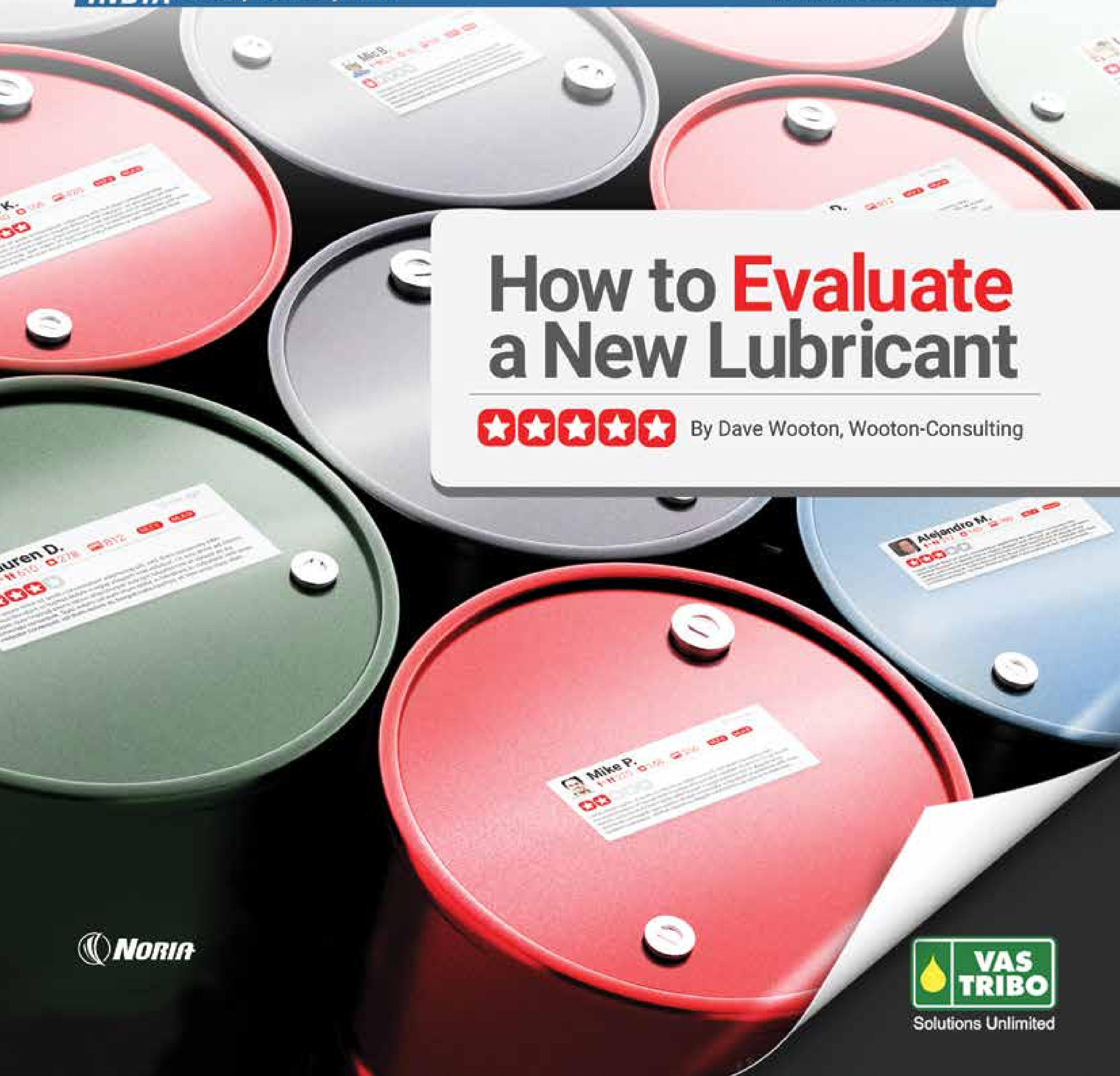
Machinery Lubrication

INDIA January-February 2018

machinerylubricationindia.com



How to Evaluate a New Lubricant

By Dave Wooton, Wooton-Consulting

Lubrication INSTITUTE
www.lubrication-institute.com

NORIA Skill Training

On-Site (Private) Training

We deliver customized training programs to meet your unique requirements. We'll provide expert instructors at a time and place most convenient for your group. Whether you have 5 or 500 people to train, We are the answer.

Online Training

Create your own flexible schedule to learn machinery lubrication and oil analysis best practices with self paced online training solutions. Get access for one full year and login from any computer any time any where 24x7

ICML Certification testing is available after all the courses.

ASIA'S ONLY COMPREHENSIVE LUBRICATION SERVICES COMPANY

Program Schedule for 2018

Essentials of Machinery Lubrication

COLOMBO (Srilanka)
20-22nd June

DELHI (India)
28-30th June

DHAKA (Bangladesh)
26-28th Nov

KOLKATA (India)
29th Nov - 01st Dec

Advanced Machinery Lubrication

MUMBAI (India)
19- 21st Nov

Oil Analysis Fundamentals

MUMBAI (India)
25- 27th June

Advanced Oil Analysis

MUMBAI (India)
22- 24th Nov

To Register Or For More Details Visit
www.lubrication-institute.com or
Call : +91 - 9431117604
E-mail: info@lubrication-institute.com

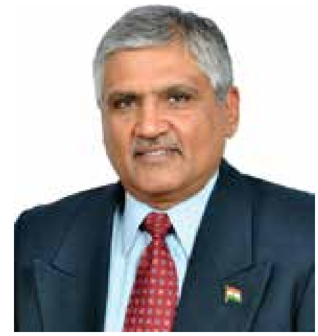
VAS TRIBO
www.tribologysolutions.com
Solution Unlimited

Scan To Know More

Contents

Machinery Lubrication
January-February 2018

Publisher's Note



Across the world, lubricant oil is primarily used in automobile engines, marine engines and for industrial purposes. Globally, more than 50% of the total lubricant volume is being used for automobile, around 40% is for industrial purpose and rest is for marine and other applications.

In the coming days, global demand of lubricant will remain stagnated or grow at a very low rate due to reasons like Low emission norms for industries and automobile sector, Advancement in engine oil technology, Use of high performance oil, and Saturation in automobile sector for developed countries. Currently, USA is the largest consumer of lubricant oil across the world. China and India comes at second and third position respectively.

The consumption pattern in Indian lubricant oil industry is similar to world lube industry. Majority of lubricant is being consumed by automobile sector (55%); rest is being used for Industrial purpose and marine industry.

Major PSU players of the Indian lubricant oil industry are IOCL - Servo, BPCL-MAK, HPCL-Turbo. These three players approximately hold 50% of the market share in Indian lubricant industry.

In 1993, lubricant industry in India got liberalized, which attracted the private players to enter into the Indian lube market. Before liberalization auto lube oil in India was sold mainly through petrol filling stations. Decline in margin due to rising base oil (main raw material for lubricating oil production) prices, increasing competition due to large number of private players, very low consumer awareness about the brands and quality and too much price sensitivity has led Indian lube oil industry to a major marketing challenge for the companies involved with it.

Distributors are the important channel partner for sales of any product. Robustness of distributor plays a major role. In case of lubricant oils there are few important roles of a distributor like Market Information, Buying and Assortment Building, Selling and promotion, Customer Relations, Risk Bearing, Branding, Financing, and Warehousing & Transporting Management of Distributors Sales Representative.

Company which is able to come up with good promotional offer for their dealers and mechanics wins the battle. Some of the major problems faced overall in the market are Delivery time from distributor to dealer, tracking of the scheme issued to dealers or mechanics, proper use of branding materials.

In India, a product can't be placed in the market on the basis of brand only, but it should match the spending power of customers. An industry where switching cost is negligible, person relationship plays an important role to capture maximum market share. Regular schemes have become part of the lube market. Not only the product, but also the superior service differentiates one company from another. An efficient distribution channel as well as hard working sales team drives a company on front foot.

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

We welcome your suggestions and feedback.

Warm regards,

Udey Dhir

JIM FITCH | NORIA CORPORATION

Make the LUBE ROOM Your Lubrication COMMAND CENTER

For any plant seeking lubrication excellence, there needs to be a visual starting point that sets the stage for what's to come elsewhere in the facility. There is no better place for that than the lube room. In fact, I've never heard of a plant exhibiting excellence in machinery lubrication that doesn't also exude excellence in the lube room. The lube room serves as the centerpiece and reference state for lubrication excellence. You have to get it right.

This is important because transformation can take a while for large plants. Rome wasn't built in a day. To succeed, you must have a solid foundation and a constant reminder of what quality and success should look like. It effectively punctuates that this standard of excellence should be replicated at each machine where lubricants are in use. There's a huge and very important psychological element here.

If you cut corners in the design and quality of your lube room, more critical corners will be cut elsewhere in the plant as well. Mediocracy becomes the norm and will be imbedded in the culture. When this occurs, the lube room transforms into a pigpen of tools, pumps, hoses, grease guns, bottles, totes and drums. Don't let that happen. Be fussy and demanding, and set a high standard that encourages reliability excellence throughout the rest of the plant.

The False Economies of Cheap

Experts agree that the best way to overcome a catastrophic machine failure is not to have one. However, those in the maintenance field understand that machine reliability comes at a price. On the one hand, focusing on machine reliability alone may fail to control wasteful and excessive expenditures. To the other extreme, initiatives that slash current maintenance expenditures without considering long-term reliability consequences are frequently penny wise and pound foolish.

Poor reliability and premature machine failures have a compounding financial impact. Half-heartedly measuring one element will spread like a cancer when measuring something else. Don't get me wrong, excellence comes from optimum choices and certainly not wasteful or unnecessary choices. Precision lubrication means a state of not too much and not too little. You want a lean, optimum state of excellence. The operating conditions and need for reliability define the optimum state.

The lube room is the perfect place to display and emphasize the best example of optimized lubrication excellence. A big part of excellence is not the result of money spent, but rather a high state of tidiness, attention to detail, quality and organization. The lube room should be a showcase of what enables machines to run reliably and at the lowest possible cost. It should be a place of pride and a glaring statement of strong and effective lubrication and reliability values. It should represent and instill the rights of lubrication.

Conspicuously Display Excellence in Practice

Use the walls of your lube room as bulletin boards to display and emphasize critical messages, especially the need for change. Don't assume lube technicians and other maintenance staff members remember and understand the tenets of lubrication excellence. They may have been told during training, but it doesn't mean they remember or will readily change the way work is done in the plant.

Lube room walls and bulletin boards should paint a clear picture of what is needed and expected. They are your front page and masterplan for change. Examples of what can be displayed as frequent reminders of your critical messages include housekeeping policies, safety policies, new standardized work procedures and tasks, training posters and wallcharts, and machine and lube room inspection tips.

Consider showing annotated photos of best practice and perhaps what is no longer allowed. Some companies use TV monitors to loop training videos on such things as oil sampling, contamination control, grease gun procedures, inspection tips, storage and handling methods, etc.

Don't Forget Metrics

Use the lube room as a command post to display key performance indicators (KPIs), including leading (what's going to happen) and lagging (what just happened or is happening) indicators. In all work environments, people need to know what's important and what's being measured. Metrics shape and define an organization.

We've all been subject to various measurements since childhood. Those early experiences ranged from the winning score of a little-league baseball game to the painfully serious day we brought home a low grade on a school report card. We learned that what counts is what is measured. We are what we measure.

Use the lube room to focus and celebrate the work that enables lubrication excellence. Construct a group of metrics and KPIs designed to stress the importance of doing just that. I'm always curious to see the charts and graphs that are posted by managers, often on bulletin boards outside their offices. A quick glance can tell you what defines the performance goals of the team that he or she manages.

Oil and grease analysis are metrics on the state of lubrication and machine reliability. Condition monitoring metrics such as these should not be lost on a computer hard drive or in files inside a desk drawer. Instead, key data must be on display in real time to communicate all non-conforming conditions as well as successes from well-behaved and

Machinery Lubrication India

Publisher
Udey Dhir - udeydhir@tribologysolutions.com

Creative Director
smassociates@gmail.com

Advertisement Sales (India)
ads@machinerylubricationindia.com

Advertisement Sales (US/Canada)
Tim Davidson - tdavidson@noria.com

Advertisement Sales
(All Other Countries)
ads@machinerylubricationindia.com
admin@machinerylubricationindia.com

CORRESPONDENCE
You may address articles, case studies, special requests and other correspondence to our

Operation office :

Editor
213, Ashiana Centre, Adityapur,
Jamshedpur-831013, India
email : editor@machinerylubricationindia.com
Tel: +91-657-2383238
Tel:(USA): +1-918-960-9738

Marketing Office
Rider House, 136,
Sector 44, Gurgaon-122003, Haryana
National Capital Region, India

Machinery Lubrication India Volume 32 - Issue 1, January - February 2018 is published bi-monthly by VAS Tribology Solutions Pvt. Ltd. Operation Office:213, Ashiana Centre, Adityapur, Jamshedpur-831013, India.

SUBSCRIBER SERVICES: The publisher reserves the right to accept or reject any subscription. Send subscription orders, change of address and all related correspondence to: VAS Tribology Solutions Pvt. Ltd. Operation Office:213, Ashiana Centre, Adityapur, Jamshedpur-831013, India.

strongly earned data. Such awareness enables control and sustainability of program goals.

Machine categories can be grouped together to show broader plant performance. Use control charts to display oil analysis trends such as particle and moisture trends, viscosity analysis, elemental analysis, ferrous density, and varnish potential. Big-picture metrics should also be added, including PM route compliance, contamination control compliance, overall lubrication effectiveness (OLE) and percent planned maintenance.

Don't Overlook Intangible Benefits

When people do bad work, they feel bad about themselves and their job. Likewise, when people do good work, they feel good about themselves and their job. Training, empowerment, housekeeping (tidiness), tools, culture, documentation, measurement, communication and machine readiness all enable good work. Reliability doesn't happen by itself. There is a human-behavior element that is critical.

What happens when you have a world-class lube room that is clean, organized and complete with everything needed? It telegraphs a subtle message to lube techs, operators and others performing maintenance tasks that quality work in the plant is recognized as important. Furthermore, it broadcasts a statement that management will invest in excellence and expects work to be done to the same standard. The culture of excellence becomes a contagion that spreads and is soon engrained in everyone. At last, the "people part" of lubrication excellence gets under control.

The lube room provides that necessary starting point — square one. When you have a high-quality lube room, you finally begin the process of getting high-quality, sustainable lubrication at the machine. This translates to far greater attention to detail when performing lubrication tasks, more intense inspections, better oil samples, cleaner machines inside and out, etc. Your lube room becomes the command center or mission control for lubrication excellence.

About the Author

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

Read More on Improving Your Lube Room

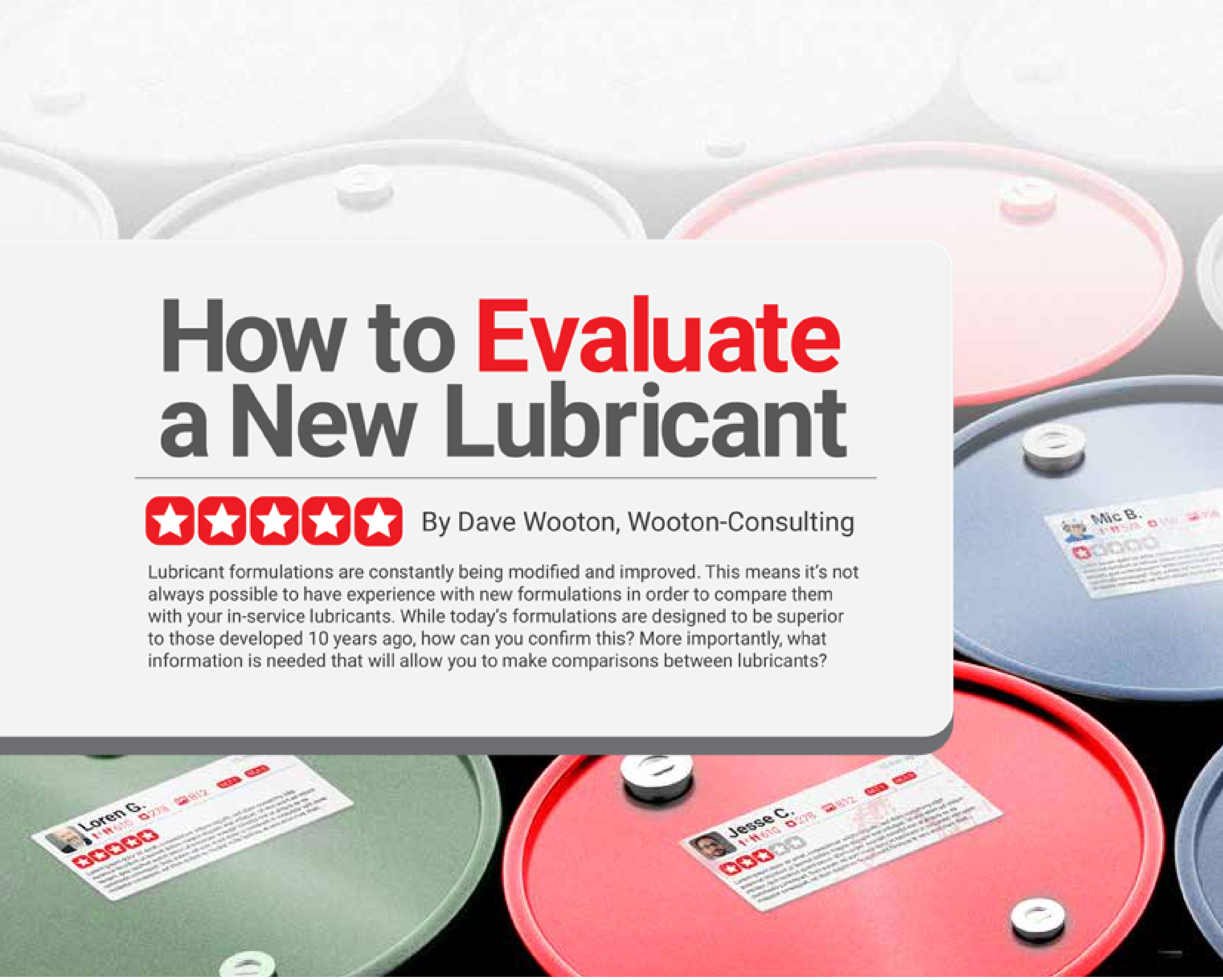
For more information on how to achieve a world-class lube room, visit MachineryLubrication.com. You will find numerous articles that have been published through the years on this important topic. To help narrow your search, the titles and web addresses of some of the most popular articles are listed below:

- Is Your Lube Room Up to Par? (http://www.machinerylubrication.com/Read/1133/lube-room)
- Constructing a World-Class Lube Room (http://www.machinerylubrication.com/Read/536/constructing-lube-room)
- Lube Room Essentials and Best Practices (http://www.machinerylubrication.com/Read/29008/lube-room-essentials)
- 5 Steps to Improve Your Lube Program (http://www.machinerylubrication.com/Read/1315/improve-lube-program)
- Designing the Optimum Lubricant Storeroom (http://www.machinerylubrication.com/Read/212/lubricant-storeroom)

How to Evaluate a New Lubricant

By Dave Wooton, Wooton-Consulting

Lubricant formulations are constantly being modified and improved. This means it's not always possible to have experience with new formulations in order to compare them with your in-service lubricants. While today's formulations are designed to be superior to those developed 10 years ago, how can you confirm this? More importantly, what information is needed that will allow you to make comparisons between lubricants?



This article will describe industry-accepted tests for predicting lubricant life, including results from real commercial lubricants. Many of these tests are used by formulators when designing and evaluating new lubricants. Comparing and analyzing these actual test results will reveal how to examine information from various resources and help you make better decisions about your lubricants.

The Lubricants

The lubricants in this study were turbine oils, which fall in the category of rust and oxidation (R&O) fluids. The samples tested included one polyalkylene glycol (PAG) oil and three different mineral oil formulations. The mineral oil formulations were chosen from a list of commercial products based on the American Petroleum Institute's Group II and II-Plus base stocks. They consisted of an older formulation, a new formulation and a new premium formulation. The PAG formulation was based on a Group V (synthetic) base stock. There are three types of synthetic PAG oils: water soluble, water insoluble and oil soluble. This study focused on water-insoluble PAG turbine oil. To complete the study, in-service lubricants were also obtained for these formulations if available.

The Tests

Since newer lubricant formulations may not have been in operation long enough for a comparable long-life measurement, bench aging tests are often used. The industry's accepted aging tests include ASTM D2272, D2619 and D665(A). The lubricants in this study were aged by these standard test methods to assess their suitability for operation first as new lubricants. After the aging tests were performed, the lubricants were measured to determine their condition. The second group of analytical tests included ASTM D5185, D6304(C), D665(A), D974, D2272, D1401, D6971, D7414, D7843 and D892.

Compatibility

The first consideration when changing

lubricants is whether the new lubricant and the in-service lubricant are compatible. This issue can impact flushing and change-out decisions as well as result in significant costs. Group V synthetics are often thought to be incompatible with Group I-IV hydrocarbon fluids. This should be the first issue addressed, but it is also one of the easiest to answer. ASTM D7155 explains how to test fluids for compatibility.

In this study, lubricant ratios of 90-to-10 and 95-to-5 were tested using two different Group II lubricants with the Group V PAG lubricant. These are the typical contamination levels observed during a lubricant exchange.

Visual Compatibility

Visual compatibility was the first phase of the compatibility testing. The lubricants were observed after they were blended and stored for three to five days. ASTM D7155 describes how to study samples and provides an appearance guide for rating compatibility. Are the lubricants clear and bright or do they appear cloudy? To meet the compatibility criteria, the blended lubricants must be "absolutely bright." As seen below, the studied lubricants all passed the visual compatibility tests.

90% PAG/10% Mineral Oil - 1   90% PAG/10% Mineral Oil - 1

Results of the visual compatibility tests

If the two lubricants do not have good

BLENDED LUBRICANTS	FOAMING TENDENCY	FOAM STABILITY	SETTLING TIME
90% PAG/10% Mineral Oil 1	60 mL	0 mL	39 minutes
90% PAG/10% Mineral Oil 2	50 mL	0 mL	33 minutes

Figure 2

compatibility, three interactions are affected: liquid-air, measured by the lubricant's foaming properties (ASTM D892); liquid-solid, measured by the formation of insoluble solids (ASTM D7843); and liquid-liquid, measured by the lubricant's demulsibility (ASTM D1401).

Foam

The change in the liquid-air interaction is measured using the ASTM D892 foam test. This measurement looks for a negative change in performance after the lubricants are blended. The test reports three values: the amount of foam at the end of the 5-minute blowing period (foaming tendency), the amount of foam at the end of the settling time (foam stability), and the settling time. Most new lubricants have a foaming tendency ranging from 10-60 milliliters and a foam stability of 0 milliliters.

Membrane Patch Test

The formation of solids is a serious problem with lubricant compatibility. This is typically an additive issue in which one additive has poor solubility in the other lubricant's base stock, or the additives in one lubricant react with the additives in the other lubricant. If severe, this can be observed in visual testing. However, the concentrations are often too low for observation.

ASTM D7843, commonly referred to as the membrane patch colorimetry (MPC) test, can be used to observe solid formation. Results are reported as a dE value based on the CIE Lab scale. The MPC results for most new lubricants are in the 2-5 dE range.

Demulsibility

Demulsibility is the lubricant's ability to separate from water. It is measured using ASTM D1401. This test blends 40 milliliters of water and oil, reporting the amount of oil, water and emulsion

BLENDED LUBRICANTS	DE VALUE
90% PAG/10% Mineral Oil 1	4.3
90% PAG/10% Mineral Oil 2	4.5

Figure 2

BLENDED LUBRICANTS	OIL	WATER	EMULSION (TIME IN MINUTES)
90% PAG/10% Mineral Oil 1	1 mL	0 mL	79 mL (30)
90% PAG/10% Mineral Oil 2	2 mL	1 mL	77 mL (30)
5% Mineral Oil 2/95% PAG	1 mL	0 mL	79 mL (30)
95% Mineral Oil 2/5% PAG	0 mL	32 mL	48 mL (30)

Figure 3

BLENDED LUBRICANTS	AMOUNT OF WATER
90% PAG/10% Mineral Oil 1	3,900 mg/g
90% PAG/10% Mineral Oil 2	4,400 mg/g

Figure 4

after a predetermined amount of time. According to ASTM D4304, a lubricant should have less than 3 milliliters of stable emulsion. The results for the blended fluids in the study are shown below and reveal that these lubricants failed the test.

Rust

When water limits are exceeded, most condition monitoring programs alert users about the lubricant's condition due to potential rust issues. Since the studied lubricants were R&O fluids, passing a rust test was a primary concern.

ASTM D4378 defines water as critical at 200 milligrams per gram (mg/g) of

TESTING SERIES	PAG	MINERAL OIL 1	MINERAL OIL 2
Weight Change of Copper Panel (mg/cm2)	-0.367	-0.008	0.017
Appearance of Copper Panel	Shiny IB	Shiny IB	Shiny IB
Original Viscosity at 40°C (cSt)	24.70	33.35	31.36
40°C Viscosity After (cSt)	26.17	33.31	31.36
% Change in Viscosity (D445 at 40°C)	5.95%	-0.12%	0.00%
Original Acid Number (D974) (mg KOH/g)	0.06	0.08	0.03
Acid Number After (D974) (mg KOH/g)	2.44	0.05	0.13
Change in Acid Number (D974) (mg KOH/g)	2.38	-0.03	0.10
Total Acidity of Water Layer (mg KOH)	6.93	2.85	0.95
Percent Insolubles	0.004%	0.000%	0.012%
End of Test Fluid ICP – Copper (ppm)	5	Nil	nil

Figure 5 Hydrolytic stability results for the tested lubricants

lubricant. The synthetic PAG lubricant failed this test. Even when blended, the lubricant's water levels still did not meet the recommended amount.

The initial study evaluated the new

New Oils | PAG 75% to EOT 2272 | Mineral Oil-1 75% to EOT 2272 | Mineral Oil-2 75% to EOT 2272

"CONTAMINATION"

In lubricating oils kills your machines

Feed clean oils to your machines

USE

DUST FREE CONTAINERS

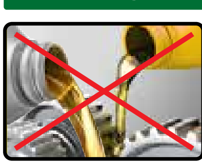
To Improve Machine Maintenance

DISTRIBUTORS ENQUIRY SOLICITED # 77389 63234

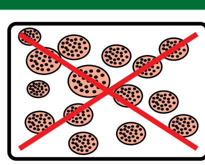
Stop use of open mouth containers...

Lubricating oils get contaminated by dust / dirt and moisture before being fed into the machines. This causes severe machanical damages to machine. Use of **DUST FREE CONTAINERS** shall lead to clean oil being fed to machine systems and reduction in cost of Mechanical Maintenance, Lubricants and Lubrications.

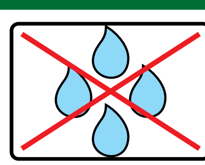
Save your precious oil from these risk factors



Mixing different Grade oils



Air borne Contaminations



Moisture based Contaminations

Spillage of Lubricating Oil

UE
Improve Reliability

URJA ENTERPRISES

B-234, Oshiwara Industrial Centre, Opp. Goregaon Bus Depot, Off Link Road, Goregaon (W), Mumbai- 400 104

Tel: +91 022 2877 9776 | 2877 9832 | E mail: sales@urjaenterprises.com | www.urjaenterprises.com

OIL IN MACHINE IS LIKE BLOOD IN HUMAN BODY

lubricants (PAG, mineral oil 1 and mineral oil 2) and determined that they passed the rust criteria. The next step was to perform the tests with aged lubricants. For this, the lubricant was run to 75 percent to the end of a rotating pressure vessel oxidation test (RPVOT). This is based on ASTM D4378, which explains that a fluid is at its end of life when the RPVOT reaches 25 percent of the new fluid (75 percent to the end of the RPVOT). RPVOT adds excess water to the lubricant as part of the test, so water is already present to cause potential issues.

The rust test (ASTM D665A) for the new and oxidation-tested lubricants showed passing results. The rust inhibitor in all three fluids was found to be sufficient to protect equipment even at high water levels. However, the synthetic PAG lubricant indicated some discoloration that could be of concern, but it was not defined visually as rust, so the sample passed.

Hydrolytic Stability

The hydrolytic stability of a lubricant is its ability to hold up to the ingress of water. Water can be a very reactive component to the lubricant's additive system. Hydrolytically unstable hydraulic fluids form acidic and insoluble contaminants, which can cause system malfunctions due to corrosion, valve sticking or a change in lubricant viscosity. ASTM D2619 is the standard method for defining the hydrolytic stability of a lubricant.

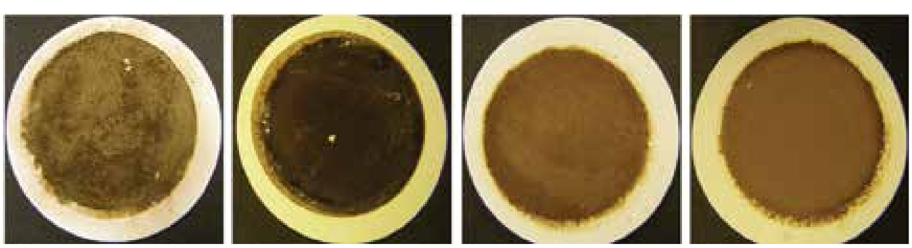
In this test, a lubricant is mixed with water and a copper test specimen, sealed in a pressure-type beverage bottle and rotated for 48 hours at 93 degrees C. At the end of the reaction time, the oil, water and sediment layers are separated for analysis.

TESTING SERIES	MPC - ASTM D7843 (DE)
PAG: RPVOT EOT	86.0
Mineral Oil 1: RPVOT EOT	97.9
Mineral Oil 2: RPVOT EOT	76.8
Mineral Oil 3: RPVOT EOT	75.4

MPC test results

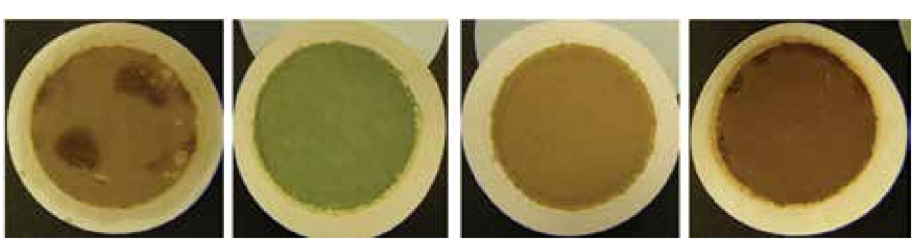
TESTING SERIES	MPC - ASTM D7843 (DE)
PAG: 75% RPVOT	65.5
Mineral Oil 1: 75% RPVOT	54.9
Mineral Oil 2: 75% RPVOT	61
Mineral Oil 3: 75% RPVOT	74.6

Test results with 25 percent of the RPVOT time remaining



PAG:RPVOT EOT | Mineral Oil 1: RPVOT EOT | Mineral Oil 2: RPVOT EOT | Mineral Oil 3: RPvOT EOT

MPC test results



PAG: 75% RPVOT EOT | Mineral Oil 1: 75% RPVOT EOT | Mineral Oil 2: 75% RPVOT EOT | Mineral Oil 3: 75% RPvOT EOT

MPC patch test results with 25 percent of the RPVOT time remaining

This test reveals the maximum weight change of copper and the maximum total acidity of the water layer. Both mineral oil lubricants passed this test, but the PAG lubricant failed. The change in lubricant viscosity was another important parameter the PAG did not pass. These experiments also indicated water sensitivity in the PAG lubricant, which should make keeping it dry a maintenance objective.

Oxidative Aging Stability

ASTM D2272 is one of the most popular tests for evaluating how lubricants behave during aging. This test method utilizes an oxygen-pressurized vessel to determine the oxidation stability of turbine oils in the presence of water and a copper catalyst coil at 150 degrees C. The number of minutes required to reach a specific drop in oxygen pressure is the oxidation stability of the test sample. With just a 50-gram sample, you have enough fluid to perform additional experiments.

NEW LUBRICANTS	ASTM D2272 - RPVOT
PAG	657
Mineral Oil 1	1531
Mineral Oil 2	1285
Mineral Oil 3	2383
IN-SERVICE LUBRICANTS	
Mineral Oil 1 – 5 years in service	1304
Mineral Oil 2 – 4 years in service	1344
Mineral Oil 3 – 8 years in service	1414

Figure 6 RPVOT results for the tested lubricants

Two types of experiments were performed using the D2272 test. The first reacted the fluid until the defined end of test. The second reacted the fluid until the time reached 75 percent of the new fluid value (25 percent of the RPVOT time remaining). Once the fluids have oxidized, their condition can be assessed with additional tests.

Varnish

ASTM D7843 is the industry standard for testing the varnish potential of in-service lubricants. All four tested lubricants exhibited similar failing varnish values at the end of the RPVOT test. Even the MPC patches showed the lubricants were in a failing condition.

LUBRICANT	ACID NUMBER
PAG: New Oil	0.03
PAG: 75% RPVOT	2.36
PAG: RPVOT EOT	21.73
Mineral Oil 1: New Oil	0.01
Mineral Oil 1: 75% RPVOT	0.25
Mineral Oil 1: RPVOT EOT	4.26
Mineral Oil 2: New Oil	0.01
Mineral Oil 2: 75% RPVOT	0.47
Mineral Oil 2: RPVOT EOT	5.31

Acid number test results

LUBRICANT	COPPER (PPM)
PAG: New Lubricant	Nil
PAG: 75% RPVOT	66
PAG: 100-minute RPVOT	793
Mineral Oil 1: New Lubricant	Nil
Mineral Oil 1: 75% RPVOT	11
Mineral Oil 2: New Lubricant	Nil
Mineral Oil 2: 75% RPVOT	5
Mineral Oil 3: New Lubricant	Nil
Mineral Oil 3: 75% RPVOT	24

Copper test results

According to ASTM D4378, you should consider replacing an in-service lubricant when the RPVOT results reach 25 percent of the new lubricant values. Therefore, the new lubricants were tested until they reached 75 percent of the new lubricant value (or 25 percent of the RPVOT time remaining). MPC values for these oxidation samples were then obtained. Again, the MPC patches showed the lubricants were in a failing condition.

The results of this test indicated lower than expected varnish levels. However, the levels were still considered critical, so it was recommended to change all four lubricants at or before 25 percent of the new oil's RPVOT value. The varnish formation of both the mineral oils and the synthetic PAG lubricants showed similar varnish levels at the recommended change value (25 percent of the new lubricant value).

It should be noted that the RPVOT life of the new mineral oil lubricants was more than 1,000 minutes, while the PAG lubricant was measured at 657 minutes. When the test for the PAG lubricant was extended to 1,000 minutes, the MPC for the fluid was measured to be 72.3 dE, which was still in the same range of the previous results. However, the viscosity was very high, making the MPC measurement difficult. In this case, the viscosity would be the most important value, as opposed to varnish.

Acid Number

Acid number, as defined by ASTM D974, has often been described as the criteria for a lubricant's end of life. For years, this was the condemnation standard for mineral oils. ASTM D4378 recommends a warning level of 0.3-0.4 milligrams of potassium hydroxide (KOH) per gram increase over the new oil's acid number. PAG lubricants have a suggested limit of 5 mg KOH/g.

At 75 to 100 percent of the end of the RPVOT test, all three lubricants had an acid number in the range suggested by ASTM D4378 as the end of the fluid's life. The high acid number in these results might also explain the rust observed in the ASTM D665 test for the PAG lubricant.

Elemental Analysis

Elemental analysis is a test that isn't often studied in relation to RPVOT. RPVOT uses a copper metal catalyst coil in the fluid. If the copper dissolves into the lubricant, it acts as an oxidation catalyst and could accelerate the test. If copper corrosion poses a potential problem at the end of the ASTM D2272 test, it should be seen in the elemental analysis as an increase in copper.

	SAMPLE PEAK AREA	% CHANGE FROM NEW	SAMPLE PEAK AREA	% CHANGE FROM NEW	SAMPLE PEAK AREA	% CHANGE FROM NEW	ANTIOXIDANT CHEMISTRY
	PAG		Mineral Oil 1		Mineral Oil 3		
New Lubricant	46218.5				16617.5		(RUL 1) Phenolic
			5889		1783		(RUL2) Amine
75% RPVOT	22097.5	47.8%			9280	55.8%	(RUL1) Phenolic
			1633.5	27.7%	744	41.7%	(RUL2) Amine
RPVOT EOT	14767	32.0%			0	0.0%	(RUL 1) Phenolic
			1550	26.3%	529	29.7%	(RUL2) Amine
1,0000-minute RPVOT	7325	15.8%					(RUL2) Amine

RULER test results

The copper sensitivity found in the hydrolytic stability test for the PAG lubricant was again detected in this test. It was observed at a higher level due to the higher oxidation of the lubricants. This offers some distinguishing parameters for comparing the lubricants.

RULER

Oxidation is often studied in relation to the quantity of antioxidant remaining in the lubricant. This parameter is measured using the RULER test (ASTM D6971). ASTM D4378 recommends a warning limit of less than 25 percent of the new lubricant's antioxidant level.

From this data, it is recommended to change the lubricant at 75 percent of the end of the RPVOT time (25 percent of the new oil's value) for both the PAG and mineral oil examples.

In-service Samples

Now the question becomes what do you see in the field. Is the field behavior of the lubricants the same as the bench oxidation tests? Field samples are difficult to obtain for many reasons, not the least of which is the time required to generate them. In examining the data below, you can see the same trends in the field as in the bench testing of the lubricants. This should provide confidence in bench testing and allow for rational conclusions about the lubricants being studied.

A Better Approach

When evaluating new lubricants, it can be difficult to determine whether the information being advertised by manufacturers is valid. A better approach is to utilize these standard performance tests that have been used successfully in the industry for years. They can enable you to make better business decisions and help optimize your lubrication program.

Questions to Ask

When determining whether a lubricant has reached the end of its service life, several questions must be asked:

- What should you do about lubricant replacement?
- Do you put the same lubricant back in again?
- What if the lubricant has been changed and no longer exists?
- Do you rely on the new lubricant's promotional materials?
- Do you rely or the experiences of your colleagues?
- Should you obtain your own performance testing data?

Answers to these questions will be valuable in your decision-making process.

TESTING SERIES	AN (ASTM D974)	DEMULSIBILITY (ASTM D1401)	RPVOT (ASTM D2272)	MPC (ASTM D7843)	(RUL 1) AMINE	(RUL 2) PHENOL
8-year-old PAG	0.34	0-2-78 (30)	468	9	38077	
					82%	
5-year-old Mineral Oil 1	0.11	40-40-0 (25)	1304	20.3		5775
						98%
12- to 14-year-old Mineral Oil 1	0.11	30-38-12 (30)	1312	18.0		4169
						71%
4-year-old Mineral Oil 2	0.01	42-38-0 (20)	1344	22.3	1262.5	4919
					19%	74%

In-service field samples

BY AL SMILEY, GPM HYDRAULIC CONSULTING

Best Ways to Reduce Eliminate Hydraulic Oil Leakage

Hydraulic oil in a pressure line can travel at a speed of 15-30 feet per second, depending on the pressure. When a valve is rapidly closed to block flow or a cylinder fully strokes, a pressure spike will occur. Unlike air, hydraulic oil is generally considered to be non-compressible. Oil will only compress 0.5 percent when pressurized to 1,000 psi. When a pressure spike occurs in the system, the pressure can increase four or five times above the normal operating pressure. Since the average duration of a shock spike is 25 milliseconds, the pressure gauge cannot respond fast enough to give an accurate indication. Pressure transducers are normally used to record pressure spikes. Shock spikes that are not properly dampened or absorbed can result in leakage and damage to the lines and components in the system. One drop of oil that drips once per second will result in a loss of 405 gallons in a year's time. At the cost of $9 per gallon, that one leak costs $3,645 in one year.

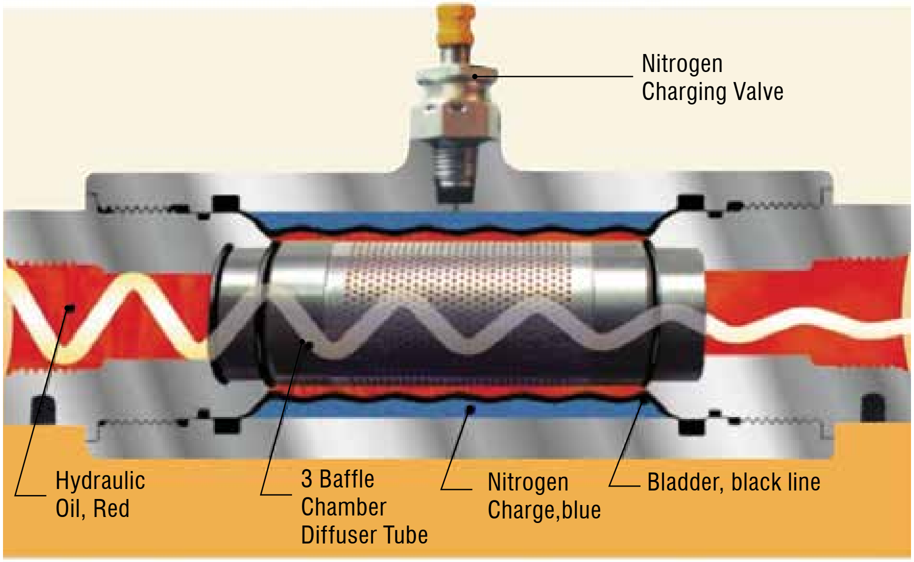
Shock Suppressors

A shock suppressor acts very much like a hydraulic accumulator except that it can be mounted directly in the line. The suppressor is pre-charged with dry nitrogen. The rubber bladder separates the nitrogen from the oil. The recommended pre-charge of nitrogen is half the maximum system pressure. The suppressor should be installed as close as possible to where the shock is occurring. For example, if shock is generated by the rapid closing of a directional valve, install the suppressor near the pressure port of the valve. When the valve rapidly closes and the shock spike occurs, the nitrogen will compress and absorb the pressure spike. The suppressor is also useful in systems that contain 90-degree bends in the piping or tubing. An additional benefit of the shock suppressor is that it also reduces noise. This can be useful in systems that utilize high-volume pumps and/or accumulators.

System Piping and Hoses

When plumbing a system, eliminate the use of 90-degree fittings in the pipe and tubing. When oil enters the fitting at a high velocity and rapidly takes a 90-degree turn, turbulence will exist and shock will be generated. This will result in leakage at the fitting or elbow. A 45- or 90-degree sweep ell will reduce

The use of 90-degree fittings in the pipe and tubing should be avoided when plumbing a system.



A cross-section view of a shock suppressor

the turbulent flow as the oil flows through the line.

Proper clamping is essential to reduce shock in the system. In the photo below, U-bolts have been used to clamp the pipes. In this installation, you can see that the pipe has moved due to hydraulic shock. This eventually will lead to wearing of the pipe and leakage. U-bolts, conduit clamps and beam clamps are not built to withstand the shock in a hydraulic system.

An example of a proper hydraulic clamp

A proper hydraulic clamp should be used (as shown below). Clamps should be spaced every 5-8 feet, depending on the size of the line, and must be tightened on a regular basis to eliminate movement of the pipe and subsequent leakage. A clamp should also be installed within 6 inches of the termination point.

When properly placed, hoses can absorb shock in the system. A hose should be installed at the outlet of the pump prior to entering the manifold or main header. This will reduce shock at the pump when the oil flow is rapidly deadheaded.

Hoses should also be installed prior to connecting to a valve, manifold or cylinder. The only exception is if the cylinder is mounted vertically. In these applications, pilot-operated check valves or counterbalance valves are used to maintain oil in the cylinder when in the raised position. The hose should therefore be installed before the check or counterbalance valve. Be sure to make the hose long enough, as its length can change when the pressure spike occurs. On the other hand, hoses should not be made too long either, as they will rub on another hose, catwalk, beam or other structure.

Pressure Settings

Pressures are often randomly adjusted by the local plant knob turner in an attempt to increase the speed of the machine. When a cylinder or hydraulic motor operates, the pressure will only build up high enough to move the load. Therefore, the maximum pressure limiter in the system should be set 200 psi higher than the pressure required to move the load. If the pressure is set higher than that, excessive shock will be generated when starting and stopping the actuator.

In a system with a pressure-compensating type pump, the compensator setting determines the maximum system pressure. When this pressure is reached, the compensator spool will shift open and de-stroke the pump. The pump will then only deliver enough oil to maintain the compensator setting. In a fixed-displacement pump system, the relief valve determines the maximum system pressure. Once the relief valve's spring setting is reached, the spool will shift open and port the pump volume back to the tank.

I was recently asked to consult with a sawmill that was experiencing leakage and shock on its lumber stacker. The stacker used a 10-inch-diameter cylinder to raise and lower the stack. The hydraulic schematic recommended that the relief valve be set to 1,200 psi. However, someone had turned the valve up to 1,800 psi. When the cylinder fully bottomed out, the pressure went up to 1,800 psi. A loud bang was then heard, and all lines in the system vibrated. We can calculate how much force was generated when the pressure

U-bolts should not be employed to clamp pipes.

Hoses should be installed at the pump outlet prior to entering the manifold or main header.

Hoses that are too long may rub on another hose or other structure.

built up to 1,800 psi using the following formula:

Force = Pressure x the number of square inches on the full piston side of the cylinder
Force = 1,800 psi x 78.54 square inches
Force = 141,372 pounds

I reduced the relief valve setting to the recommended 1,200 psi. This severely reduced the noise and shock when the cylinder bottomed out. With the pressure at 1,200 psi, we can calculate the amount of force that was reduced on the cylinder using the same formula:

Force = 1,200 psi x 78.54 square inches
Force = 94,248 pounds

The difference in force between 1,800 psi and 1,200 psi is 47,124 pounds or almost 24 tons. All plant personnel should be made aware of the negative effects caused by pressures being out of adjustment. In addition to reducing shock and leakage, turning pressures down decreases electrical energy consumption of the electric motor and heat generation in the system.

If you have shock and leakage in your systems, there is something you can do about it. By properly setting the pressures, installing accumulators and shock suppressors where needed, verifying that the system is piped and hosed correctly, and adding or adjusting pilot chokes, you should be able to reduce or even eliminate shock and leakage in your hydraulic systems.

About the Author

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

BENNETT FITCH | NORIA CORPORATION

Overcoming the RISKS of COLD Machine Starts

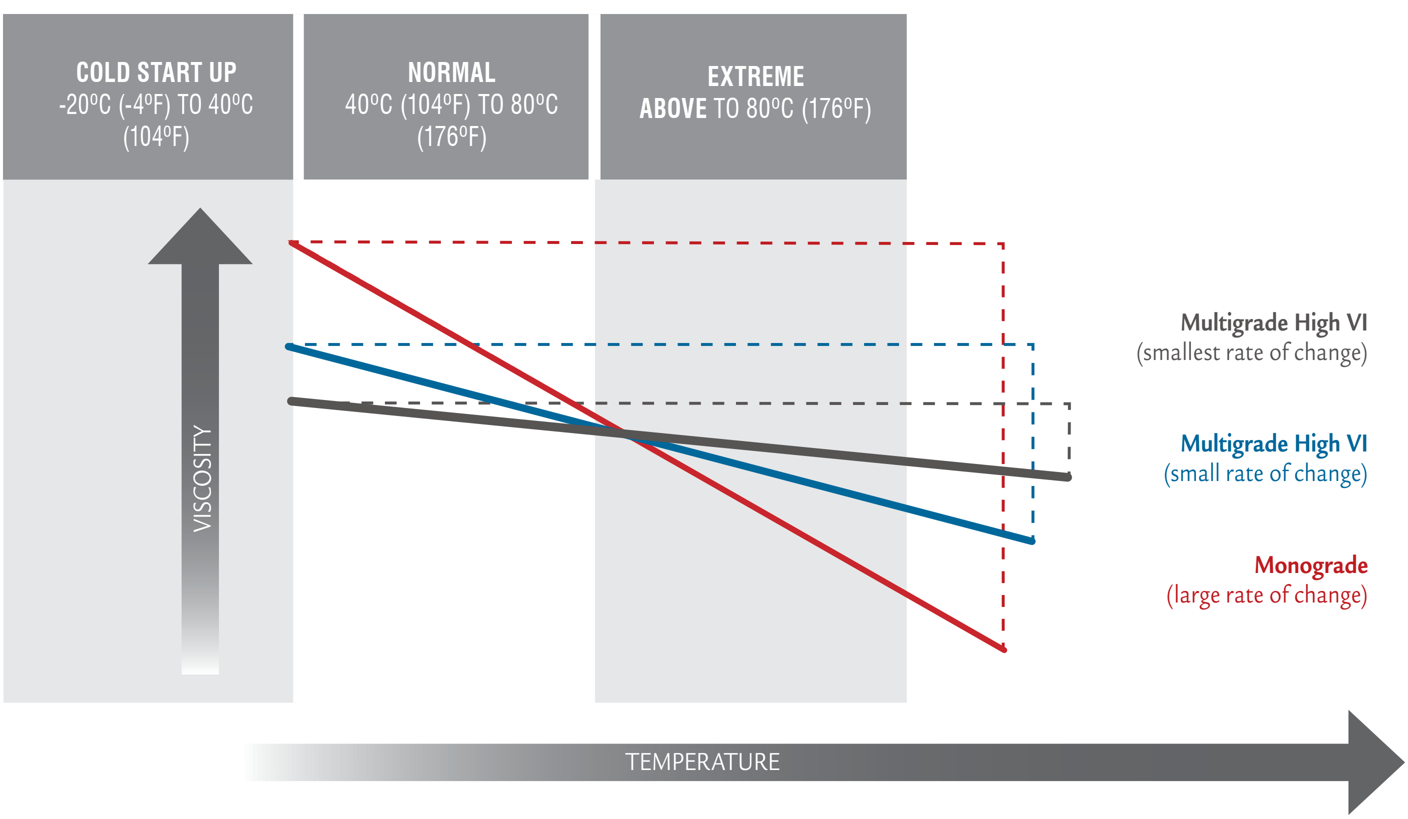
The lubricant is arguably one of the most essential components of a machine, but it also happens to be one of the most vulnerable. Greatly influencing this vulnerability is the temperature, which has an inverse correlation to the most important lubricant property – viscosity. By becoming aware of the potential effects that temperature can have on your lubricants, you can better understand how a machine could fail and hopefully prevent future failures.

Startup Temperature

Startup temperature is the ambient temperature upon initial startup of a machine before the lubricant has a chance to reach the operating temperature. During typical operation, the many contributors to heat generation such as friction will cause the temperature to rise and reach an equilibrium with its surroundings, also known as the machine's operating temperature. Knowing a machine's operating temperature is crucial when selecting the appropriate lubricant viscosity, since viscosity has a dependent relationship with the surrounding temperature.

Cold Machine Starts

The term "cold machine starts" refers to low ambient temperatures that can be detrimental to a machine's operability. The vehicle and mobile equipment industries have long been developing solutions for this challenge of dealing with extreme temperatures, including those in very cold environments. This has led to the



creation of advanced lubricant formulations, such as pour point depressant additives and multi-viscosity oils, as well as advanced engine designs with the integration of block and pan heaters.

Lubricant Failure

To comprehend the potential machine failure modes associated with a cold start, it is essential to review the ways in which a lubricant can fail from these conditions, both physically and chemically. Not only does the lubricant become more viscous at cold temperatures because of the temperature-viscosity relationship, but it can eventually congeal when it passes below a certain temperature point called the pour point. Under test methods defined by ASTM D97, the pour point describes the cold temperature point in which the oil begins to become immobile and will no longer flow.

For example, gear oil at a cold enough temperature can be placed on the floor and stood upon like a block of ice. However, unlike water, which maintains a constant viscosity until it solidifies at an exact temperature, oil will gradually become thicker and congeal at varying rates. This makes it challenging to set lubricant selection standards for the equipment operation. Therefore, even though the oil has not yet reached the pour point, the viscous nature of the cold oil can cause substantial flow restriction in machine components like hydraulic or circulating oil pumps. The consequences of a pump flow restriction can be catastrophic, with effects such as surface wear from vaporous cavitation and bearing wear from starvation.

Beware of Vaporous Cavitation

Vaporous cavitation is particularly concerning, as it is symptomatic of high pressure differentials in the pump, such as during high viscosity cold starts. As oil is drawn in on the suction side of a hydraulic pump, dissolved air is desorbed from the oil coalescing with vaporous bubbles, which then continue to expand. These larger vaporous bubbles respond destructively when compression occurs during the pump's transition from the suction side to the high-pressure side. This sudden and drastic increase in pressure forces these bubbles to collapse, leading to damage of the nearby oil and machine surfaces from the adiabatic effect.

Some additives are affected by the low temperature conditions of machine startup. For instance, certain extreme-pressure additives are only activated at elevated temperatures as a result of surface friction from high speeds or high loads. If the machine is operating at slower speeds during startup and in a cold environment, the additive can become significantly less effective. Other additives like rust inhibitors can have poor solubility and stratify to the bottom of sumps and storage containers during prolonged stagnant periods in cold temperatures. If the oil continues to operate at cold temperatures, the foam tendency can increase, especially with low viscosity oils. All these degradative effects on lubricant additives will result in limited protection of the machine components from corrosion, premature wear and foam.

Filter Resistance and Failure

All machines behave differently to high viscosity in cold-start conditions, depending on the design of the machine and the component sensitivities. For example, in any system where fluid is circulated, such as a forced circulating lube oil system or a wet sump circulating system, the oil should flow through a filter. The filter elements will naturally cause flow restriction. Higher flow restriction results in a higher pressure drop, leading to the filter bypass valve opening (if equipped), the filter element rupturing or both. Because the viscosity increases during a cold start, the pressure drop also increases due to increased resistance through the filter element.

Unfortunately, the potential for failure is not isolated to the filter in these conditions. Not only can the filter rupture, but it can also trigger a chain reaction with other secondary failures on the machine. When the oil starts to channel in between cracks as the filter ruptures, the buildup of contaminants on the filter has a chance to push through all at once. The mass ingression of particles will then directly promote wear on the machine.

Generally, the leading cause of failure from cold-start conditions is from increased flow resistance. Even if the

Cold Engine Starts (Viscosity too High)

CONDITIONS	EFFECTS	SOLUTIONS
• Extreme cold	• Air binding or flow limited	• Quality oil
• Gradual cooling	• Loss of oil pressure	• Correct wintertime viscosity or
• Wrong wintertime viscosity	• Dry start	• Engine/oil pre-heater
• Cold temperature plus high soot load	• Engine wear	

SAE GEAR OIL				75W		80W		85W	90			140Z	
SAE ENGINE OIL			5W	10W	20			30	40	50			
ISO Grade			15	22	32	46	68	100	150	220	320	460	680
°F	°C	Diesel											
248	120				4	4	6	7	9	12	13	18	23
230	110				4	6	7	9	12	15	19	24	30
212	100		1	5	5	7	9	11	15	19	25	32	41
194	90		3	5	7	9	11	15	20	26	34	44	58
176	80		5	7	9	11	15	20	27	36	48	63	85
158	70		6	9	11	15	20	28	39	52	71	95	130
140	60		8	12	15	21	29	40	57	80	110	151	211
122	50		11	15	22	30	43	62	99	128	181	254	365
104	40	1	15	22	32	46	68	100	150	220	320	460	680
86	30	2	21	32	51	76	116	175	271	409	613	907	1,380
68	20	3	33	51	87	135	214	334	536	838	1,290	1,980	3,130
50	10	4	52	87	162	264	438	711	1,190	1,920	3,070	4,870	8,020
32	0	5	85	180	340	585	1,020	1,720	2,990	5,060	8,400	13,900	23,900
14	-10	9	185	375	820	1,500	2,770	4,880	8,890	15,700	27,200	47,000	85,000
-4	-20	15	400	800	2,350	4,650	91,20	16,800	32,300	60,000			

Ref. Donaldson Filtration Solutions

Oil Kinematic Viscosity Combined with Temperature in Centistokes (cSt)

filter doesn't rupture, the viscous oil will result in damage. The table below illustrates how viscosity can change as a result of a temperature change. A 220 ISO VG oil with a viscosity index of approximately 100 will increase to more than 5,000 centistokes when the temperature drops to 0 degrees C (32 degrees F).

Lubricant Starvation

Most mechanical methods that help supply oil to lubricated components will become hindered when temperatures drop. As mentioned previously, if the oil is designed to flow through piping, such as a lube oil circulating system, the oil can become greatly restricted and starve the machine. Other oil-lifting devices can also lose their effectiveness under such conditions. Ring oilers start to drag, causing unwanted friction, while oil slingers hold onto the viscous oil, resulting in an insufficient distribution of lubricant to higher lubrication zones.

Grease Applications

Grease has similar risks in cold environments since the oil within the grease still abides by the temperature-viscosity relationship. The potential for lubricant starvation from a lack of grease application is a common issue. With any application method designed to push grease through an orifice or grease line, such as a centralized grease system, single-point lubricator or even manual greasing, grease movement may be significantly restricted in cold temperatures. Consequently, the grease may not be properly applied in the component's friction zones. Certain greases intended for cold temperatures are formulated to handle these conditions. Test methods such as ASTM D4793 and D1478 have been developed to determine how grease restricts motion in a bearing under cold temperatures.

Gearbox Systems

Most types of gearboxes are at risk of starvation, including splash-lubricated, wet sump circulating systems or forced lube oil circulating systems. When the oil is too viscous during startup, it cannot reach the gear meshing zones due to a lack of injector pressure or channeling of the oil in splash-lubricated systems. As a result, the unlubricated high-pressure contact pivot points on the gear teeth can become damaged. In addition, any gear system that must overcome the churning effects applied by the viscous oil will experience limited power transmission as well.

Engines

Nowadays, it is common for machines in cold environments to be equipped with heating elements to allow the machine to start. However, as temperatures continue to drop, simply using block heaters does not eliminate the risk to engine components which have not yet mitigated localized oil that remains below the pour point. For instance, even though the machine may be freely turning over at startup, if the oil sump is still in a gelled state, the lubricant cannot perform its role properly. This can lead to engine seizure. Air pockets can form in the gelled oil, called air binding, and starve the pump of oil. To prevent this, pan heaters and higher quality lubricants are often used to help keep the viscosity down. When conditions are uncertain, you can observe the oil flow from the tip of the dipstick for assurance of the oil's viscous state.

Journal Bearings

The oil wedge formed during rotation of a journal in the bearing housing is a careful balance of speed, viscosity and load. In any circumstance when the viscosity is undesirably high, such as when temperatures are very low, the oil can begin to whip around the journal, causing the shaft to wobble. Excessive wear can then occur from the reduced working clearances.

Hydraulics

For hydraulic systems, the biggest risks in cold temperatures are cavitation and filter element failures in hydraulic pumps, as mentioned previously. Another problem that can arise involves hydraulic seals. While contamination and installation issues are the most common reasons why seals leak and fail, cold starts and cold operating temperatures also pose a threat of seal embrittlement.

Bearings

Bearings with rolling elements will have reduced mobility when oil or grease becomes too viscous in cold temperatures. Viscous oil leads to churning losses and skidding of the rollers. Skidding will damage the rolling elements and cage structure. Friction increases as these components are damaged and can result in a failure. In grease applications, the oil in the grease becomes considerably challenged at low temperatures. The base oil separation rate will be insufficient at low temperatures because the viscous oil will stay trapped in the thickener held outside the raceway. During these conditions, lubricant starvation can cause early bearing failure.

Avoiding Machine Failure During Cold Starts

Thankfully, over the last few decades, lubricant manufacturers have become aware of the effects that cold temperatures can have on machines. This has led them to develop formulations that can handle these conditions, including during machine starts. The base oil plays a major role, as many highly refined mineral oils and synthetics are less affected by temperature swings. This is represented by the viscosity index. Viscosity index improvers can enhance this property. The higher the viscosity index, the less change in viscosity per a change in temperature. Pour point depressants can also improve the characteristics of oil in cold temperatures. These base oil and additive properties, along with a correctly selected viscosity grade or multi-viscosity grade, offer viable solutions in cold temperatures.

Nevertheless, at times lubricant formulations may not be enough to avoid the pitfalls of cold starts. In these cases, machines can be equipped to overcome the frigid elements through the installation of block and pan heaters, as mentioned previously, as well as pre-lube systems that prepare the machine's components for a cold start.

The consequential failure that can arise from not properly preparing for cold-start conditions will be gradual and indirect. Not only can cold temperatures be the root cause of unfavorable lubricant conditions, but their presence can also trigger a chain reaction, leading to highly viscous lubricants, which introduce the opportunity for lubricant starvation, increased contamination, premature wear generation, inactive additives and other impending effects. Once machine operators and reliability engineers are aware of the risks that cold temperatures present, particularly at startup, adjustments can be made to prevent these chain reactions from occurring. ■

References

- Applied Hydraulics Magazine. (1956, February). 67-70.
- Bbehrouz, A. (2014, September). "Dead Sensor." Mechanical Engineering Magazine.
- Cash. W. (2016, April). "Best Ways to Combat Oil Gelation." Machinery Lubrication.
- Diemand. D. (1990, December). "Lubricants at Low Temperatures." Cold Regions Technical Digest.
- Fitch, E.C. (2002, July). "Temperature Stability of Lubricants and Hydraulic Fluids." Machinery Lubrication.
- Fitch, J.C. (2012, August). "The Hidden Dangers of Lubricant Starvation." Machinery Lubrication.
- Hochmann. M. (2013, March). "Gear Lubrication – Gear Protection Also at Low Oil Temperature." Gear Solutions.
- Khonsari, M. & Booser, E.R. (2007, March). "Low Temperature and Viscosity Limits." Machinery Lubrication.
- Manney, D. "Extend the life of your gearbox with predictive maintenance." Retrieved from www.lselectric.com/extend-the-life-of-your-gearbox-with-predictive-maintenance.
- "OWI-Lab invests in -40°C cold start-up test bench for wind turbine drivetrain components." Retrieved from www.owi-lab.be/content/owi-lab-invests-40%C2%B0c-cold-start-test-bench-wind-turbine-drivetrain-components.
- Wikström, V. (2000, November). "Lubrication of Bearings at Low Temperatures." Retrieved from http://evolution.skf.com/us/low-temperatures.

About the Author

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

"What are the benefits and pitfalls of an oil reclamation service? Can it save you money? Are there any negative results?"

There are many benefits of using a reclamation service, such as its positive impact on the environment. Another advantage is you will not need to purchase costly equipment, supply the labor or dedicate time to reclaim the oil yourself. There also will be no cleanup or mess to contend with after the reclaiming process. The oil will be cleaned to an ISO standard of your choice and returned to service likely cleaner than when it was new.

Typically, you will receive a comprehensive report on the oil before the reclamation and after it goes back into service. This will allow you to compare the results and ensure you are getting what you pay for. Additive packages can also be restored to their pre-used state by the reclaiming service.

Many different types of oils can be reclaimed, including hydraulic oils, turbine oils, circulating oils for bearing lubrication, paper machine oils, gear oils, quench oils, some metalworking fluids, transformer oils, some synthetics and several specialty fluids. Unfortunately, in most cases, only large amounts of oil (more than 550 gallons) can be reclaimed.

The other pitfalls of using a reclamation service will largely depend on the reclamation company that is used.

Investigate the quality of each company being considered and verify all references. If not, you may end up with an oil that damages your machinery.

The risk of cross-contaminated oil is high if the reclamation service does not flush its equipment after every use. In addition, if the company does not have the appropriate permits to transport your oils to its facility and there is a spill or incident, you could be liable.

Keep in mind that the reclaimed oil is no longer the oil you purchased from the distributor but is now blended oil. Check the warranty details of the reclamation service for what to do if you have any issues with the oil. Also, ensure that the warranty on your machinery is not voided by using reclaimed oil.

Oil reclamation can save you money. If you have large amounts of oil you would like to keep in service without the cost of a full change-out, reclamation can be a cost-effective option. In fact, many reclamation companies claim they can save up to 85 percent of the oil's original cost. Just be sure to check the credentials of the company beforehand to avoid a lot of heartache.

"What is the best cleaning procedure for contaminated oil drums?"

There are several ways to address this situation, from the best practice of using a cleaned and properly sized container for housing and transporting the oil to the worst practice of rinsing and refilling the drum. All methods have pros and cons and will impact the reconditioned oil's life span. The worst thing to do is to recondition the turbine oil and then put it back into a drum that hasn't been properly cleaned. The same goes for putting new turbine oil into an already contaminated system. By doing so, the antioxidants will be attracted to these byproducts and be rendered useless before even being put into service.

Replacing each drum will save you time and energy. The process of cleaning an oil that has already led to a varnish problem can be labor-intensive and very time-consuming. Reconditioning used drums will not be easy, but it can be done. A number of systems on the market target varnish. The problem is that every drum will need to go through this cleaning process, which will take a significant amount of time.

Other factors that should play into your decision of which cleaning process to use include the type of failure that occurred within the lube oil, the type of varnish that is present and the equipment that is at your disposal. The process may be as simple as a wand flush using a filter cart or filtering the oil within the drum through an electrostatic process. Either way, it will be a slow process.

The best and most economical solution would be to use a larger container for transporting and cleaning. Larger containers allow you to filter the oil in the container while minimizing handling. This will eliminate the time involved transferring the oil from a 55-gallon drum to a larger container for filtering and reduce the environmental, health and safety risks. While this may not be the most cost-effective option at the front end of the project, it will yield considerable benefits in the long term.

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

LOREN GREEN | NORIA CORPORATION

Understanding the CHANGING Requirements for FOOD-GRADE LUBRICANTS

In January 2011, the Food Safety Modernization Act (FSMA) became law in the United States. With roughly 15 percent of the U.S. food supply imported, this law was intended to strengthen the food safety system. Previously, the Public Health Security and Bioterrorism Preparedness Response Act had been signed into law following the events of Sept. 11, 2001. It gave the Food and Drug Administration (FDA) the detention authority over food items if there is a credible threat of serious health consequences or death. The law also requires any facility engaged in the manufacture, processing, packing or holding of food for consumption in the United States to be registered with the Secretary of Health and Human Services, and allows the debarment of importers with a history of repeated or serious food import violations. These two pieces of legislation granted the FDA the power to confiscate adulterated food and potentially close a business.

The FDA also has resurrected usage of the "Park Doctrine," which is based on a 1975 Supreme Court decision affirming the right to bring criminal charges against corporate executives based on a strict liability theory. This enables the FDA to charge executives with a criminal misdemeanor for violations of the Federal Food, Drug and Cosmetic Act (FD&C) of 1938. Penalties for these violations are a maximum of one year in prison and/or a $100,000 fine if the violation does not result in a death. In a case involving death, the fine is $250,000. Keep in mind that these penalties are just for the executives. The organization can be fined $250,000 for a case not involving death and $500,000 if a death is involved. If the violation is found to have been committed with the intent to defraud or mislead, or occurs after a prior conviction, the penalties are up to three years of imprisonment and/or a fine of $250,000 and $500,000.

Please note that these violations can result in hefty fines and possible prison sentences for executives regardless of the intent or knowledge of violations occurring within an individual's area of

Plant managers could be held **criminally liable** for food being "adulterated" or contaminated with oils and greases which are used in **manufacturing and other related processes of food production.**

responsibility. It is also important to understand that the definition of executives includes plant managers.

FSMA Regulations

The FSMA has created six new types of criminal violations under the FD&C and brought about the implementation of a seventh. These violations are:

- Operating a facility not in compliance with the FSMA Preventive Controls Regulations (for both human and animal food)
- Failure to comply with the FSMA Produce Safety Regulation
- Failure to comply with the FSMA Food Defense Regulation
- Refusal or failure to comply with an FDA recall order
- Knowing and willful failure to comply with consumer recall notification requirements
- The importing or offering for importation of a food if the importer does not have a foreign supplier verification program in compliance with the FSMA Foreign Supplier Verification Program Regulation
- Failure to comply with the Sanitary Food Transportation Act Regulation

In September 2013, two melon farmers in Colorado were arrested for violations of the FD&C Act following a deadly listeria outbreak that was traced back to their produce. They pled guilty to the charges and were sentenced to five years of probation, with the first six months under house arrest, 100 hours of community service and $150,000 to the victims of the outbreak.

In September of the following year, the former owner, president and CEO of the Peanut Corporation of America was found guilty on 67 federal felony counts associated with a salmonella outbreak. His brother, who was the vice president of the company, was found guilty on 30 charges.

While these are extreme examples, it is apparent the FDA is not taking violations of the law lightly. It is also easy to see how plant managers and others could be held criminally liable for food being "adulterated" or contaminated with oils and greases which are used in manufacturing and other related processes of food production.

Other changes outlined in the FSMA include fees associated with reassessments conducted by the FDA. The rate for these fees is $221 per hour for domestic travel and $285 per hour for international travel, which can add up quickly. These fees are to be paid by the "responsible party" within 90 days of receiving the invoice.

A Focus on Prevention

One of the cornerstones of the FSMA is the realization that the FDA likely would not be staffed sufficiently to oversee all the changes mandated by the law. Much of the burden falls on a company's CEO and board of directors to ensure that the food they produce is safe. The primary guiding principle is the application of the Hazard Analysis and Critical Control Points (HACCP) to the roughly 80 percent of the food supply regulated by the FDA. This represents a major shift in ideology. Previously, the focus had been on responding to contamination in the U.S. food supply. Now the focus is on prevention.

Section 103 of the Food Safety Modernization Act deals specifically with prevention. It requires the owner, operator or agent in charge of a human or animal food facility which manufactures, processes, packs or holds food to evaluate hazards that could affect food safety, identify and implement preventive controls to prevent those hazards, monitor those controls and maintain monitoring records, and conduct verification and reverification activities. In addition, the responsible parties are to identify and evaluate hazards that may be intentionally introduced, including acts of sabotage or terrorism, as well as develop a written analysis of the hazards.

A major piece of the required documentation is a "food safety plan." This plan addresses, among many other things, lubricants and lubrication. It should also include written hazard analysis, preventive controls, a supply chain program, procedures for monitoring preventive controls, corrective action procedures, verification procedures and a recall plan.

HACCP Principles

The HACCP system provides a logical, scientific approach for controlling safety issues in food production. The seven principles that make up an HACCP plan are: to conduct a hazard analysis, identify critical control points, set critical limits for each critical control point, create monitoring procedures, determine corrective actions, develop record-keeping procedures, and establish verification procedures.

Hazard Analysis

According to the HACCP principle, conducting a hazard analysis involves preparing a list of steps in the process where significant hazards occur and describing preventive measures. A food safety hazard is defined as "any biological, chemical or physical property that may cause a food to be unsafe for human consumption." The focus of this article is on the chemical properties.

Based on the United States Department of Agriculture's "Guidebook for the Preparation of HACCP Plans," chemical hazards fall into two categories: naturally occurring poisons, chemicals or deleterious substances that are natural constituents of foods and are not the result of environmental, agricultural, industrial or other contamination; and added poisons, chemicals or deleterious substances that are intentionally or unintentionally added to foods at some point in growing, harvesting, storage, processing, packing or distribution. This second group of chemicals can include lubricants, cleaners, paints and coatings.

The United States Department of Agriculture stresses the importance of being aware of chemical hazards at the following points: prior to receiving chemicals at your facility, upon receiving chemicals, at any point where a chemical is used during processing, during the storage of chemicals, during the use of any cleaning agents or maintenance chemicals, prior to shipment of the finished product, and in trucks used to ship the finished product.

Once the types of hazards and how they occur have been identified, it is possible to conduct an analysis for each process and/or product to be covered under your HACCP plan. This plan should be as specific to each individual facility as possible. Separate the analysis into two activities: brainstorming and risk assessment. Also, if one does not already exist, develop a process flow diagram to identify each step in the process. This may include a walkdown of the facility starting at the raw material delivery stage and continuing through to loading of the finished product.

The hazard analysis can be divided into three steps: First, ensure that the prerequisite sanitation standard operating procedures and others are in place, and evaluate your operation for hazards. Next, observe the actual operating practices. Finally, assess the likelihood and severity of the hazard's occurrence.

55%

of MachineryLubrication.com visitors use food-grade lubricants at their plant, based on a recent survey

The analysis should allow for the identification of all significant biological, chemical and physical hazards for each step and each ingredient. You then will need to identify measures to prevent these hazards from compromising the safety of the finished product. These measures may include using only approved chemicals, such as food-grade lubricants, having detailed product specifications for chemicals entering the plant, inspecting trucks used to ship the finished product, properly labeling and storing all chemicals, and training employees who handle chemicals.

Critical Control Points

A critical control point is defined as "a point, step or procedure in a food process at which a control can be applied and, as a result, a food safety hazard can be prevented, eliminated or reduced to acceptable levels." After the hazards and preventive measures have been determined, it is possible to identify the points in the process where the preventive measures can be applied to prevent, eliminate or reduce the hazard to an acceptable level.

Critical Limits for Critical Control Points

A critical limit is defined as "the maximum or minimum value to which a physical, biological or chemical hazard must be controlled at a critical control point to prevent, eliminate or reduce to an acceptable level the occurrence of the identified food safety hazard." In the case of lubricants, the FDA has set this limit at 0 parts per million for non-food-grade lubricant contamination.

Monitoring Procedures

Monitoring is essential to an HACCP system. It can warn of an impending loss of control so action can be taken before a critical limit is exceeded. Monitoring generally will be more effective if the personnel responsible for monitoring understand its purpose and importance, and are clearly identified and properly trained. Monitoring procedures usually relate to online processes.

Corrective Actions

Once the HACCP plan is implemented, corrective actions must be taken any time a critical limit is not met. These actions should include determining the disposition of a non-compliant product, correcting the cause of the non-compliance to prevent a repeat, examining the process or product again at the control point to ensure the results are within the limits, and maintaining a record of the corrective actions and results of the applicable testing.

Under HACCP, the actions to be taken in the event a critical limit is not met at a critical control point must be established in advance. Personnel responsible for monitoring the critical control points should understand the process and be trained on how to perform the corrective actions. All corrective actions should also be documented, with the responsible personnel signing an acknowledgement.

If a corrective action is required that has not been previously identified in the HACCP plan, this should be documented as well. It may be necessary for the product to be held for further investigation. This investigation may include product testing, consultation with a third party or processing authority, or a thorough records review.

Record-keeping Procedures

Accurate and complete records are important because they serve as written documentation of compliance with the HACCP plan. These records will allow you to trace the history of an ingredient, finished product or in-process operation should problems arise. They can also help you identify trends in an operation that could result in a deviation.

HACCP systems should include records for critical control points, establishment of critical limits, how deviations were handled and the results of verification activities. These records must contain the product identification, critical criteria, time and date of the observation, and the monitor's and reviewer's signatures.

Verification Procedures

The HACCP system should be assessed periodically to ensure it is working correctly. Among the points to evaluate would include the monitoring equipment's calibration process, any corrective actions, and observations of monitors and monitoring activity. A periodic evaluation of employees is also recommended to ensure that corrective actions are performed and documented properly.

Validation of the HACCP plan will demonstrate that it prevents, eliminates or reduces all identified microbiological, chemical and physical hazards to a regulated and/or commercially feasible level. The responsibility for this validation rests on the regulated industry. The validation assembles the data to prove that the HACCP plan developed and implemented by a company will control the process and prevent food safety hazards.

A reassessment should be performed at least annually to determine if the HACCP system is adequate. A reassessment is also necessary any time new hazards have been identified or when changes have occurred in the process, ingredients, raw materials, vendor, product volume, personnel, packaging, distribution or any other factor that could affect the hazard analysis.

In conclusion, as the FDA continues its efforts to fully implement the Food Safety Modernization Act, companies that manufacture food and beverage products must prepare for the changing requirements. If they fail to comply, their plant managers could face hefty fines, criminal prosecution or even imprisonment.

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.

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. When should the reservoir be cleaned/flushed?

A) Every time the oil is changed.
B) When the plant is in a shutdown.
C) When the system fluid viscosity changes by 7 percent or more.
D) When sludge and deposits are detected at the oil drain.
E) When the breather is changed.

2. Which of the following represents the highest NLGI consistency?

A) Block grease
B) ISO 460
C) 000
D) 18/16/13
E) 8

3. A crackle test can only detect water above:

A) The saturation point, which depends on oil type and temperature
B) 100 ppm
C) 1,000 ppm
D) 10,000 ppm
E) 1 percent

Answers

1. D
A tank should be cleaned/flushed to avoid contaminating the new oil. Sludge and other deposits are oxidation byproducts. Some of these deposits work as pro-oxidants that attack the antioxidant additives of the new oil, resulting in the rapid depletion of these important additives. Consequently, the base oil will be unprotected and become oxidized in a short period of time.

2. A
Block grease represents the highest NLGI consistency. The NLGI number for block grease is 6. It is as hard as cheddar cheese spread.

3. A
Below the saturation point, there will be no visible or audible change. Above the saturation point, bubbles and audible crackling will be noticed based on water and/or other volatile substance concentration.

YELLOW PAGES

To advertise in this space contact admin@machinerylubricationindia.com

Machinery Lubrication

Lube-Tips™

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

Quick Test for Lubricant Compatibility

Suppose you run out of a lubricant and are in critical need to top off the reservoir. If the equipment is force-lubricated from a sump, it usually is better to leave it a little low until you can obtain the proper fluid. If you simply cannot resist the temptation to conduct a science experiment, take a few minutes to perform the following test: In a clean, clear plastic bottle, add equal amounts of both lubricants, leaving some headspace. Shake the bottle vigorously and allow to settle. Do you see more than one layer, a hazy or milky appearance, any color change or sediment? Any of these results is a red flag and a warning not to mix these fluids. In two separate bottles, vigorously shake the samples of the two fluids separately. Do the bubbles rise to the top and pop as quickly in the mixture as they do in the individual fluids? If you skip the test and go ahead and mix the lubricants, a foaming problem and subsequent major disaster could be heading your way.

Prevent Damage When Changing Bearings

When changing pillow-block bearings with a cylindrical outside diameter on the outer race, be sure to clean the grease channel located in the housing prior to installation of the new bearing. The grease in the channel tends to attract dust and dirt over time. When the bearing is changed, this dirt can become displaced into the grease channel as the new bearing is tipped into the housing. The dirt can either pass through the application hole in the outer bearing race or plug off the hole, resulting in damage to the new bearing.

Oil Sampling Made Easy

If you collect a lot of oil samples from tight areas or hard-to-reach locations, obtain a battery-operated medical suction unit. Your sample bottle hand pump can be easily converted so the suction unit will draw the sample directly into the bottle as the hand pump did. Just install a new bottle and turn on the suction unit. You now can use both hands and all your concentration to get the tubing into the oil in the sump. These units can be obtained from any medical-supply store.

TRAINING ON "ESSENTIALS OF MACHINERY LUBRICATION"

Essentials of Machinery Lubrication course provides the foundational skill set for applying best lubrication practices and product knowledge. The three days Training was conducted from 23rd to 25th of November'17 in Kolkata. The Companies participated other than VAS Tribology Solutions Pvt. Ltd. are Indian Oil Corporation Ltd., Hindustan Petroleum Pvt. Ltd., Petronet LNG, SAS Machinetools Pvt Ltd. Through this training Participants got to know proven industry methods for selecting, storing, filtering and testing lubricants to boost reliability and generate lasting results in machine efficiency/maintenance.

ADVANCED MACHINERY LUBRICATION & ADVANCED OIL ANALYSIS TRAINING IN MUMBAI

Lubrication Institute organised three days Training on **Advanced Machinery Lubrication** and **Advanced Oil Analysis** in Mumbai. The training was conducted from 27th November to 2nd December'17. The companies participated are Bharat Petroleum Corporation Ltd., Indian Oil Corporation Ltd., NCH India Pvt. Ltd., Emirates Aluminium, International Paper, Caltex and Total KSA. The training was a great success as the participants enhanced their knowledge on Advanced Machinery Lubrication which covered topics like lubricant selection, troubleshooting, predictive maintenance and more. Advanced Oil Analysis covered foundational to

advanced oil analysis information including oil sampling, lubricant health monitoring, contamination measurement and control and wear debris monitoring. In addition to learning the right metrics for program implementation and evaluation, participants got a view on the most advanced levels of diagnostics and predictive maintenance.

OIL ANALYSIS TRAINING FOR KUWAIT OIL COMPANY

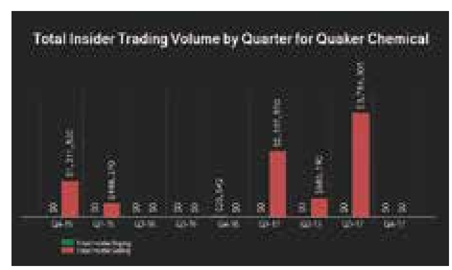
Kuwait Oil Company (KOC),an associate of Kuwait Petroleum Corporation (KPC) is responsible for Exploration, Drilling, Production, Export & Marine & Gas in the state of Kuwait. It production currently exceeds 3 MMBOPD, through its four fields mainly, North Field, West Field, South Field and South East Field. As a part of their ongoing program to reinforce the knowledge base of their technical manpower, KOC organised a 5 day training of "Oil Analysis- Level-1" from 28th Jan 2018 to 1st Feb 2018 at Hotel Radisson Blu, Salwa, Kuwait. The training was followed by ICML Certification Exam on 4th Feb 2018.

Ms Hana Kamal (Sr Training Officer), Ms B.Laila (Training Officer), Mr Jawad Abbas Esmaeel & Mr Md Saqer (Sr Engineer Equipment Support & Reliability) at KOC played an active part in the organising and delivery of the training.

Quaker Acquires Remaining Interest in INDIA JOINT VENTURE

Quaker Chemical is a leading global provider of process fluids, chemical specialties, and technical expertise to a wide range of industries, including steel, aluminum, automotive, mining, aerospace, tube and pipe, cans, and others. For nearly 100 years, Quaker has helped customers around the world achieve production efficiency, improve product quality, and lower costs through a combination of innovative technology, process knowledge, and customized services. Headquartered in Conshohocken, Pennsylvania USA, Quaker serves businesses worldwide with a network of dedicated and experienced professionals whose mission is to make a difference. Quaker Chemical Corporation announced that it acquired the remaining 45% ownership interest in its India joint venture, Quaker Chemical India Private Limited (QCIL), from its joint venture partner, Asianol Lubricants Private Limited. The JV had locations throughout India to serve metalworking and steel industries. Asianol has a factory in Kolkata and depots in Raipur, Hyderabad and Pune. Quaker is building a plant in Dahej, north of Mumbai, which will be completed within a year.

India has been relaxing its restrictions on foreign-owned businesses in recent years in a bid to attract more outside investment. Previously, some types of businesses required domestic entities to own majority stakes in joint ventures.



Brenntag Claims RAJ PETRO

Brenntag AG is a German chemical distribution company in Berlin. Brenntag distributes petroleum-related products to customers in India, Asia Pacific, Africa and the Middle East.

Brenntag AG signed an agreement to get hold of India's Raj Petro Specialities Pvt. in two phases. It will acquire a 65 percent stake of the Mumbai and Chennai-based supplier of lubricants and process oils in the first tranche of the deal, which is expected to close in April. Brenntag will acquire the remaining 35 percent in 2022, or may choose to defer the deal for another year or two. The two firms will operate Raj as a joint venture in the interim.

With facilities close to major ports in the west and the southeast of India, Raj offers Brenntag the potential to expand beyond India, Brenntag Asia Pacific CEO Henri Nejade said.

Brenntag has been gradually acquiring chemical distribution companies around the world throughout the past decade. It entered Asia in 2008 and has since expanded to 15 countries in the region.

BP Lubricants to Add THIRD PLANT IN CHINA

British Petroleum is a British multinational oil and gas company headquartered in London. It is one of the world's seven oil and gas "supermajors", whose performance in 2012 made it the world's sixth-largest oil and gas company, the sixth-largest energy company by market capitalization and the company with the world's twelfth-largest revenue (turnover). BP said that it plans to build its third plant for blending lubricants in China by the end of 2021, in Tianjin for about 1.5 billion yuan ($227 million) as it looks to meet the country's rapidly growing demand. The plant's annual production capacity of 200,000 metric tons will include lubricants and greases for automotive, industrial, marine, and aviation applications, as well as specialty lubricants and additives. "Premium lubricants are a growth business for BP and ensuring that we can meet demand in a country growing as quickly as China is essential to our success," said BP Downstream CEO, Tufan Erginbilgic, in a company statement. China's lubricant market slowed up in the past years, BP's announcement can boost up the demand in the country.

SERVO AUTO ANCILLARY MEET

SERVO WORLD-CLASS LUBRICANTS
100% PERFORMANCE. EVERYTIME.

Servo Auto Ancillary Meet 2017

Indian Oil has conducted first ever Servo Auto Ancillary Meet at Gurgaon 21.12.2017. Programme was attended by 114 participants from 51 Auto Ancillary industries and Machine OEMs of North and Eastern India. Customers have also made presentations regarding performance and savings achieved by use of Servo lubricants.

Chief Guest of the event was Shri Sunil Kakkar, Executive Vice President (Supply Chain) of Maruti Suzuki India Ltd., Gurgaon. He gave a glimpse of future prospects of Automobile Industry and related changes expected in Auto Components.

Shri KL Murthy, Executive Director (Lubes) Indian Oil Corporation Limited emphasised on the importance of Indian Auto Ancillary industry considering high growth trajectory of the automobile industry. He highlighted role of Servo range of lubricants in the rapidly changing manufacturing technologies.

There was panel discussion on Growth Opportunities & Challenges for Indian Auto Ancillary Industries. Role of Lubricants & Metal Working Fluids in Auto Ancillaries was also discussed. Panellists were Shri SK Shrivastava, Uno Minda Group; Dr. Baldev Chhikara, Mark Exhaust System Ltd. and Shri Soumen Ganguly, Indian Oil. Impact of technological disruptions like BS VI fuels, Electric Vehicles was also deliberated by highly experienced panellists.

There were 3 technical sessions:

- Metal removal fluids,
- Metal treatment & Metal protection fluids
- Metal Forming fluids/other oils & Productivity improvement tools

16 presentations were made by Auto Ancillary Industries, Metal working equipment OEMs and Research Scientists of Indian Oil. Active participation of the industry members resulted in highly engrossing Q&A sessions. Programme was well received by participants.

GARRETT BAPP | NORIA CORPORATION

VOLATILITY vs. FLASH POINT: What You Should Know

A number of testing methods can be used to determine the performance characteristics of a lubricating oil. Two common tests that have endured over time are flash point and volatility. Although the methods, technology and practices have changed through the years, both of these tests are still utilized today and provide viable ways to assess new and used oils.

Flash Point

The flash point test dates back to the mid-19th century as one of the earliest identifiers of an oil's physical properties. It was originally used to determine the fire hazards of fuels and oils being stored and transported.

The flash point test measures the tendency of an oil to form a flammable mixture with air. Once the oil sample is heated, a flame is exposed to the headspace. Ignition is the determining point. The lowest measured temperature at which the oil will ignite or flash is recorded as its flash point. If the test is performed over a longer period of time, the oil's fire point can be obtained. The fire point is when ignition is sustained for five seconds.

Several methods can be employed to determine an oil's flash point. Each varies depending on the fluid's viscosity and the chosen method. Among the ASTM tests that are available include ASTM D56, Flash Point by Tag Closed Cup Tester. It is utilized for viscosities below 5.5 centistokes (cSt) at 40 degrees C (104 degrees F), as well as for viscosities below 9.5 cSt at 25 degrees C (77 degrees F) and flash points below 93 degrees C (220 degrees F).

ASTM D93, Flash Point by Pensky-Martens Closed Cup Tester, is used for petroleum products with a temperature range of 40 to 360 degrees C (104 to 680 degrees F) and biodiesel with a temperature range of 60 to 190 degrees C (140 to 374 degrees F).

ASTM D92, Flash and Fire Points by Cleveland Open Cup, is another option for obtaining an oil's flash point. Although the technology has evolved, the open and closed cup tests of today closely resemble the practices of more than 100 years ago. While often seen as a precursory test of new oil, flash point can also be utilized in used oil analysis to detect fuel dilution, base oil cracking and contamination.

Volatility

The Noack volatility test was developed by Dr. Kurt Noack in the 1930s and first used in Europe. It was introduced as a way to reveal the evaporation loss of lubricating oils. In 1984, Al Amatuzio

began using the test in the United States to determine the performance of motor oils. Volatility testing became standard for North America in 1992 with the creation of the American Petroleum Institute's SH/ International

While the flash point tells you very little about an oil's volatility, an oil's volatility can tell you a lot about its flash point.

Lubricant Standardization and Approval Committee's GF-1 oils, which set the bar for the current standards in environmental emissions and fuel economy.

Volatization is a term used to described the "boiling off" of lighter molecules in fluids. It is closely related to oil consumption in automobile engines. The test simulates the oil's reaction to internal temperatures associated with piston rings and cylinder walls.

Known as ASTM D5800, the Noack volatility test reveals the evaporation loss of lighter oil molecules and additives at high temperatures. Depending on the method, a measured sample quantity is placed in a crucible or reaction flask and heated to 250 degrees C (482 degrees F), with constant air flow drawn through for 60 minutes. Assessing the before and after weight will determine the evaporation loss.

There are three different procedures for ASTM D5800: Procedure A, which uses the Noack evaporative testing equipment; Procedure B, which employs the automated non-Wood's metal Noack evaporative apparatus; and Procedure C, which utilizes the Selby-Noack volatility test equipment.

Procedure A was first introduced in the 1930s using a toxic mixture of compounds known as Wood's metal for sample heating. Wood's metal, also called Lipowitz's alloy, contains bismuth, lead, tin and cadmium. The toxicity comes from the lead and cadmium.

84%

of lubrication programs have a true champion, according to a recent survey at MachineryLubrication.com

The Selby-Noack test was introduced in the mid-1990s by Theodore Selby and his colleagues using a noble metal heater. It eliminates the need for Wood's metal and utilizes a collection of evaporated material for later analysis. This is particularly useful in identifying elements such as phosphorus, which is known to lead to premature failure of catalyst systems.

Volatility testing plays an important role in engine lubrication where high temperatures occur quite frequently. Evaporation losses can be seen in the amount of oil consumption or the need for top-ups. This can also result in a change in the oil's properties, as additives may evaporate during the volatilization process.

As lighter molecules "burn off" or evaporate, heavier molecules remain, causing a shift in the fluid's viscosity. Leaving behind heavier or "thicker" oil can contribute to reduced fuel economy due to added viscous drag as well as poor oil circulation throughout the engine, greater oil consumption, higher wear rates and increased emissions.

Tests That Serve a Purpose

Flash point and volatility tests serve a purpose, just for different conditions. They are also related. After all, for an oil to reach its flash point, it must first volatize. While the flash point tells you very little about an oil's volatility, an oil's volatility can tell you a lot about its flash point. Volatility testing has proven that with better base oils, improved emissions and fuel economy will follow.

Keep in mind that synthetic lubricants generally have higher flash points and do not begin to evaporate until a much higher temperature is reached. On the other hand, mineral oils may start to vaporize much earlier than their flash points. If you are dealing with hazardous conditions, a flash point test is a staple that simply must be conducted. ■

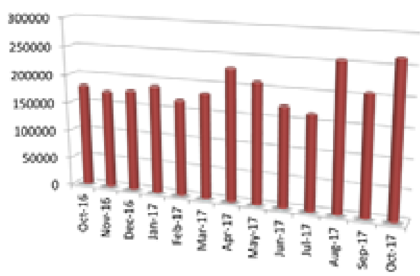
About the Author

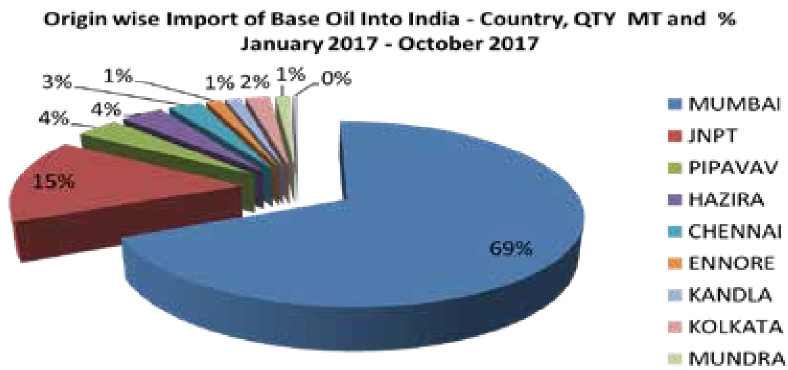
Garrett Bapp is a technical consultant with Noria Corporation, focusing on machinery lubrication and maintenance in support of Noria's Lubrication Program Development (LPD). He is a certified lubrication specialist through the Society of Tribologists and Lubrication Engineers (STLE) and holds a Machine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

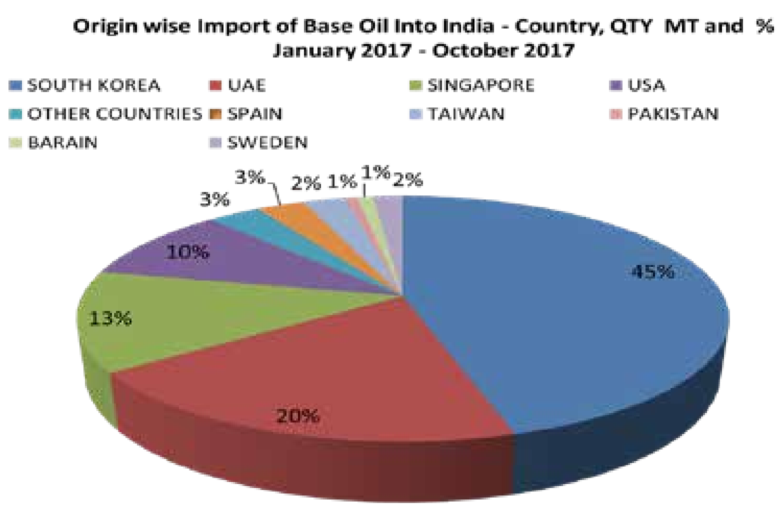
BASE OIL REPORT

The crude which was trading around $50/bbl at the beginning of year 2017 climbed to $68/bbl in the first week of January 2018, resulting in a rally of over 20 percent in the crude oil prices in the last one year. Higher oil prices do pose a concern for fuel importing countries like India which would have an adverse impact on the economy as well as companies which used crude as part of the raw material in their product. The rise in global crude prices is backed by output cut by OPEC & Russia, freezing weather in the US which has fuelled demand for heating oil. Strong economic data from major economies and falling crude oil inventories coupled with Middle East tensions will keep the commodity on trader's radar.

MONTH WISE IMPORT OF BASE OIL IN INDIA







Import of the country has fall down by 6% during Jan to October 2017, as compared to the same period last year i.e. Jan to October 2016.

Dhiren Shah (Editor – In – Chief of Petrosil Group)

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

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

Month	Group I - SN 150 Iran Origin Base Oil CFR India Prices	Group II -J-500 Singapore Origin Base Oil CFR India Prices	N- 70 South Korea Origin Base Oil CFR India Prices	Bright Stock USA Origin Base Oil CFR India Prices
October 2017	USD 670 – 785 PMT	USD 735 - 750 PMT	USD 680 - 690 PMT	USD 1090 – 1110 PMT
November 2017	USD 690 – 705 PMT	USD 755 - 770 PMT	USD 700 - 710 PMT	USD 1110 - 1130 PMT
December 2017	USD 690 – 705 PMT	USD 755 - 770 PMT	USD 700 - 710 PMT	USD 1110 - 1130 PMT
	Since October 2017, prices have gone up by USD 20 PMT (3%) in December 2017.	Since October 2017, prices have gone up by USD 20 PMT (3%) in December 2017.	Since October 2017, prices have gone up by USD 20 PMT (3%) in December 2017.	Since October 2017, prices have hike up by USD 20 PMT (2%) in December 2017

PILOT (Practical Industrial Lubrication Orientation Training)

An accessory and activity based onsite practical lubrication training

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

Main contents of the course include:

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

Lubrication INSTITUTE
www.lubrication-institute.com

Phone : +91-657-2383238
Mobile : +91-9431117604
Email : info@lubrication-institute.com
Website : www.lubrication-institute.com

Inspiring productive change through education & training