Thorp, Seminole Electric Cooperative

Thirty years without a complete oil change usually would be considered impossible. In this case, there was makeup fluid over the 30+ years, which amounted to slightly more than the system volume on each of the two units. The testing parameters for acid levels, particle counts, water and conductivity were maintained within specifications with a few exceptions. Varnish was identified, but no exclusive tests such as membrane patch colorimetry (MPC) or quantitative spectrophotometric analysis were conducted to confirm or quantify the amount of varnish. Of course, the 30 years without an oil change did not come without consequences, as was discovered after the system flush and chemical cleaning were completed.

The System and Components

The Seminole Electric Cooperative is a two-unit, 1,300-megawatt coal-fired generating station south of Jacksonville, Florida. The electrohydraulic control (EHC) reservoirs and systems are larger than normal, utilizing 9,000 liters of fluid

New oil vs. 30-year-old oil

per unit. Three 650-liters-per-minute submerged screw pumps are located in the reservoir. When required, they provide flow at 40 bar at the turbine level. There are 10 control-valve and 10 stop-valve hydraulic actuators on the high-pressure, intermediate-pressure and low-pressure turbines. A full-flow filter offers 25-micron filtration up to the turbine actuators, while an acid-remediation and 1-micron polishing filter skid runs in kidney loop off the reservoir. Two 2,400-watt heaters in the filter skid sustain the fluid temperature when the system is offline. Super-dry air is supplied to the reservoir headspace for maintaining the moisture level in the fluid. Tube and shell coolers keep the fluid temperature at the desired level.

System Flushing and Cleaning

Due to the complexity and size of the system, an outside company was contracted to perform the flushing and cleaning. A large 1,100-liters-per-minute pump/filtration unit would provide the circulation. A large quantity of fittings, flanges, jumper hoses and valves was required to flush the system. For a true high-velocity flush, the fluid was circulated at five times the normal flow rate to achieve turbulent flow through the piping and components. This was accomplished by running sections or circuits rather than the entire system during the oil flush.

To help with the cleaning process, the oil was heated and temperature cycling was performed. No filtration was done during the cleaning process. Particle counts were taken in the beginning for a baseline and after the completion of each system process. The particle counts usually spiked rapidly and then began to level out as the process proceeded. Once three consecutive particle counts remained level or dropped slightly, the flush/cleaning was stopped. All fluid was drained from the system, air was blown through the piping to help remove any trapped fluid, and the vessels that could be opened were cleaned and wiped out, including the reservoir. Time was of the essence, as the fluid would begin gelling as it cooled, making it harder to remove and clean.

A large pump/filtration unit provided the circulation for the system flush.

What Is EHC Fluid?

Electrohydraulic control (EHC) fluids are typically fire-resistant lubricants, which are important in applications where hydraulic fluids can be exposed to high temperatures or sources of ignition, such as power generation, furnaces, foundries, and military and aeronautical applications.

What is a fire-resistant fluid? According to ExxonMobil, "fire-resistant hydraulic fluids are specially formulated lubricants that are more difficult to ignite and do not propagate a flame from an ignition source. Fire resistant should not be confused with fireproof, as fire-resistant fluids will still ignite and burn given specific conditions."

Fire resistance is defined by ISO 12922, rev. 2 (2013), which evaluates fluids based on three tests selected to represent three different fire scenarios: spray flammability (ISO 15029-2), wick flame (ISO 14935) and hot manifold ignition (ISO 20823). The difference between some of the fluids as tested, based on ISO 12922 rev. 2, is whether they will self-extinguish once the heat source is removed.

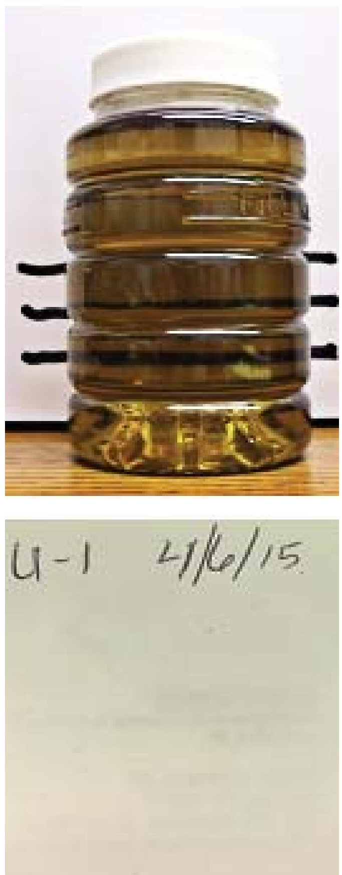
The Rinse Cycle and the New Fluid

After the entire system was drained and wiped down, the reservoir was filled with a lesser value phosphate-ester fluid, which was used to rinse and clean out the system. Approximately three-fourths of the tank volume or 6,000 liters were used for the rinse. This was completed in the same manner as the flush, utilizing different system sections or circuits. This time the fluid was filtered as it ran through the system. Particle counts were taken at the end of each complete system cycle. Once the desired particle count was reached for three consecutive cycles, the rinse was completed. The rinse fluid was then drained and saved in large totes for use on the second unit's flush. Piping was blown out, and the reservoir and all vessels were opened and wiped down. New filters and acid-remediation media were also installed. The system was now ready for the new fluid.

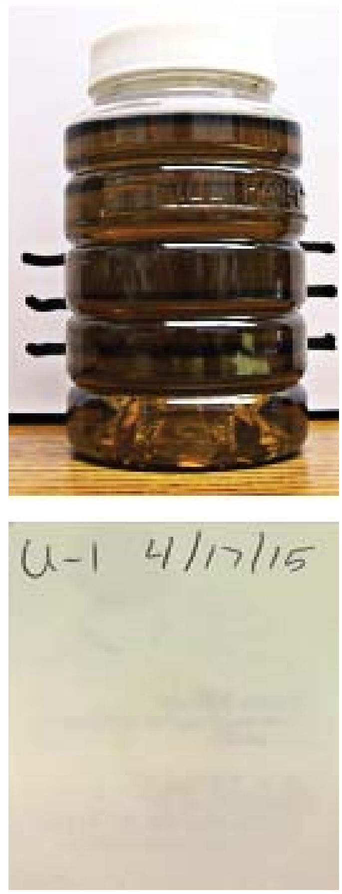
Of the new EHC fluid, 6,000 liters had been transferred to large totes from the drums and flowed through a polishing filter for several days. The remaining 3,000 liters were pumped through the filter skid when it was installed in the reservoir. Since the unit was not able to be run when the project was completed, a filter skid was kept onsite and used on the reservoir through the commissioning of the system and valve setting. Once particle count levels were acceptable, the filter skid was removed and the system filtration was resumed.

When the system was returned to service, a few minor leaks and loose flanges were reported. Of the hundreds of fittings and flanges that had been opened, bypassed and reassembled, a few leaks were expected.

0% TXP

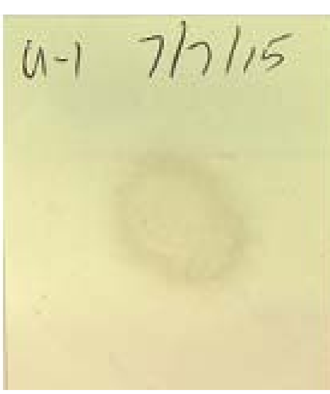


24 hours, 1.2% TXP

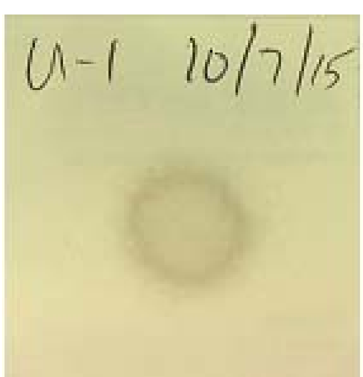


264 hours

984 hours



3 months, 1.9% TXP



6 months, 2.11% TXP

Blotter spot testing to determine organic and solid insolubles

The 30 years without an oil change did not come without consequences, as was discovered after the system flush and chemical cleaning were completed.

The Aftermath

The second unit's flush was completed first. The fluid manufacturer, oil analysis lab and others were contacted to determine which tests could be conducted to confirm that the cleaning agent had been thoroughly removed, which was a concern at the time. All tests indicated that everything was good to go.

The new fluid was expected to darken slightly once it began circulating, but this occurred much quicker than anticipated. Since ester has incredible cleaning properties, the assumption was that it was removing residual buildup that remained after the flush. When the fluid continued to get darker and darker, the fluid manufacturer was contacted to see what other tests could be performed to verify the additional cleaning of the system.

The old fluid contained trixylyl phosphate (TXP) and aryl phosphate, which the new fluid did not. The manufacturer suggested a gas chromatography test to see if TXP was present in the new fluid. If so, it could be presumed that the old material was being removed from the system internals.

The first test for TXP on the second unit occurred in December 2014, approximately eight months after the flush. The TXP levels came in at 2.2 percent. The next test for TXP took place in October 2015. The TXP levels were now 1.87 percent. The question was whether the levels were actually decreasing or were the results within the percentage of deviation for the test.

After the second unit's flush and TXP testing, preparations were made for the first unit. Its TXP levels at 24 hours of circulation were 1.2 percent. At three months, the levels increased to 1.9 percent, and at six months, they rose to 2.11 percent. The tests correlated with a darkening of the fluid as well as an increase in the blotter test rings, the MPC color and the weight of the patches. Although the particle counts were within the specified range, only particles greater than 4 microns were measured. It was apparent that submicron particles were involved, which normal filtration would not remove.

The next step in the process will require specialized testing to determine the particulate makeup. Knowing if the composition includes oxidation byproducts, inorganics or carbon/soot from micro-dieseling will be critical in choosing the best method for removing it from the fluid. Depth media, electrostatic filtration and a specialized blend of ion-exchange resins are some of the methods generally considered for varnish or submicron particle removal. Each claim to have advantages over the others for different types of particles.

One problem with a 9,000-liters reservoir is the turnover rate when utilizing side-stream or kidney-loop filtration. With most of these technologies, slower flow through the media or elements is required for them to work properly. A 40-liters-per-minute system would only turn over the reservoir volume of 9,000 liters six times in a 24-hour period. Normally, with sideline or kidney-loop filtration, it is believed that seven times the reservoir volume turnover is equivalent to one-time full-flow filtration. To get ahead of the problem, it is suggested that a reservoir be turned over at least three times per day, which would require a large 110-liters-per-minute system or several smaller systems running in parallel.

In conclusion, the law of unintended consequences, which states that actions always have effects that are unanticipated or unintended, wins again. In performing an industry-accepted practice of a high-velocity chemical cleaning and system flush, it was discovered that the system's age and buildup were a problem. Once the particle makeup is identified, the source of the particles can hopefully be reduced or eliminated, and the process of cleaning the system can begin. Will this be a one-time cleanup or will the system require constant, specialized filtration to keep it in pristine condition? Only time will tell. ■

How to Determine Grease Compatibility and Why It's Important

By Richard N. Wurzbach, MRG Labs

Grease compatibility charts have been developed and circulated since the 1980s without much alteration. However, grease technology has changed significantly over the years, and there are many examples of performance that contradict several widely used compatibility charts. This article will describe the most common examples of incompatible grease mixing and how to determine if two greases are compatible.

Examining Compatibility Charts

A number of organizations rely on compatibility charts to make important maintenance decisions. These charts are readily available in published papers, periodicals and Web pages. Unfortunately, very few charts give any reference for the origin of the data or any research utilized to establish the compatibility relationships described. Significant concerns have also been raised about some of these charts after greases presented as compatible have proven to be quite incompatible.

A selection of 17 compatibility charts was recently evaluated for differences. The chart on pages 14-15 shows the labels used in these charts and how many times these descriptions appear in the charts. Seventeen occurrences would indicate that a grease category was present in each of the charts found, and there were only three such products.

The three products that appeared in each of the tables were aluminum complex, lithium complex and calcium complex. However, the commonality ends there. A total of 25 different product descriptions were found in the 17 tables. Some may have been referring to the same product categories but failed to use common nomenclature, so it is difficult to determine where there might be an overlap.

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Contradictions

Several contradictions were discovered among the various charts. For example, one chart indicated that barium-complex grease is compatible with clay-thickened grease, while others suggested this mixture is incompatible. Some charts listed polyurea grease as being compatible or borderline compatible with calcium complex, but another chart showed calcium complex to be incompatible with polyurea.

Although there were significant disagreements between the various charts, they all had one thing in common — few provided any link or reference to research that was conducted to develop them. That is to say, the charts being used to make significant engineering and design decisions are contradictory and do not indicate the source of information or research used to compile them.

Upon observation, it becomes obvious that several of the charts are derived from the others. The various descriptions used imply that some may have been copied from the others. Many charts include a disclaimer, usually stating that it would be preferable to clean out all old grease and avoid any mixing, or that the charts are believed to be accurate at the time of publication. This underscores the challenge of finding a single authoritative chart to be used with confidence when making decisions regarding grease mixing.

Basis for Grease Compatibility

It is interesting to note that these grease compatibility charts focus only on the family of thickener involved. However, there are three components to any formulated grease: the base oil, the additives and the thickener. When mixing oils, the key considerations are the viscosity of each product, the base oil type and the thickener. Somehow, though, these critical parameters are overlooked when utilizing grease compatibility charts. This is somewhat understood, since the most common reason for grease mixing problems is related to differences in the grease thickener, but that is not the only issue.

Base Oil Compatibility

Greases are manufactured from both

TYPE	PROLAB	TRIBOLOGY.COM	AMSOIL	LUBRITENE	NSK	TRANSIT LUBE	EASTERN MARINE
Aluminum Complex	1	1	1	1	1	1	1
Barium				1	1		
Barium Complex	1	1	1			1	1
Calcium				1	1	1	
Calcium Stearate	1	1	1				1
Calcium 12-Hydroxy	1		1	1	1		1
Calcium 12-Hydroxystearate		1					
Calcium Complex	1	1	1	1	1	1	1
Bentonite Clay	1	1		1			
Clay			1		1	1	1
Lithium				1	1	1	
Lithium 12-Hydroxy	1		1	1	1		1
Lithium 12-Hydroxystearate		1					
Lithium Complex	1	1	1	1	1	1	1
Sodium				1	1	1	
Polyurea	1			1	1	1	
Polyurea (Conventional)		1	1				1
Polyurea (Modified)	1						
Polyurea Shear Stable		1	1				
Polyurea (LUB-LM type)							1
Calcium Sulfonate	1	1	1				1
Silica Gel							
Silica	1						
Polyurea (Lubrilife)							
Lithium Stearate							

Compilation of 17 grease compatibility charts mineral oil and synthetic oil bases. Some synthetic base oils are incompatible with mineral oils and other types of synthetics, just as in the mixing of lubricating oils. Therefore, it is important to consider the type of base oil in the grease when determining compatibility. If the grease thickeners are compatible but the base oils are not, the resulting mixture can be problematic. Viscosity is critical when selecting any lubricant. Likewise, when greases are mixed where the base oil viscosities are significantly different, the resulting mixture will not be optimized for the application.

Additive Compatibility

It is understood that when oils are mixed, any incompatibility in the additive packages will result in poor performance and often additive reactions creating deposits. While reacting additives will not settle to the bottom in grease, as is the concern in oil, the changes can cause problems, impacting additive effectiveness and in some cases creating corrosive conditions in the grease. Additive compatibility with the metallurgy of the lubricated component must also be considered.

Thickener Compatibility

Mixing of greases with incompatible thickeners can result in the most immediate and obvious changes that interfere with effective lubrication. Many mixtures will initially soften, often to the point of migration through seals or away from lubricated surfaces. Some mixtures will cause the thickener to release the oil, with the separated phase running freely from the bearing, gear or

housing. Other mixtures harden initially and lead to component load issues and poor grease motility. This potential effect is not easily determined. Simply mixing two greases together to observe changes may not provide any obvious difference. However, carefully mixing the greases in different ratios and

ULTRA LUBE	ACCURATE LUBRICANTS	PRIEST OIL CHART 1	PRIEST OIL CHART 2	THIXO GREASE	EXXON MOBIL	HIPER TECH	AMSOIL	CENEX	LUBE TALK WEB	TOTALS
1	1	1	1	1	1	1	1	1	1	17
			1			1	1			5
1		1		1				1	1	10
		1	1			1	1			7
1				1				1	1	8
1			1	1	1	1	1	1	1	13
1										2
1	1	1	1	1	1	1	1	1	1	17
1						1	1			6
	1	1	1	1	1			1	1	11
		1	1			1	1			7
	1		1	1		1	1	1	1	12
1										2
1	1	1	1	1	1	1	1	1	1	17
		1				1	1			6
		1	1			1	1			8
1				1				1	1	7
										1
1	1				1			1	1	7
										1
	1				1	1		1	1	9
						1				1
										1
				1						1
				1				1	1	3

subjecting them to mixing, working and heating cycles can reveal measureable changes in properties to predict their performance in a machine.

Testing for Grease Compatibility

If research has demonstrated the unreliability of the different grease compatibility charts, it is important to discuss what additional steps can be taken to evaluate grease compatibility. ASTM D6185 (Standard Practice for Evaluating Compatibility of Binary Mixtures of Lubricating Greases) involves the mixing of the intended greases in ratios of 25-75, 50-50 and 75-25. The resulting mixtures are evaluated for changes in dropping point, shear stability and storage stability. These last two parameters include measuring changes in the cone penetration value.

While this standard has greatly improved the uniformity to which greases can be tested for compatibility, it should be noted that the three evaluation tests are static in nature. Although there is some mechanical working of the grease prior to testing, this is minimal mechanical perturbation.

When a grease mixture is introduced into a machine, such as a motor bearing, it will undergo significant mixing and working in a relatively short period of time. This compares to the 60 double strokes utilized to mix and work the binary mixture evaluated in the standard.

A mixture of greases introduced in a common ball bearing operating at 1,750 revolutions per minute will see nearly 30 million mixing and working events in just three days of operation. This mixture will be subjected to continuous dynamic forces, and its performance and possible degradation will be influenced by this more than the static response seen in cone penetration or dropping point measurements. The ability of this testing to adequately predict in-service mixtures may be reasonably questioned.

Working in a Bearing Simulator

Some studies have been performed to improve the mixing and working of grease to better simulate machine conditions. The electric motor test stand shown below was developed for the Electric Power Research Institute's Effective Grease Practices guideline. This test stand consists of the end bell from a 60-horsepower electric motor mounted with a ball bearing in a stub

Grease mixing test stand

shaft. The shaft is turned by a fractional horsepower motor, coupled to a turned-down shaft. The housing of the end bell is removed and replaced by a Plexiglas

TEST	GREASE 1	GREASE 2
NLGI Grade	2	2
Thickener Type	Polyurea	Polyurea
Penetration, Worked (ASTM D217)	280	285
Viscosity of Oil, cSt at 40°C (ASTM D445)	116	115

Testing two common polyurea-thickened greases

window to observe the condition of the grease under dynamic conditions. For the purpose of testing grease mixtures, the 25-75, 50-50 and 75-25 ratios are packed sequentially into the bearing by hand, and the adjacent housing area is packed half full. This is then run for 72 hours to achieve the 30 million plus perturbations of the grease. The conditions observed are noted, and the grease is removed from the bearing.

Dynamic Analysis

The resulting mixture is analyzed by Fourier transform infrared (FTIR) spectroscopy to note any reaction or unexpected oxidation of the components in the grease. The grease is also evaluated by elemental spectroscopy to assess unexpected final ratios of additives as compared to the anticipated averaging of values seen in the original products, adjusting for mixing ratios.

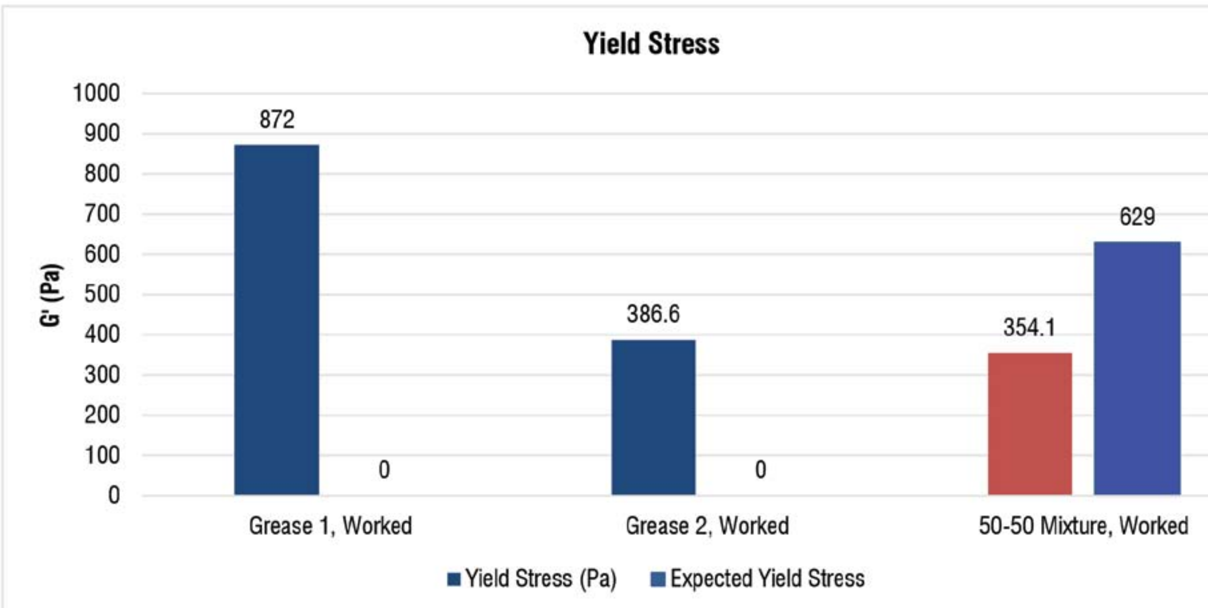
Finally, the grease is tested in a controlled stress rheometer to identify changes in flow and shear properties as compared to the original products. The values measured include the yield stress, which can predict the hardening or softening the grease may undergo; the oscillation stress, which can give insight into the likelihood of oil separation and other effects; and recoverable

	FE	CR	PB	CU	SN	AL	NI	AG	SI	B	NA	MG	CA	BA	P	ZN	MO	TI	V
Grease 1	4.9	1.0	0.2	0.3	0.0	1.4	1.7	0.1	1.6	0.2	1.0	21.5	3.4	15.6	0.0	576.8	1.9	0.0	2.2
Grease 2	1.1	0.5	0.0	0.6	0.0	3.5	0.6	0.1	2.0	0.1	0.5	0.2	1.2	8.2	123.6	2.3	1.4	0.0	1.3
50-50 Mixture	0.8	0.4	0.0	0.3	0.0	0.0	0.3	0.1	1.7	0.6	0.8	10.2	5.1	4.6	31.8	301.7	1.1	0.0	0.5

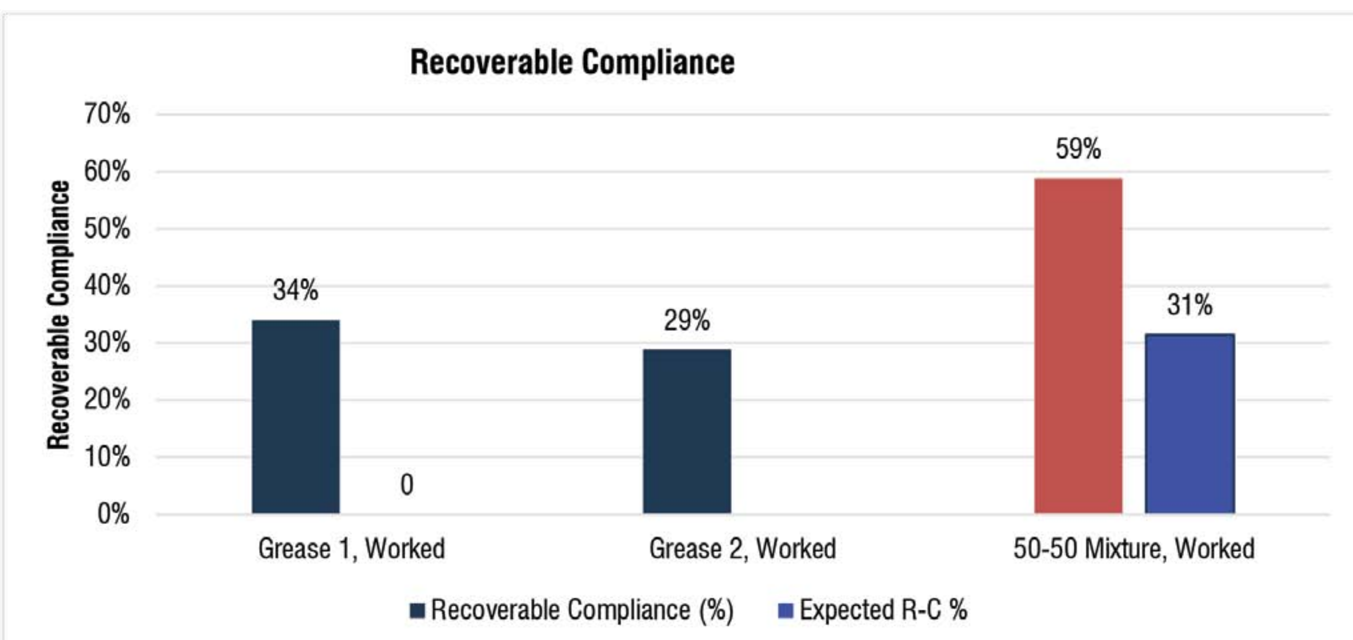
Elemental spectroscopy values for the reference greases and the 50-50 mixture

TRIAL	G' (PA)	EXPECTED G'	YIELD STRESS (PA)	EXPECTED YIELD STRESS	RECOVERABLE COMPLIANCE (%)	EXPECTED R-C %
Grease 1, Worked	31,690	--	872	--	34%	--
Grease 2, Worked	12,480	--	386.6	--	29%	
50-50 Mixture, Worked	8,605	22,085	354.1	629	59%	31%

The rheological values for the two worked reference samples and the 50-50 worked mixture, with the values of concern in yellow



The expected and actual yield stress values for the 50-50 mixture and the reference greases



The expected and actual recoverable compliance values for the 50-50 mixture and the reference greases compliance, which can help to identify those mixtures that might experience "channeling" or "tunneling" in the equipment housing.

Taken together, these tests may provide a more comprehensive picture of the potential effects of mixing two grease products together and help users avoid reliability issues from grease mixing, even for products that might otherwise appear to be compatible on charts.

Examples of Grease Compatibility Testing

The following test results for binary grease mixtures were obtained using the previously described methods and the grease mixing test stand to mix and work the samples. The first example is of two common polyurea-thickened greases. This mixture was chosen for a company looking to consolidate the number of greases in its facility. One area of the facility used a particular grease in all electric motors, while the remainder utilized another grease. The goal was to consolidate to one product for all motors. Unfortunately, it would not be possible to completely clean out all of the grease being replaced from the motors. Therefore, it became necessary to verify that one polyurea grease could be added directly to a motor containing the other. According to most grease compatibility charts, polyurea greases are compatible with each other, and such a transition would be allowed.

The table above shows the product information for both greases tested. These greases are very comparable based on their consistency and viscosity of the base oils.

The table below reveals the differences in elemental spectroscopy values for the reference greases and the 50-50 mixture. The areas highlighted in yellow show the contrast between the greases and evidence of mixing.

These variations reveal an obvious formulation difference between the greases (most likely involving anti-wear additives), but this alone would not be sufficient to disqualify the mixture for compatibility if the resulting product still functioned effectively with regard to wear resistance.

The table at the top of page 20 shows the rheological values for the two worked reference samples and the 50-50 worked mixture. The areas highlighted in yellow indicate values of concern.

In this case, each of the values for the 50-50 mixture is significantly different than the expected numerical average of the unmixed greases. This demonstrates a change in properties due to mixing and raises concerns about this mixture's performance in the long term. It could be expected that the mixture may be subject to softening, oil separation and a tendency to channel when allowed to persist in a mixed state in the motor housing. For this reason, the mixture was not permitted at the facility, and the decision was made to keep two greases in place until the motors could be removed and thoroughly cleaned of the existing product.

Strategies to Minimize Mixing Effects

It can be difficult to avoid mixing greases in a plant environment, but several steps can be taken to minimize the impact and likelihood of mixing incompatible greases.

Step 1: Provide Clear Guidance

All personnel involved in applying grease to equipment should be trained and receive instruction on the proper product to use on each piece of equipment and the location. This includes employees and contractors who may be working in the facility. Provide labels and color codes where possible to prevent confusion.

Step 2: Involve Purchasing in Grease Specification

A common area for grease mixing is in new and rebuilt equipment. Even when all plant personnel are given clear guidance on using the correct products, equipment may be returned to the facility with a grease that is different than what will be added while in service. New bearings, gears, motors, etc., often come supplied with a product that is incompatible with the grease being used to relubricate.

Step 3: Consolidate Lubricants

Identify the minimum number of products required to meet the design of the equipment in use and consolidate to that number. Do not stock additional products for convenience or brand loyalty. This increases the likelihood of mixing.

Step 4: Test Potential Mixtures

If the wrong grease has been inadvertently added to a machine or consolidation is required that will transition the use of a product in a machine, perform simulated mixing and working of the mixtures as well as dynamic properties testing to evaluate the mixture's performance. For those mixtures that prove to be incompatible, the extra effort must be taken to thoroughly clean all traces of grease from the housing, supply lines and bearings/gears to ensure long life and reliable machinery operation.

Grease compatibility charts may seem to be a convenient way to make decisions based on actual or potential grease mixing. However, the unreliability of these charts and the complex interaction of base oils, additives and grease thickeners require that a more certain approach be employed for optimal equipment performance. The efforts to avoid mixing where possible and to test mixtures for compatibility issues as well as taking the appropriate actions will be an investment in reliability that will pay dividends. ■

19th NLGI-INDIA CONFERENCE REPORT

NLGI Serving the grease industry since 1933

National and international experts met at Varanasi during the 19th Lubricating Grease Conference to ponder on frontiers of grease technologies and the other issues looming large for the grease industry and even discussed the latest analytical and tribo techniques. The Conference was organised under the aegis of the National Lubricating Grease Institute (NLGI) - India Chapter. The attendees consisted of engineers, scientists, manufacturers, users of lubricating grease and gear oils and those involved in supplying raw materials, equipment and services to this industry. With more than 250 participants including 26 from overseas representing Austria, Australia, Hungary, China, Qatar, UK, Malaysia, Germany, France, Sweden, Italy and USA, 17 companies showcasing their equipment and innovations, 21 technical papers on areas such as grease composition & performance, specialty, additives & gear oils and case studies along with 2 business talks by Vanderbilt Chemicals, LLC and ExxonMobil Lubricants covering latest research in greases and its applications. The next conference shall be held in Amritsar (Punjab) in February, 2018.

SERVO AUTO OEM MEET

SERVO AUTO OEM MEET

Indian Oil Corporation Ltd conducted an All India SERVO Auto OEM meet on 10th Feb 2017 at Hotel Lalit Ashok, Bengaluru. Theme of the meet was - “Driving the Xtra Mile”

The meet was aimed at sharing and deliberating the latest developments in emission norms, fuel technology, lubricant technology, greener fuels, vehicle technology and after treatment devices. The purpose of this program was to strengthen relationship with valued customers and other stake holders and to position SERVO® as one stop solution for all applications in Auto industry. Sekhar Viswanathan, Vice Chairman and Wholetime Director, Toyota Kirloskar was the Chief Guest on the occasion.

ENOC EPPCO

Lubrication INSTITUTE www.lubrication-institute.com

ENOC (Emirates National Oil Company) a leading integrated energy company of UAE, along with EPPCO Lubricants, UAE conducted a 3 day In-House training program on "Essentials of Machinery Lubrication" for its sales and technical services team at its Learning & Development Centre in Dubai (UAE) from 19-21st Feb 2017. The graduation ceremony was graced by Mohammed El Sadek, Director-Lubricants Division who gave away the certificates to the participants. He emphasised the importance of training in today's context, where the competition is from several multinational companies with huge resources. After the completion of the training, a certification exam was conducted by ICML, in which 11 individuals qualified for various levels of certification. Congratulations to all participants and all certified professionals!!

PETROMIN
Performance From the Heart

Lubrication INSTITUTE
www.lubrication-institute.com

Petromin Corporation, a leading lubricant manufacturing and marketing company of Kingdom of Saudi Arabia (KSA) conducted a 3 day In House training program on "Practical Case Studies form Automotive & Industrial Sector" for its sales and technical services team in Jeddah, KSA. This was the third program organised in the last 2 years for Petromin Corporation by Lubrication Institute.

The training covered the following major subjects:

1. Higher engine oil consumptions
2. Varnish formation in turbine oils
3. Foaming in Industrial gear oils.
4. Extension of drain periods for engine oils
5. Premature Engine Oil thickening
6. Loss of pressure in hydraulic systems
7. Oil Analysis for monitoring lubricant health.
8. Selection of correct lubricant for specific application.
9. Importance of lubrication hardware selection. Etc.

A specially prepared "Lubrication Engineers Handbook" was also handed over to the participants, which would assist them during the customer site visits.

MD. AATIF | VAS TRIBOLOGY SOLUTIONS

ART AND SCIENCE OF BELT CONVEYOR LUBRICATION

Today, belt conveyors are among the most commonly used convening equipment in all walks of life, thanks to Thomas Robins for his series of inventions in 1892, which led to development of belt conveyor.

Working of belt conveyor is very easy to understand. Conveying of material is achieved by placing materials on an endless belt supported and driven by a combination of pulleys and idlers. Apart from mining application, belt conveyors are used in a host of industrial application and many other areas including at airports.

Belt conveyors are important and expensive equipment. To prevent unnecessary downtime, particular attention should be given to ensure its reliability. It is particularly important in a conveyor belt 'system' where a series of belts are used for material conveying.

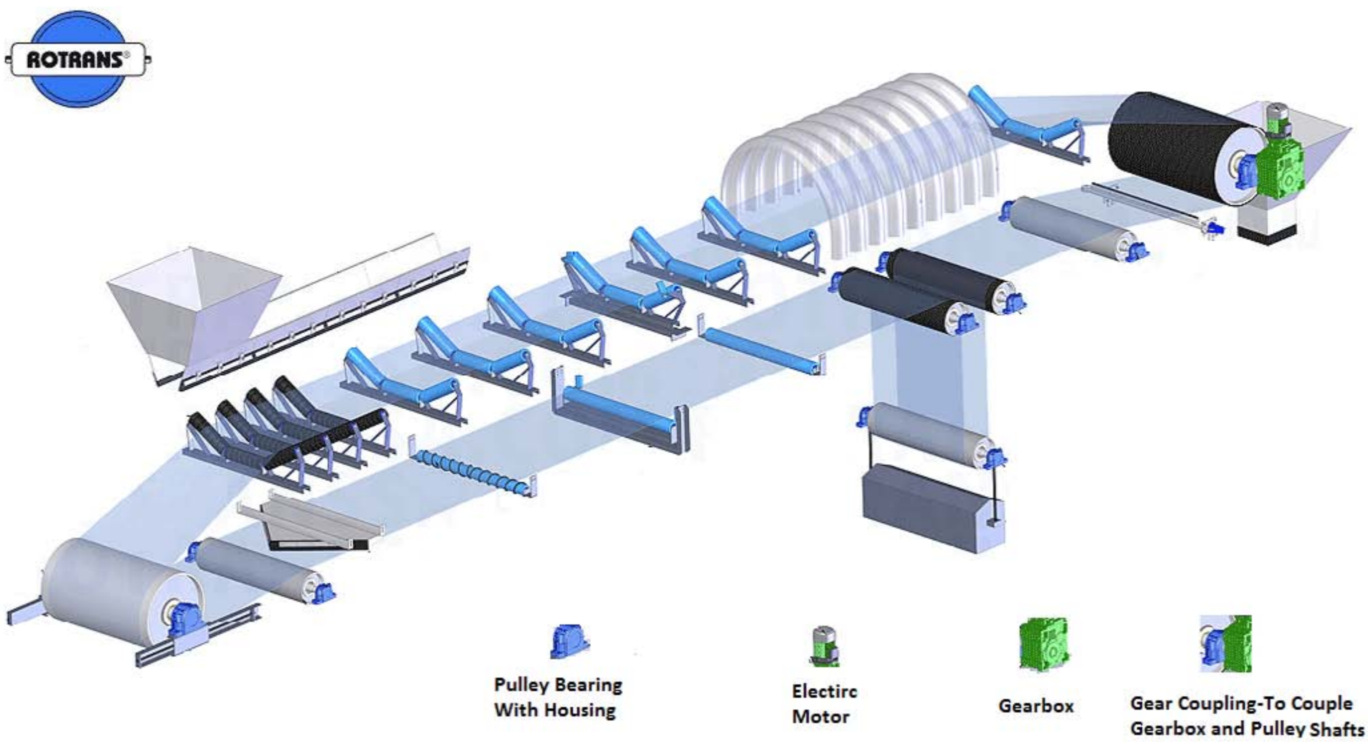
Although in a generic maintenance budget contribution of expenses occurred for lubricant procurement is only about 2-5% but if you look at the failures associated with the lubrication it may go up to 60%, depending upon the type of industry and prevailing maintenance practices. It is very important to understand not just the cost of lubricant but the total cost of lubrication.

A conveyor comprises of a variety of equipments where lubricants are applied. Each equipment has its own unique lubrication requirement. It includes drive motor, couplings, gearbox and pulley bearings. Idlers have sealed bearing which is lubricated for life. While ordering idlers, it is better to ask suppliers to have high quality grease in sealed bearings.

Courtesy-Rotrans S.A

Belt Pulley Bearing Lubrication

In a belt conveyor, pulleys are used in a variety of ways, to transmit power, change the direction of force or provide tension to the belt. Different names are given for each type of pulley like the one which drives the entire belt, called "head drum pulley", one at the tail end side, called "tail drum pulley", pulley for changing direction of belt is known as "bend pulley", providing additional force to maintain the grip called "snub pulley", and the one which provide tension in the entire belt known as "take up pulley". Each end of the pulley is supported by bearings on the shaft,



Belt conveyor and its parts. In this layout, motor and gearbox is used as a single unit and fluid coupling has not been used. Courtesy-Rotrans S.A

which require lubrication.

Lubrication of pulley bearings is not very complex. Pulleys rotate smoothly with negligible vibration. Rotation of bearing is slow. Operating temperature of well lubricated pulley bearings tends to be closer to ambient temperature.

Lithium complex soap based mineral oil grease has reasonably good oxidation and mechanical stability and can provide desired level of protection. Use of simple lithium soap based grease should be avoided and limited to non critical belt pulleys only. Base oil viscosity of grease can be in the range of 220-320 cSt.RPM of pulley bearings varies according to application. It is always better to select base oil viscosity based on DN factor (factor, representing peripheral speed). As most of the belt pulley bearings are subjected to heavy loading, EP additive (to provide sacrificial soapy layer on the asperities) based lubricants is helpful to provide protection at boundary lubrication condition.

Contamination Control is the Key

One of the most challenging aspects maintaining reliability of a pulley bearing is implementation of effective contamination control strategy. Pulley bearings are prone to contaminant ingression by numerous ways like ineffective sealing, missing grease nipples, contaminant ingression during grease application etc.

Most of the solid contaminants (ores, limestone, coal and other solids etc), being abrasive in nature not only causes additional friction and wear but also deteriorates the lubricant which negatively effects its performance properties.

Grease nipple, a tiny accessory installed on bearing housings for regreasing, is a very effective tool in helping in contamination control. Unfortunately its value is rarely realized by maintenance personnel. New bearing housing comes with grease nipple installed on it. Maintenance personnel need to ensure its usability. In many cases, it has been found that after initial installation with housing, it is not included in inspection/maintenance checklist. Often negligence causes these grease nipples to get either damaged or misplaced. As the nipples gets misplaced or damaged, contaminants around housing find their way to ingress inside bearing causing continuous degradation of lubricant and bearing surfaces. In some cases, instead of replacing grease nipple, cleaning cloth or cotton waste is used for blocking the open bore. Bear in mind that cloths or cotton waste are ineffective in stopping contaminant ingression. In extreme cases, nipple bores are left open, inviting ambient contaminant to easily ingress.

These practices are far away from the best and promote pulley bearing failures. To avoid contamination of grease during regreasing in such cases it is recommended to re grease bearing by using proper grease coupler (preferably 4- jaw) along with standard grease nipple. Contamination of lubricant can be further avoided by using grease nipple caps. It covers the tip of nipple which eliminates any possibility of contaminants getting inside through nipples. Colored nipple caps can also be used to identify the type of lubricant to be applied, avoiding cross contamination. Remember one can apply best lubricant on the pulley bearings but you will not get the best reliability until and unless you implement best contamination control strategy.

Another way how contaminants find their way inside pulley bearing is damaged housing seal. Often over greasing of bearing generates enough pressure to burst seal. These burst seals easily allow contaminants to enter inside the bearing. To avoid seal damage, regreasing quantity of each bearing should be calculated and fixed. Same quantity of grease should be applied while regreasing. During PM schedule, old grease should be cleaned out of the housing to create void space to accommodate fresh grease for regreasing. Housing seal replacement should be included in annual maintenance task.

Grease Nipples with Nipple Cap

End cover installed at the side of bearing housing is provided for protection of bearings against contaminants. If end covers are not installed, open housing end can cause heavy contamination of grease that can also lead to bearing failure. One must ensure that it is installed at the side of housing so that bearings and lubricants can be protected.

A very common myth in that lube technicians have is that while regreasing by using coupler and nipple, a lot of grease would leak out at the junction point. Upon close examination, you will find that either coupler or nipple was faulty. Nipple can have worn tip or damaged or stuck ball (which acts as NRV for grease inside bearing). Coupler may have loose or worn out jaws. It is always a good practice to keep sufficient inventories of grease nipples and couplers of different sizes along with other lubrication accessories.

If Lube techs are trained for lubrication best practices plant will get good return in the long run. They should be equipped with common cleaning accessories like cleaning brush, cloth and wire brush. Cleaning of bearing housings before regreasing should be a part of SOP.

Electric Motor lubrication

In a Belt conveyor, electric motor is used to drive (rotate) the belt pulley for its rotation to move the belt. As the rotation (RPM) of motor is normally higher than required for belt movement, Gearbox is used for reducing RPM to the desired level. Broadly, motor consists of two parts, stator and rotor. Rotor is the part which rotates due to rotating magnetic field of stator, in turn rotating the drive shaft of head rum pulley. Rotor of motor is supported on bearings (mostly rolling element) at both ends. In electric motors, mostly grease is used to lubricate these bearings. In grease lubrication is performed by base oil held by thickener, providing an oil film that prevents the harsh metal-to-metal contact between the rotating element and races.

Motor runs at higher rpm than the pulley bearings, so base oil viscosity requirement of motor bearing is lesser. For motor bearings, base oil viscosity for mineral based oil of around 90-110 cSt (at 40^{0}C) can be considered as an optimum value.

Another important aspect of motor grease is its additive package. Motor grease has to perform lubrication for a longer period of time hence should not oxidize very fast. ASTM D3336 can be helpful to compare the life of different greases at elevated temperature.

Biggest disadvantage of using general purpose (or belt pulley bearing grease) is presence of Extreme Pressure (EP) additives. Unlike belt pulley bearings, motor bearings are subjected to low contact loading, so requirement of such additives to provide sacrificial soapy layer on the asperities is generally not required. Traditional EP additives are found to be corrosive to yellow metals. These additives can react with the yellow metals (copper, brass, bronze) to cause continuous corrosion of surface. Electric motor winding part is made up of copper so there is a high risk of lubricant to come in contact with the windings (Due to over greasing or bearing seal damage) and consequent damage of windings. Winding damage can cause motor failure. It has been observed in many cases that the motor has failed due to contact of grease with the windings. Corrosion of the bearing cage and windings has also been reported in many cases due to over lubrication.

Consistency of grease is represented with NLGI number, for motor application NLGI 2 or 3 are required based on mounting position. Polyurea or Lithium complex based thickener is commonly used for motor grease formulation.

While regreasing, make sure that purge port located at the bottom side of bearing is clear to facilitate old grease to come out of the bearing. Hindrance in used grease to purge from bearing may cause excessive churning resulting in overheating, seal failure or even bearing failure.

Fluid Coupling

A fluid coupling is a device that uses fluid to transmit kinetic energy from one shaft to another. Main purpose of installing fluid coupling in conveyor belt is to avoid high initial torque which motor might experience during

CHECK LIST

Lube Technicians

1) Trained for lubrication best practices and negative effects of over greasing.
2) Has 'Standard Procedures' for every lubrication tasks.
3) Have access to sufficient lubrication and (lint free) cleaning accessories.
4) Knows the general specifications of every lubricant they handle.
5) Reward for achieving lubrication enabled reliability goals.

Conveyor Pulley Lubrication

1) Grease selected based on performance requirement and OEM recommendations
2) Regreasing done through adaptor and nipple.
3) Cleaning of bearing housing before regreasing,everytime!
4) Grease quantity calculated for each bearing.
5) Grease gun re calibrated on periodic intervals.
6) Bearing housing 'end cover' installed.
7) Bearing housing seal condition OK.
8) Pulley bearing housing protected against rain water (especially bend pulley).
9) Pulley bearing easily accessible for regreasing.
10) PM schedule for execution of grease change activity (cleaning old grease, and applying new grease)
11) Checklist for inspection of lubrication accessory installed on belt conveyors lubricated equipments.

Gear Coupling Lubrication

1) Use of special 'Coupling Grease' to achieve better coupling reliability.
2) Change and replace coupling grease at least once in a year.
3) Inspection of gear teeth to identify abnormal wear.

Electric Motor Lubrication

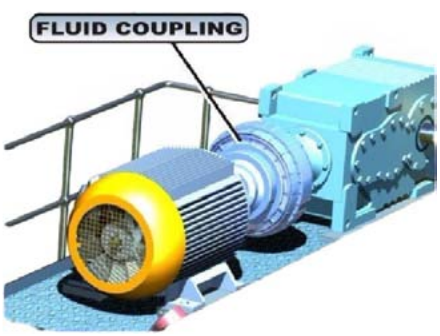
1) Use of Non EP 'Motor Bearing Grease'.
2) Purge port clear to facilitate old grease purging.
3) Apply calculated amount of grease in the bearing, or use of ultrasound assisted lubrication.
4) Regreasing through nipple and coupler only.

Fluid Coupling

1) Correct oil viscosity. (Follow OEM recommendations.)
2) Correct oil level. (Follow OEM recommendations.)
3) Sufficient cooling of coupling.
4) Periodic checking of oil quality and quantity.

starting. Fluid couplings use a primary mover (motor) and a driven machine (gearbox and head drum pulley of belt conveyor).It can also act as an overload protection device. At overloading condition, high temperature of oil causes the fusible plug to melt (~150^{0}C), allowing oil to be drained and decouple the drive and driven components.

Fluid coupling uses oil to transmit power. Selection of correct lubricant is an important parameter for efficient and reliable power transmission. During operation, a fluctuation in conveyor load gets transferred to coupling, causing slip and temperature



Assembly of a motor, fluid coupling and gearbox. Courtesy-CKIT

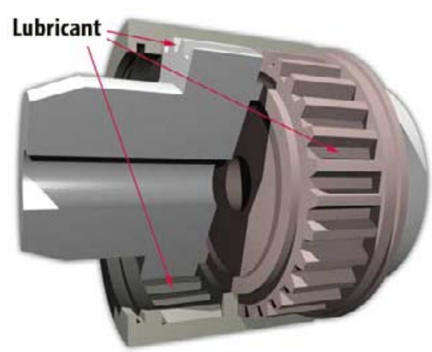
rise. Fluid coupling oil should have good thermal and oxidation resistance to minimize oil degradation under such conditions. Typical mineral based hydraulic oil used in plant is found to fulfill such performance requirements. Viscosity requirement of fluid coupling oil can vary in the range of ISO VG 32 to VG 68.

Coupling should be filled with optimum oil level. Coupling manufacturers mentions the exact amount of oil to be filled either in terms of volume or oil filling angle. Quantities of oil to be filled are calculated by manufactures based on power transmitted by coupling or by measuring the coupling slip and drive motor current. During oil filling oil has to be filled to recommended angle till it starts over flowing. Fluid coupling oil should be regularly checked for correct quantity and quality. Now a day's coupling manufacturers supply coupling having drain plug cum bull's eye type oil level indicator from which oil can be verified without opening the plug.

Gear Coupling

Gear coupling is used to couple two rotating shaft with the flexibility to bear minor misalignments. Two shafts are connected with the combination hubs and sleeves, having internal and external gear teeth. Interface of gear teeth which experiences low amplitude relative motion, require lubricant to reduce friction and wear. Gear couplings are mostly lubricated with grease, which should have performance property specifically designed to lubricate gear couplings. It should never be lubricated with general purpose grease.

General purpose 'EP2' grease or what people consider as 'Miracle Grease' found in every kind of industry which is used in almost every type of application. It should never be used for gear coupling lubrication. General purpose grease has thickener of higher density



Lubrication requirement of a gear coupling.

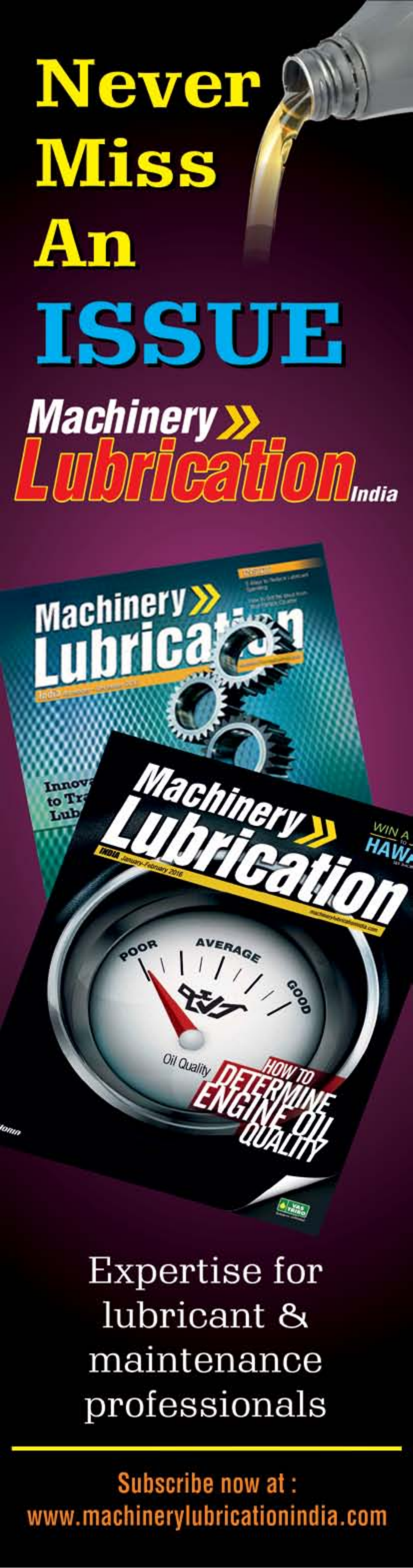
than the oil. At high speed condition, oil and thickener may separate, making it ineffective for providing protection of gear teeth. Additionally general purpose grease has base oil of around 200 cSt, which is not sufficient to form film and provide protection under heavy load conditions experienced by coupling teeth.

As the couplings are subjected to high loading, high base oil viscosity based grease is required to provide film thickness. Apart from film thickness, high viscosity oil due to higher cohesive force also helps in slowing oil leakages. Base oil viscosity for coupling grease varies in the range of 600-900 cSt. Most of the lubricant manufacturer mentions oil separation characteristics of coupling grease by following ASTM D 4425 method.

Coupling grease should have good tackiness/adhesiveness to make it able to stick to the coupling parts and resist centrifugal forces. Sliding contact coupled with high load can create boundary lubrication condition on the teeth surface; to provide protection at teeth surface Extreme pressure (EP) additives provide sacrificial lubrication film to minimize the effect of boundary lubrication. Grease used for coupling should have consistency of NLGI class 1. As far as grease thickener is concerned, lithium polymer thickener is commonly used for coupling grease formulation.

Author's Note: An easy to use checklist for ensuring effective belt conveyor lubrication is mentioned on page 25. Belt conveyor uses variety of gearboxes i.e., worm and wheel, multistage reduction, splash lubricated etc. Lubrication of these gearboxes will be discussed in upcoming issues of Machinery lubrication India.

About the Author: Mohammad Aatif is a mechanical engineer and is associated with VAS Tribology Solutions. He has experience and in depth knowledge of Cement and Power industry lubrication. He looks after Lubrication Program Development (LPD), a consulting vertical of the organization in the field of lubrication enabled reliability and holds MLA II and MLT I certifications through the International Council for Machinery Lubrication (ICML). Contact Aatif at mdaatif@tribologysolutions.com



TEST your KNOWLEDGE

This month, *Machinery Lubrication India* continues its "Test Your Knowledge" section in which we focus on a group of questions from Noria's Practice Exam for Level I Machine Lubrication Technician and Machine Lubricant Analyst. The answers are located at the bottom of this page.

1. With regard to the ISO cleanliness code system:

A) The higher the value, the dirtier the oil
B) The higher the value, the cleaner the oil
C) The target value should be 200-400 ppm
D) The target value should be as high as possible
E) This is only useful to monitor new oil purchases

2. Additives can become depleted by:

A) Oil flow
B) Decomposition and adsorption onto metal surfaces
C) Water evaporation
D) High pressure
E) They are not depleted

3. An oil's viscosity is measured to be 180 centistokes (cSt) at 40 degrees C. Which ISO grade is it?

A) 150
B) 180
C) 220
D) 180 ± 10 percent
E) None of the above

Answers

1. A
The higher the value, the dirtier the oil. On average, the number of particles in each ISO code range is double the number of particles in the previous one. For example, on average ISO 19/17/14 is two times dirtier than ISO 18/16/13.

2. B
Additives can be depleted due to decomposition where the additive molecules change irreversibly as in oxidation, thermal degradation, hydrolysis, etc. Another cause of additive depletion is adsorption in which additives adhere to machine surfaces or take a ride on particles or water. This is due to the fact that some additives are polar and are attracted by other polar elements.

3. E
As per ISO 3448 viscosity classification, the ISO viscosity grades are 2, 3, 5, 7, 10, 15, 22, 32, 46, 68, 100, 150, 220, 320, 460, 680, 1,000 and 1,500 centistokes at 40 degrees C. Since 180 centistokes at 40 degrees C is not among them, the correct answer is E. Each subsequent viscosity grade (VG) within the classification has approximately a 50-percent higher viscosity.

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WHY and HOW to Test New OIL DELIVERIES

Over the past 15 years, it has been stated numerous times in *Machinery Lubrication* that new oil is not clean oil, and yet while visiting 12 different plants during the last six months, I discovered that not a single one of them was sampling lubricants upon receipt. Since many of these organizations filter their oils before placing them into service, they probably think this additional step doesn't matter. However, though filtering oil will remove dirt and particles, there is so much more that could be wrong with the oils you are putting into your machines. For the sake of your plant's reliability, please read this article and heed the recommendations that it offers.

What Is Your Acceptable Quality Limit?

In statistical process control, the term "acceptable quality limit" (AQL) refers to the worst tolerable process average that is still considered acceptable. According to Wikipedia, this is "a test and/or inspection standard that prescribes the range of the number of defective components that is considered acceptable when random sampling those components during an inspection." These defects generally fall into three categories: critical, major and minor. The manufacturer usually determines which defects fall into which category.

What are your product quality controls? Is your AQL 95, 97 or 99.5 percent? Consider that the world's largest oil producer has reported production rates of 241,668,000 gallons of oil per day. Even with a 99.9-percent AQL, this means that 241,668 gallons of oil produced daily would have some sort of defect. Over the course of a year, this would total more than 88 million gallons of defective oil. While I'm not alleging that oil companies are producing millions of gallons of oil that is out of specification, it is a possibility.

> The possibility of receiving the wrong oil or lubricants that do not meet the required specifications is very real.

Of course, you can't know for certain if you don't sample and test your oil upon receipt.

Sampling and Testing New Oils

Hopefully, you now understand why you should be sampling and testing new oils, but how can you do this? Most of the issues that occur are related to the oil's viscosity, as opposed to the base oil type or additive mixtures, but this does not discount the benefit of a full quality test slate. Let's begin by discussing the simplest tests that can be performed and then move to the more complex.

Viscosity

A viscosity comparison is one of the easiest tests to perform. Many viscometers can also provide quick results, which is important since the delivery person will not be willing to wait around for a long time while you sample and test the oil. Although it would be obvious if you received an ISO 220 gear oil instead of an ISO 32 hydraulic fluid, can your eyes tell the difference between an ISO 32 and an ISO 46 or 68? Granted, moving up a grade may not have much of an impact on the equipment's operation, but going down a grade or two most certainly will. While you may not be able to distinguish between the two different viscosities, I can assure you that your equipment will.

The chart at the bottom of this page shows how a lubricant's film thickness increases by 62 percent when the viscosity is doubled. The reverse also applies. If you cut the viscosity in half, you reduce the film thickness by a comparable amount.

Particle Counting

A particle count is another easy test to conduct prior to the acceptance of a lubricant. Again, there are many simple-to-use, quick and fairly accurate particle counters available on the market. This test can give you a good idea of how much filtration will be needed prior to adding the new oils to your equipment.

Offsite Testing

The viscosity comparison and particle count tests can and should be performed onsite prior to accepting a lubricant delivery, as they can quickly reveal if something is wrong. However, neither of these tests provides a true indication that the product in the container matches what is on the label. To accurately determine this, a series of tests must be conducted. In most cases, this level of testing will require the sample be sent offsite to a laboratory.

Trust But Verify

Some lubricant suppliers offer oil analysis as part of their services. However, I warn you to not allow the fox in the henhouse. Although many who provide testing are honorable and do a good job, unfortunately some do not. If you send a sample from a new drum of oil to your supplier, it is in their best interest to "confirm" that drum is good. Likewise, if you send a sample of in-service oil, it is in the supplier's best interest to "determine" that it is bad and in need of changing out.

While serving in the U.S. Navy, I learned a tenet that Ronald Reagan was famous for saying: "Trust but verify." This expression applies here as well. I would suggest having a third-party lab on standby to help keep your supplier honest. Again, most are decent and

Incoming Oil Test Slate

The following is a recommended slate of tests for incoming oil:

Viscosity at 40 degrees C (ASTM D445)

Viscosity at 100 degrees C (ASTM D445)

ISO particle count (ASTM D7647)

Acid number (ASTM D664, D2896, D974, D3339)

Karl Fischer moisture (ASTM D1744 or D6304)

Elemental spectroscopy (ASTM D5185, D6595)

Fourier transform infrared (FTIR) spectroscopy (ASTM E2412)

Additional Tests by Fluid Type

Compressor, Gear, R&O and Turbine Oils

Color (ASTM D1500)

Foam stability/tendency (ASTM D892)

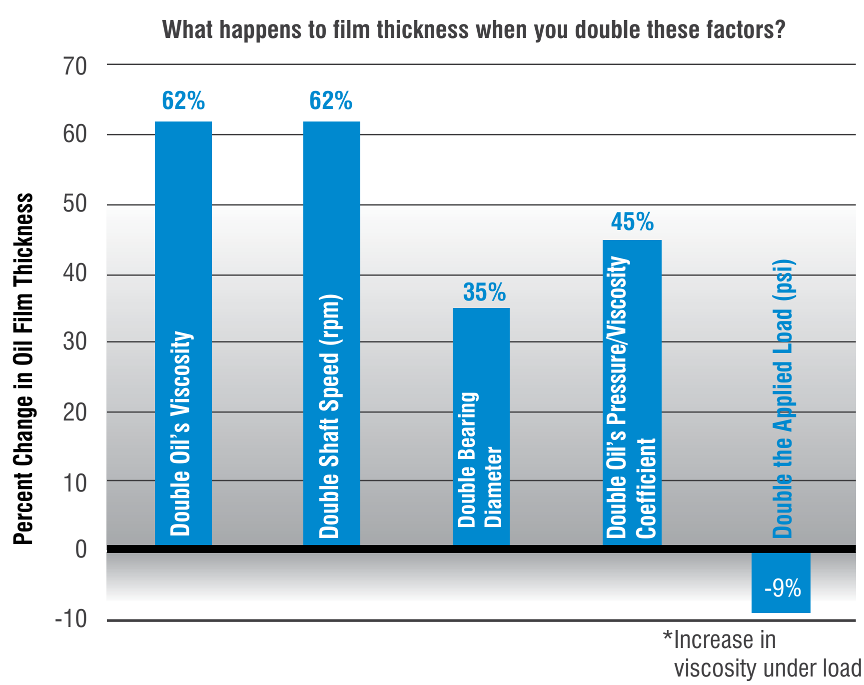
Demulsibility (ASTM D1401, D2711)

Linear sweep voltammetry (ASTM D6810, D6971)

Hydraulic and Motor Oils

Varnish potential (ASTM D7843)

RPVOT (ASTM D2272)



honest, but how will you know unless you follow Reagan's advice? You don't have to send every sample to an independent lab for verification, just enough to feel confident that the supplier is providing trustworthy analysis. I would also recommend visiting the supplier's warehouse and laboratory if possible.

How to Draw a Proper Oil Sample

Proper oil sampling will be essential for your oil analysis program to be effective. The question then becomes how can you draw a representative sample. The procedure below outlines the best practice for drawing a sample on a static container.

Preparation

Confirm that the port identification plaque corresponds to the work order. Next, remove the plug from the tank opening and clean the exposed ports.

Hardware Flushing

Insert one end of the new nylon tubing into the tank and the other end into the vacuum pump. Do not tighten the knurled nut on the sampler to allow air to vent during sampling. Loosely thread

on the purge bottle. Purge 10 times the estimated dead volume by pumping the vacuum pump. Loosen the knurled nut to stop flow and remove the flush bottle.

61%

of lubrication professionals do not sample or test new oil upon receipt, according to a recent survey at MachineryLubrication.com

Sample Bottle Preparation

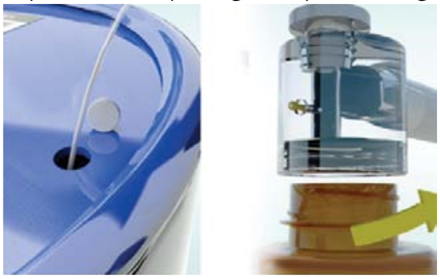
Open the sampling bottle. Tightly thread the sampling bottle onto the sampling pump (the nylon tubing end must puncture the bag).

Sampling

Extract the oil sample by pulling the vacuum pump handle. Fill the bottle no more than three-fourths full. Stop the oil flow by loosening the knurled nut to break the vacuum. Extract the tubing from the tank.

Labeling

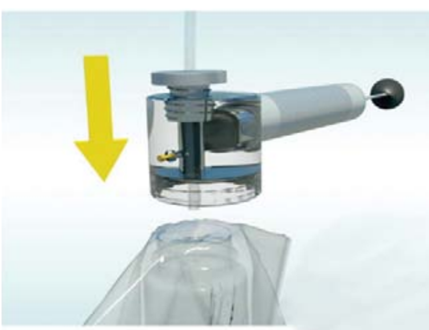
Unthread the sampling bottle from the vacuum sampler and tightly secure the cap without opening the plastic bag.



Write the required data on the label and attach it to the sampling bottle if not completed previously.

Cleaning

Detach the tubing and discard it. Clean the sampling pump and place it in a plastic bag. Wipe clean and reinstall the dust cap on the sampling valve. Wipe up any fluid that may have spilled on the machine. Dispose of the purged fluid, nylon tubing and any used lint-free cloth in accordance with the plant's environmental policy.



Hold Suppliers Accountable

It is critical to your oil analysis program that you sample and test oils upon receipt. The possibility of receiving the wrong oil or lubricants that do not meet the required specifications is very real. Consider how uncomfortable you become when one of your customers is delivered the wrong product or one that is of poor quality. What are the costs involved in getting that product back and replacing it? What are the hidden costs in the damage to your relationship with your customer? How many times can you make that mistake before it affects your reputation and business? Shouldn't you hold your vendors and suppliers to the same standard? Remember, they are not responsible for the reliability and uptime of your machines — you are. To fulfill this responsibility, you must ensure that you receive clean, quality lubricants for your equipment. ■

About the Author

Loren Green 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 I certification and a Machine Lubricant Analyst (MLA) Level III certification through the International Council for Machinery Lubrication (ICML). Contact Loren at lgreen@noria.com to find out how Noria can help you verify the cleanliness of new oil deliveries.

Lube-Tips™

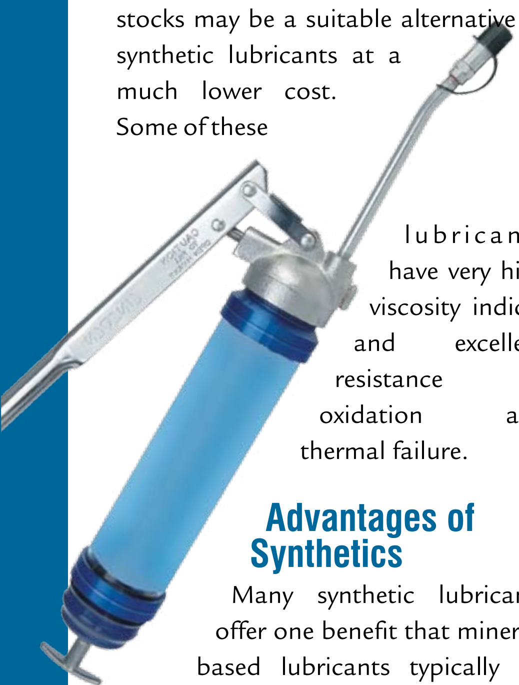
THE "LUBE-TIPS" SECTION OF *MACHINERY LUBRICATION* MAGAZINE FEATURES INNOVATIVE ideas submitted by our readers. Additional tips can be found in our Lube-Tips email newsletter. If you have a tip to share, email it to admin@machinerylubricationindia.com.

Avoid Suction Line Filters

Avoid the use of suction line filters because they can cause problems such as cavitation in the pump. However, be sure that the suction line at least has a protection strainer with a 200-micron rating to help keep small, hard objects from damaging or jamming the pump. Always check with the pump manufacturer before fitting any devices immediately upstream of the pump, as these can affect pump performance and lead to issues downstream in work-end components.

Lubricant Alternatives for Hot Applications

In hot applications, severely hydroprocessed and hydrocracked base stocks may be a suitable alternative to synthetic lubricants at a much lower cost. Some of these lubricants have very high viscosity indices and excellent resistance to oxidation and thermal failure.



Advantages of Synthetics

Many synthetic lubricants offer one benefit that mineral-based lubricants typically do not. Energy savings due to the lower frictional characteristics of certain synthetics can be found to be as high as 5-10 percent.

How to Calibrate a Grease Gun

It is very important to calibrate your grease guns. Many lube technicians don't know how much grease they are applying when using a particular gun. Some grease guns apply twice as much as others with the same single stroke of the gun. Every grease gun should be calibrated and labeled with the type of grease in the gun and the number of pumps per ounce, as well as dedicated to that grease alone. To calibrate, pump grease into a tablespoon until full. Double the number of pumps (shots) and you have pumps (shots) per ounce.

Advice for Storing Oil

Avoid the use of galvanized oil storage and dispensing containers. The zinc in the galvanizing can act as a catalyst to promote lubricant oxidation and premature depletion of critical additives. There are many other types of more chemically stable platings for metal containers. Stainless steel or plastics are also suitable alternatives.

Prevent Engine Failures with Coolant Analysis

A major mobile equipment manufacturer estimated that an average of 53 percent of all engine failures are a direct result of problems with the cooling system. Periodic coolant analysis, including glycol content, pH, conductivity, inhibitor analysis, visual inspection and resistance to corrosion, may be as valuable as routine oil analysis in preventing failure due to the cooling system.

Tips for Retaining Grease in Bearings

Inclined or vertical shafts can result in grease escaping from the bearing due to gravity. This will eventually lead to lubricant starvation and premature failure of the bearing. Consider using a grease with good adhesive properties of penetration class 2 to 3. In addition, a baffle plate, mounted in the housing below the bearing, will help to retain the grease where it is needed — in the bearing.

Keep Track of Filter Changes

For the do-it-yourself auto enthusiast, always write the mileage and date on the filter casing with a permanent marker when changing any filters on your vehicle. Also, be sure to record this information on the vehicle's service history docket. For the minor cost of an oil, fuel and air filter, frequent replacement will ensure a reliable and clean-running engine with added improvement in fuel economy.

Don't Forget Oil Sampling Ports

When specifying new equipment onsite, always remember to include the optimum primary and secondary sampling ports in the design. It saves time at this stage rather than after commissioning, when fitting the ports may be difficult. Work with the original equipment manufacturers and let them know your particular needs for the type of sampling valve, etc.

"What could be the reason for a hydraulic pump failure and how can we prevent such failures in the future?"

A hydraulic pump failure can be caused by a number of factors. There are several different types of pumps available on the market, and each can have its own specific failure mode. Of course, certain failure modes are common to all types of pumps. Some of these failures can be caused by poor system design, using low-quality fluids and/or poor contamination control.

The best way to prevent future failures is to ensure that you are using quality hydraulic fluids. Keep in mind that the fluid is the single most important component of a hydraulic system, so always use high-quality hydraulic fluids with the correct viscosity.

Hydraulic fluids should also be kept clean, cool and dry. This is very important. One of the ways you can do this is through quality filtration. Filters should be selected only if they achieve the target cleanliness levels that have been set for the fluid in the system. Also, use quality filters in locations that assure the required protection and upgrade the filters when necessary.

In addition, consider the possibility of using offline filters, because the cost of removing dirt is often much less in an offline mode than trying to do everything in a pressure-line filter location on the hydraulic system.

It is estimated that between 70 to 80 percent of hydraulic system failures are from contamination, with particle contamination making up the largest portion. Therefore, it is best practice to regularly perform oil analysis with particle counts.

Remember, the hydraulic pump is generally the most expensive component on a hydraulic system. It has the highest reliability risk, the highest contaminant sensitivity risk and the ability to cause chain-reaction failures. In other words, when the pump begins to fail, it starts to kick out debris into a debris field downstream of the pump. If there is not a good filter downstream, this debris moves on to other

components like valves and actuators, and can lead to damage in those components as well.

Be wary of quick-fix solutions like switching to costly synthetics and expensive filtration systems. Instead, provide solutions to the problems that exist. It is critical to set the proper cleanliness and dryness targets and to develop contamination control procedures that will allow you to meet those targets. By doing so, you should greatly reduce and possibly eliminate your pump failures.

"What does spike energy indicate?"

Spike energy is a term more associated with vibration analysis than with any of the other predictive maintenance technologies. Basically, as a machine begins to fail and the interior working surfaces degrade, varying levels of vibration emanate from the bearing while wear progresses. Spike energy is the high frequency levels of the vibration being produced by the "ringing" of the internal surfaces rubbing together.

As with any predictive technology, the power is in the vigilant monitoring of the equipment. To get the maximum return, you should establish a baseline when the machine is first put into service. This will serve as a point against which all future results will be compared.

As wear continues, the level of vibration or "noise" will trend upward. By understanding the natural frequency of the metals that are degrading, you can begin to make calculated guesses at the amount of wear as well as the relative life remaining in the component.

This can be related to trending wear debris with oil analysis. When a machine is put into service, the first sample is usually the cleanest in terms of wear debris. While contaminants such as dirt and water are introduced into the system, the surfaces begin to degrade and produce more wear debris. By tracking not only the amount of wear debris but also the rate of generation of these particles, you begin to get a better picture of the degradation rate and the machine's overall health.

With oil analysis, you have the added benefit of looking at wear debris shapes to monitor wear and diagnose the root cause. It is harder to do this when simply using vibration.

Consistency is paramount to catch any incipient machine failures and to accurately predict machine health. If you are using vibration to monitor wear generation or a machine's failure modes, you must capture the vibration results from the same spot on the equipment each time it is to be monitored. The same is true

for oil analysis. To trend properly, you must sample from the same location using the same procedure each time a sample is extracted.

In a world-class facility, you wouldn't simply rely on a single technology to accurately predict the wear and failure of machine parts. Vibration is a powerful tool, as is oil analysis. When you merge the two together, you get a much clearer picture of what is happening inside the machine and can better predict when a failure might occur. Be sure to integrate all of your predictive maintenance systems for maximum reliability.

If you have a question for one of our experts, email it to admin@machinerylubricationindia.com

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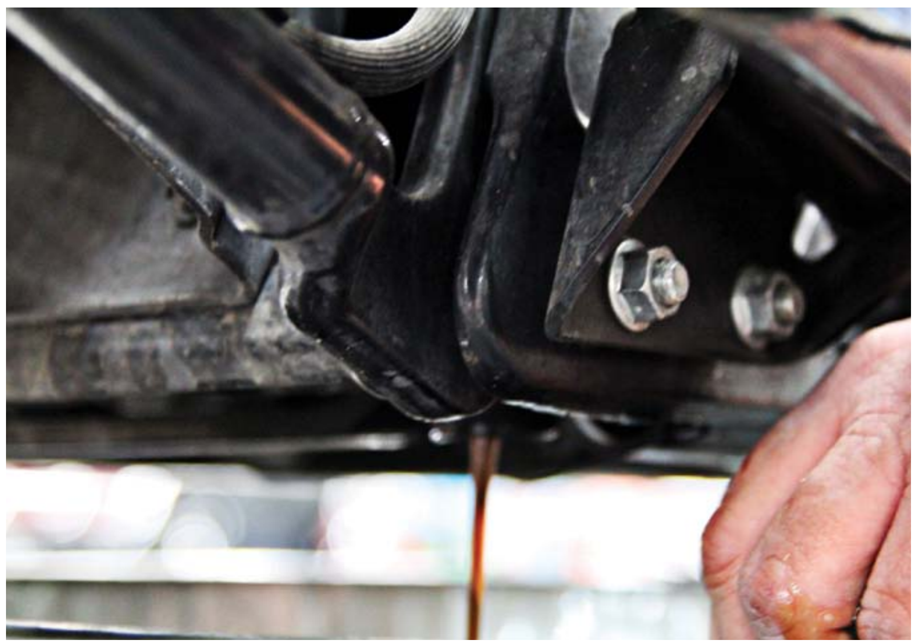
TIPS for Better MOTORCYCLE Lubrication

I always knew it was my destiny to own a motorcycle. I grew up near the Starved Rock State Park in Oglesby, Illinois, where it seemed you could find a group of motorcyclists riding together at any time. I can still recall the distinct sound of a Harley as it fired up and the high-pitched zoom of a sport bike speeding toward the curves ahead.

Those memories would lead me to buy my first motorcycle. I distinctly remember the day I brought her home. Excited as a child on Christmas morning, I had to wait a few months before I could go on my first ride, since my purchase was in mid-February and I was living in Wisconsin at the time. The wait seemed unbearable, but over the next couple of months, I was able to research how to properly maintain my bike.

It was at this point that I became more confused than ever. The owner's manual seemed to clearly indicate which oil to use and at what interval to change the oil, as well as how to store, winterize and get my bike rolling again in the spring. The chaos began when I joined a motorcycle forum. Everyone had an opinion on which oil was best. Since these forum members were older than I was, I figured they must have known what they were talking about.



Based on their recommendations, I headed to the local motorcycle shop and proceeded to purchase the first oil for my motorcycle. I was then stopped again by the man behind the counter, who had his own opinion on what oil would work best in my bike. Faced with many different choices of oils and their claims, I decided to go with the recommendation from my fellow forum riders.

Fast forward a few years. I now find myself in the lubrication field, gaining knowledge from various sources and applying it to plant applications. I've somehow become the expert my friends and colleagues come to for advice about their own cars and motorcycles. Their questions typically include which oil is best, what viscosity grade to use and if a synthetic or conventional oil is better. These were the same concerns I had only a few years earlier.

Indeed, there are many considerations when selecting an oil for your motorcycle. As with anything new, you should start first by reading the owner's manual.

Manufacturer Recommendations

Important details like the oil change interval should be listed inside the owner's manual. For my first motorcycle, the manufacturer recommended an interval of one month or 950 km for the initial oil change, which can be the most critical one in the bike's lifespan. It allows any break-in wear and manufacturing debris to be drained from the engine and discarded. The manual should also specify the appropriate oil viscosity for different temperature ranges. My manual suggested using an SAE 10W30 for temperature ranges of -12 to 33 degrees C. For temperatures of 4 to 98 degrees C, the manufacturer's suggestion was an SAE 20W40. In addition, the selected oil had to meet the American Petroleum Institute's service designation of SG or higher as well as the MA standard by the Japanese Automotive Standards Organization (JASO).

Other key findings in my user's manual included information about not using diesel-specific oil with an American Petroleum Institute (API) classification of CD or higher. In bold letters, it stated, "Do not use oils labeled Energy Conserving II or higher." The main reasons for this statement were because of my motorcycle's wet clutch and the friction modifiers that energy-conserving oils use, as they can lead to premature clutch wear due to clutch slippage.

Understanding Viscosity

Viscosity is defined by the oil's resistance to flow and shear. The higher the viscosity, the more viscous the fluid. The lower the viscosity, the easier the fluid flows. With motorcycle oils, the viscosity grade is represented by the SAE grading system. The higher the grade, the more viscous the oil.

Temperature has a significant impact on an oil's viscosity. Take honey, for example. At cold temperatures, honey flows very slowly, meaning it has a high viscosity. If you apply a heat source, the honey will flow easier, changing its viscosity. With a higher viscosity, oil has increased load-carrying capabilities.

It's best to choose a **viscosity** range based on **where** and **how you ride.**

It is essential to understand viscosity when selecting a motorcycle oil. Viscosity is an oil's most important physical property. The viscosity is what keeps the internal surfaces of your engine from coming into contact with each other. If the viscosity is too low, the gears inside the gearbox will come into contact and produce friction, leading to higher oil temperatures, decreased gear protection and increased wear. If the viscosity is too high, it may take longer for the oil to reach the cylinder walls, resulting in wear. Selecting the right viscosity requires a balance between the seasons, regional temperatures and the type of driving the rider will be doing.

Decoding the SAE Grading System

Rarely are monograde lubricants used for motorcycle applications. A monograde oil is represented by a single designation, such as SAE 40. These oils have a much narrower operating temperature range than that of multigrade oils.

With motorcycles and the broad range of temperatures in which they are driven, you will need an oil that can provide protection at colder and startup temperatures but also offer protection once the engine is hot. This can be achieved with a multigrade oil.

For my first motorcycle, the manufacturer suggested using an SAE 10W30 oil. The "SAE 10W" signifies that the oil will act as a 10W grade at colder temperatures. The "W" stands for winter. Having a lighter viscosity fluid is crucial on startup so that all internal components are lubricated quickly, reducing the amount of wear. The "30" in the designation is a measure of the oil's viscosity at 100 degrees C (212 degrees F). This indicates how thick the oil will be at the engine's operating temperatures.

Motorcycle-specific Oils vs. Automotive Oils

One of the main differences between a motorcycle engine and an automobile engine is that motorcycles typically use a combined sump for the transmission and engine. Automobile oil formulations generally have special friction modifiers blended in to increase fuel mileage and decrease wear. In a wet sump application, these friction modifiers would interfere with clutch performance. I've heard the argument that motorcycles have higher engine temperatures and speeds, but I don't believe this plays a major factor in oil selection. Instead, a

motorcycle oil should be chosen for the intended application or at least meet all the service designations.

In 1998, JASO introduced a rating system for motorcycle oils. Previously, the majority of motorcycle oils utilized automotive oils as a base. As automobile manufacturers began requiring more friction modifiers be used in their vehicles, these formulations caused clutch slippage and gearbox pitting. JASO specified four grades: JASO MA, MA1, MA2 and MB. The first three (with the designation of MA) signify that the oil is intended for a four-stroke motorcycle with an oil sump for the engine, gearbox and clutch. MA fluid is non-friction modified. If an oil is rated at MA, it means the oil's test results were between MA1 and MA2 standards. JASO MB grade oil is also designed for four-stroke motorcycles but has lower friction properties. These oils are not to be used where a service designation of MA is required.

Synthetic vs. Mineral

When choosing between synthetic and mineral oils, you must understand what makes the two different. Mineral or conventional oils are refined from crude oil and separated into API classifications of Group I, II and III. The higher the classification, the more refined the oil. Due to the refining process involved with Group III mineral-based oils, lubricant manufacturers can legally market these oils as synthetic even though they do not have a true synthetic base oil.

Synthetic oils hold an API classification of either Group IV or V. Synthetics are man-made fluids with uniform oil molecules. Their viscosity generally remains more consistent across a broader operating range, which means they are ideal in colder conditions and high heat applications.

An oil's change in viscosity with respect to a change in temperature is known as its viscosity index (VI). The higher the viscosity index, the less change in viscosity of the oil. Synthetic base oils are known to have viscosity indexes of 150 and higher.

Multigrade mineral oils are formulated with viscosity index improvers. While this makes the oil useful over a broader operating range, it can also have drawbacks, such as with the shearing of the viscosity index improver. At higher temperatures, these viscosity index improvers shear down faster and allow the oil to degrade quicker. For instance, an oil that began its life as an SAE 10W40 could break down to an SAE 10W30 or thinner.

56%

of lubrication professionals do not know what to look for when selecting a motorcycle oil, according to a recent survey at MachineryLubrication.com

Synthetic base stocks have few if any viscosity index improvers but are still able to achieve multigrade requirements. Lubricant manufacturers blend in more performance and longevity additives to make the oil last longer, decrease wear and provide better mileage. The improved mileage and horsepower come from the oil molecules being uniform and in reducing the amount of fluid friction within the lubricant film.

Selecting the Right Oil

In conclusion, it's best to choose a viscosity range based on where and how you ride. For me, the perfect selection is an SAE 10W40 synthetic, as I like to get in a few last-minute rides before storing the bike for winter but also need protection for when temperatures reach 100 to 110 degrees F during summer. People who ride in Texas may require added protection on the upper end of the scale but not so much on the lower side. For those who ride up north in places like Wisconsin, an oil with a good cold range should be considered. I don't discourage anyone from using a conventional oil in their motorcycle. The choice is completely yours. For me, I prefer the comfort of knowing that I can get a little longer out of an oil change. In the end, always try to select an oil that's right for you and your bike.

About the Author

Garrett Bapp is a technical consultant with Noria Corporation, focusing on machinery lubrication and maintenance in support of Noria's Lubrication Program Development (LPD). He is a certified lubrication specialist through the Society of Tribologists and Lubrication Engineers (STLE) and holds a Machine Lubrication Technician (MLT) Level II certification through the International Council for Machinery Lubrication (ICML). Contact Garrett at gbapp@noria.com.