January - February 2020

Machinery Lubrication

INDIA

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Extending Oil Change Intervals:

How to Manage the Unintended Consequences

INSIDE

Real-Time Oil Monitoring:
The smarter way to clean your oil

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Impacting Your Production


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Protomac H SPL 46 & 68 : High Viscosity Index Hydraulic Oil for Dumpers, Excavators & Other varied applicaitons ❑ **Unitrans/OIB Oil :**
Transmission cum Hydraulic oil for backhoe loaders, Axle oil for front loaders ❑ **SC-HT :** Grease for dumpers ❑ **Liplex HD/HDX :**
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Publisher's Note

Changing the oil can be very expensive, sometimes exceeding 40 times the cost of the oil. Therefore, lubricants must be considered as an asset rather than a consumable.

There could also be problems like using contaminated or incompatible oil. The aging process for oil is very similar to that of the human body. Thus, when you expose a lubricant to elements within the machine, such as heat, water, air or other contaminants, irreversible damage can occur. While base oil doesn't wear out, the longer it runs in your machinery, the less effective the additive packages will be. This results in viscosity increase, sludge and corrosive acids attacking metal surfaces and bearings. Using lower quality lubricants can cause these problems to follow much faster.

Although retrofit additives may extend the life of a lubricant, they can't prevent aging and degradation. Adding retrofit additives can also upset the lubricant's formulation balance.

There are ways to restore depleted additives in order to extend oil change intervals. One way is by additive reconstruction, which involves introducing an additive concentrate to in-service oil. This is usually applied to machines with large oil volumes such as compressors or turbine oils. However, additive reconstruction should only be done after lab testing has confirmed that adding a supplement will not harm the performance of the lubricant's other properties.

Another option is a bleed-and-feed partial oil change, which is used when changing the oil is risky or inconvenient. It involves draining a portion of the oil volume and then immediately introducing the new oil. Doing this can remove some of the contaminants and introduce fresh additives.

A baseline test should be performed on any new lubricants to provide a reference and to help determine the oil's quality so that the problems can be detected before they become catastrophic. Used oil that has a higher base number than the fresh oil is indicative of detergent being added to the old lubricant. Higher viscosity at extended service intervals can mean the original viscosity index improvers in the lubricant may have sheared. An increase in iron reveals abnormally high wear, which can result in severe damage to any part of the machine that comes in contact with these objects.

We would like to thank our readers for the great response to our previous edition's cover story – "Creating a Culture of Lubrication Excellence and Reliability-Centred Maintenance" so much that a few have requested us to guide them to compete for the John R. Battle Award for Lubrication Excellence instituted by Noria Corporation, USA.

Our current issue's cover story is "Extending Oil Change Intervals: How to manage the unintended consequences" which will help our readers to know about the unintended consequences of going years without an oil change. You will find much more in this edition.

Happy Reading!!

We welcome your feedback & suggestions.

Wishing you all "Happy and Prosperous New Year 2020".

Warm regards,

Udey Dhir

Jim Fitch | Noria Corporation

Machinery Lubrication Engineer **Is Now a Professional Certification**

"Unlike other exams and certifications related to lubrication and lubricant analysis, the MLE stands alone as the highest professional designation in our industry."

I'm proud to say that the Machinery Lubrication Engineer (MLE) certification has arrived. Now, through studying and testing, qualified candidates can earn the right to hold this prestigious title. Unlike other exams and certifications related to lubrication and lubricant analysis, the MLE stands alone as the highest professional designation in our industry. It also has a more holistic purpose. Let me explain.

Many know that the International Council for Machinery Lubrication (ICML) was

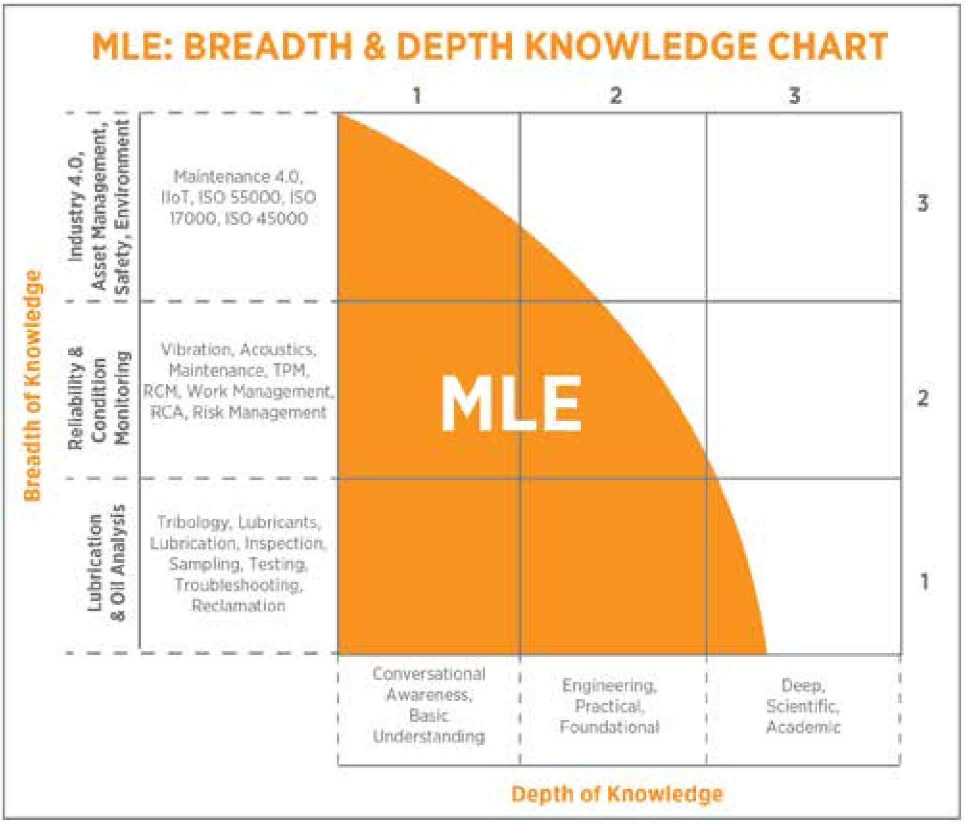

Figure 1. The breadth and depth of knowledge to become certified as a Machinery Lubrication Engineer.

organized to serve practitioners in the lubrication field, especially maintainers of lubricated mechanical machinery. So, it makes sense that the MLE would have a similar focus and purpose.

Perhaps the best way to describe the profile of those whom the ICML targets for MLE certification is to look at the 35 subject-matter experts and volunteers who toiled for years to bring it to life. These individuals are the thought leaders and trusted advisors who have helped guide the ICML as well as the larger global lubrication community.

You might say they are "real-world" lubrication and reliability experts. Their knowledge is not limited to books, scientific research, mathematical models, tribology journals or formulation chemistry. Instead, they are hands-on professionals who practice in their field, who have learned more from experience than theory and who focus more on the practical than the abstract.

I mentioned holistic because the ICML committee assembled a body of knowledge (BoK) for the MLE that goes beyond traditional lubricant and lubrication subjects. Like other certifications, the MLE BoK consists of the topics that must be mastered to become certified. Yes, there is a need for solid competency related to lubricants and lubrication. What is not needed, though, is deep technical knowledge that falls outside the maintenance and reliability plant-environment workplace.

Furthermore, lubrication co-mingles with numerous companion reliability and asset management subjects. It should not be separated from the many tasks and functions that have shared objectives. A body of knowledge was needed that defined cross-functional skills and competencies to adequately serve the "big picture" in reliability and asset management. Likewise, it needed to project a comprehensive understanding of what lubrication is trying

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1. **Skills.** Job/Task Skills, Training and Competency
2. **Machine.** Machine Lubrication and Condition Monitoring Readiness
3. **Lubricant.** Lubricant Selection
4. **Lubrication.** Routine and Periodic Lubrication Tasks
5. **Tools.** Lubrication Support Facilities and Tools
6. **Inspection**. Machine and Lubricant Inspection
7. **Oil Analysis**. Lubricant Analysis and Condition Monitoring
8. **Troubleshoot**. Fault/Failure Troubleshooting and RCA
9. **Waste**. Lubricant Waste Handling and Management
10. **Energy**. Energy Conservation and Environmental Impact
11. **Reclaim**. Oil Reclamation and System Decontamination
12. **Management**. Program Management and Metrics

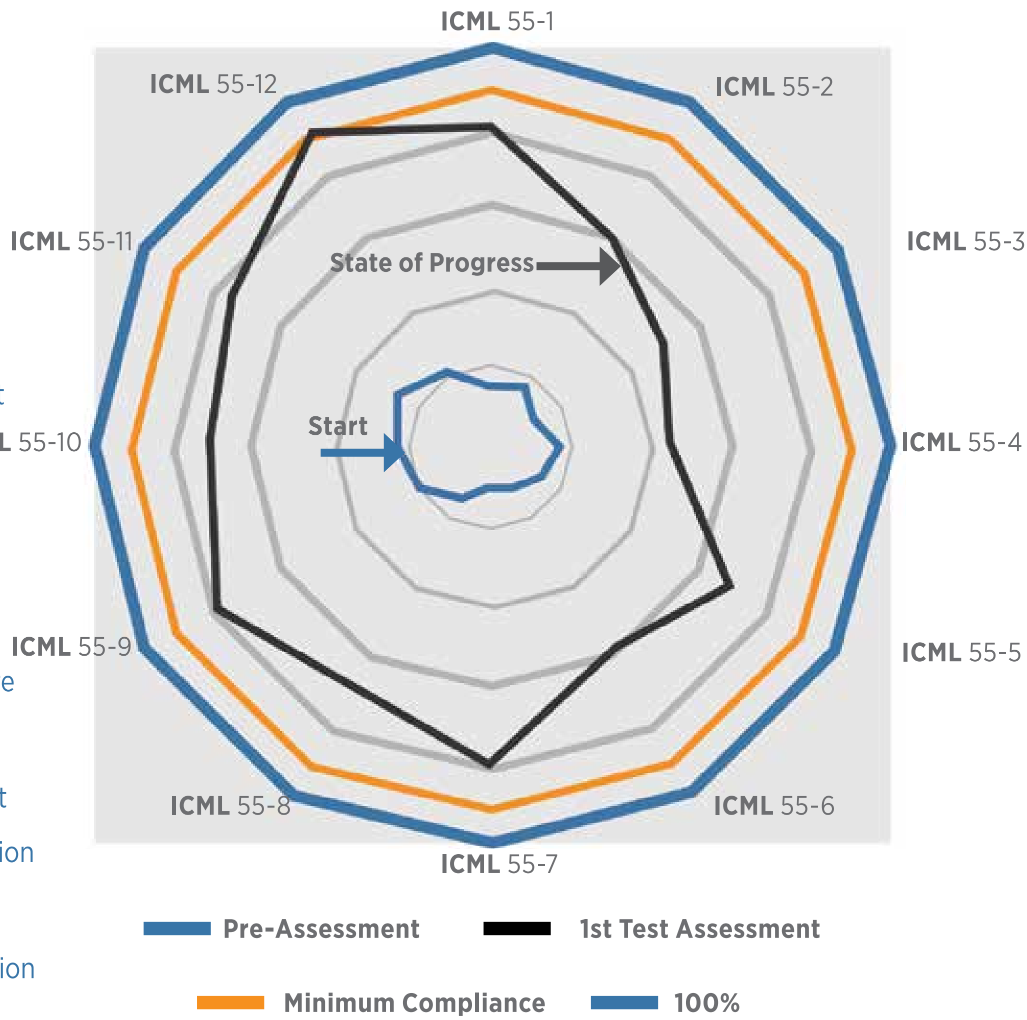

Figure 2. The list of 12 ICML 55 subjects along with an illustration showing the stages of maturity for full compliance and certification.

to achieve and how lubrication professionals enable the realization of these objectives through knowledge, competency and execution.

On the surface, this sounds easy. The reality was quite different. Deciding what to include and what not to include was a monumental task that took great vision and a fair bit of deliberation by volunteer experts. After all, without a consensus on the BoK, the construction of even the first MLE test question could not begin. See Figure 1 for a chart illustrating the breadth and depth of knowledge to become certified as an MLE.

Enter Asset Management Standard ICML 55

The solution for scoping and completing the MLE body of knowledge was first to write an overarching standard on the management of lubricated mechanical assets. The main requirements of this standard (part 1) have now been written and are available through the ICML (see the announcement article by Paul Hiller on page 44). It is the work-product of four years by 45 experts who possess broad knowledge on subjects both central and peripheral to the lubrication field. These include 34 trainers and consultants, nine book authors, 40 separate organizations and 15 countries. Most of these experts also participated in the formation of the MLE.

ICML 55.1 is the standard (part 1 of 3) that carefully delineates the requirements for certification. It is mapped structurally to ISO 55001, ISO 14001 and ISO 9001, which also address requirements for compliance and certification. ICML 55.1 is organized across 12 subject areas, or elements, for how compliance can be achieved where life cycle and reliability needs must be optimized and balanced against maintenance resources. It will be followed soon by ICML 55.2, which is a practical guideline for asset owners on how to achieve compliance of the requirements listed in ICML 55.1.

Routine Tasks of a Machinery Lubrication Engineer

The following is a breakdown of the many routine jobs or tasks that may fall under the responsibility of a Machinery Lubrication Engineer. Of course, this will vary considerably from company to company.

Selection of Lubricants

- Oversees the selection and performance specifications of all lubricants
- Establishes grease vs. oil guidelines
- Ensures lubricants are optimally selected with respect to cost, reliability, energy conservation, safety, quality and environmental factors
- Ensures lubricants are compatible with the machine, process fluids and work environment
- Writes standards for all lubricant products
- Implements a lubricant consolidation strategy
- Is a member of the buying team for selection of lubricant supplier(s)

Selection of Lubrication Equipment

- Selects oil mist, single-point, centralized and other automatic lubrication equipment
- Selects oil level control devices
- Selects sight glasses and bottom sediment and water (BS&W) bowls
- Selects top-up and dispensing containers as well as fill port hardware
- Selects lubricant dispensing equipment
- Selects grease fittings, tags and grease guns
- Selects storage room tools and equipment

Selection of Contamination Control Products

- Defines fluid cleanliness and dryness targets
- Selects filter suppliers, filter types and performance specifications
- Verifies that lubricants and additives are compatible with filters and separators
- Selects breathers and headspace-management equipment
- Selects oil reclamation equipment and/or service providers
- Selects filter carts and offline filtration equipment
- Selects lubricant heaters and coolers
- Selects sump reservoir flushing and cleaning equipment and/or service providers

Management of Lubrication Suppliers and Service Providers

- Oversees quality, service and support by vendors for lubricants and related products and services
- Identifies procedures for receiving inspection of incoming products (including lubricants)
- Establishes lubrication and contamination control guidelines associated with equipment rebuilders
- Sets up a supplier performance tracking program
- Routinely communicates supplier performance to purchasing, engineering and management

Lubrication and Inspection PMs and Work Order Management

- Oversees the writing and scheduling of routine lubrication and inspection PMs, and ensures they are consistent with best practice
- Oversees staffing and performance of lubrication work orders

Writes Lubrication Procedures to Be Consistent with Best Practice

- Tank/sump flushing and cleaning
- Oil drain interval and criteria (interval based or condition based)
- Top-up procedures
- Grease gun calibration
- Handling and storage practices
- Machine inspections
- Contamination control
- Filter changes and used filter inspection
- Grease gun operation (including how much and how often)

Lubricant Handling, Storage, Consumption and Conservation

- Oversees all lubricant storage room activities and equipment, including layout, lube container selection, transfer equipment, pumps and tools, ventilation, funnels and hoses, safety equipment and procedures, housekeeping standards, training, record-keeping, etc.
- Responsible for management of lubricant inventories, reorder points, stock rotation, setting of expiration dates, product labeling and incoming delivery inspections
- Responsible for tracking and management of lubricant consumption, including leakage control
- Establishes lubricant consumption strategies
- Responsible for environmental conservation practices, including best practices for waste oil and used-filter disposal

Develops Lubrication-related Engineering Specifications for New Machinery

- Identification of all lubrication points, lubricant type, procedure and frequency of relubrication
- Installation of sampling ports and procedure
- Set up of oil analysis testing requirements by machine
- Filter, breather and vent selection
- Selection of level gauges, sight glasses and other inspection windows

- Flushing ports and quick-connect selection
- Initial cleanliness/dryness targets
- Training of lubrication technicians on proper PMs and inspections
- Participates in the commissioning of new equipment

Warranty and Regulatory Compliance Management

- Ensures machines are lubricated in accordance with manufacturer warranties
- Ensures warranty claims are submitted for defective lubricants and lubrication equipment
- Ensures all lubricants and lubrication practices (including storage, containment and disposal) are in compliance with relevant government regulations and industry standards

Manpower Planning, Administration, Staff Training and Certification

- Writes job descriptions, defines job skills and defines certification requirements for maintenance employees/contractors with lubrication responsibilities
- Manages all lubrication and oil analysis direct-line reports and job responsibilities
- Conducts quarterly skill-development workshops for lubrication technicians and analysts
- Selects and schedules onsite training programs, including certification relating to oil analysis, failure analysis, troubleshooting, lubrication best practices and contamination control

Lubrication Information Management

- Supports the selection and management of lubrication software and other information technology products/processes, including data entry, oil analysis software, predictive maintenance (PdM) software, lubrication scheduling software and related computerized maintenance management system (CMMS) modules

Oil Analysis Program Design and Coordination

- Selects the oil analysis laboratory
- Selects onsite oil analysis instruments
- Selects oil analysis software and report format
- Identifies when, how and where samples will be obtained
- Selects routine oil analysis test slate for each machine
- Sets oil analysis alarms and condemning limits
- Defines additive reconstruction strategies
- Performs/coordinates laboratory-quality assurance tests
- Provides data integration and interface to other reliability technology activities, including vibration, acoustics and thermography

Failure Modes and Effects Analysis (FMEA); Failure Reporting, Analysis and Corrective Action System (FRACAS); Root Cause Analysis (RCA); and Troubleshooting

- Participates in FMEA and reliability-centered maintenance (RCM) planning initiatives
- Participates in RCA and FRACAS activities relating to failures of grease- or oil-lubricated machinery
- Develops troubleshooting templates and fault trees for common machine conditions and trains maintenance staff on their use

Management Reporting and Performance Metrics

- Defines overall lubrication program goals, budgets and plans
- Evaluates proposed lubrication capital expenditures using standard economic analysis methods
- Coordinates annual lubrication audits and benchmarking services
- Implements overall lubrication effectiveness metrics and other key performance indicators
- Makes routine progress reports to management and maintenance staff
- Ensures the overall lubrication activity program is aligned with asset management, reliability, safety and environmental objectives

ICML 55 is a seminal work in the field of lubrication and condition monitoring. As such, it has no precedence. It is the work of the global lubrication, tribology, reliability, condition monitoring and asset management community. For the first time, definition and specificity are provided, clearly stating the practical and realistic meaning of lubrication excellence and its role in supporting reliability, safety, environmental responsibility, energy conservation, asset management and much more.

By following the requirements of ICML 55.1, users not only can achieve an optimized level of reliability but also can have the foundational bedrock for programmatic sustainability. Such sustainability is essential to counter shifting-ground challenges associated with aging machines, environmental issues, new technology (e.g., Industry 4.0), staffing/management changes, ownership changes, etc.

Any organization on an ICML 55 journey requires an individual with both technical and programmatic knowledge to blaze the trail in pursuit of full organizational certification. The MLE is that individual. The 24 subjects in the MLE body of knowledge were extracted directly from the 12 interrelated subject areas of ICML 55.1. This perfect alignment is strategic and purposeful, engineered to facilitate achievement and sustainability of lubrication in the context of reliability, maintenance and asset management, as well as ICML 55.1 certification. Figure 2 lists the 12 ICML 55 subjects and includes a chart illustrating the stages of maturity on the journey to full compliance and certification.

Responsibilities of a Machinery Lubrication Engineer

An MLE is a professional with extensive training and experience. Certification validates competency. This individual may hold other certifications such as Certified Maintenance & Reliability Professional (CMRP), Machine Lubrication Technician (MLT), Machine Lubricant Analyst (MLA), Certified Lubrication Specialist (CLS) or Certified Reliability Engineer (CRE). Most MLEs will pursue a management path, but others may prefer more technical jobs like staff engineer, consultant or advisor. In a typical plant, the MLE likely will have task responsibility over technicians, analysts, inspectors, operators, millwrights and others performing a wide range of lubrication-related work.

An MLE is a professional with demonstrated competencies in the 24 body of knowledge subject areas. The complete BoK and domain of knowledge can be found at LubeCouncil.org.

No Longer Pedestrian

Carefully read the MLE responsibilities listed in the sidebar. The skills and knowledge needed to perform the jobs on the list are extensive and run deep. In an age of Industry 4.0, Maintenance 4.0, lean manufacturing and asset management, it would be foolhardy to view the responsibilities of the MLE as trivial or pedestrian. The concept and definition of lubrication excellence have been rewritten and will continue to evolve. The bar has been raised and is held as the new standard of excellence. The MLE is a high distinction and is ready today. ***MLI***

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.
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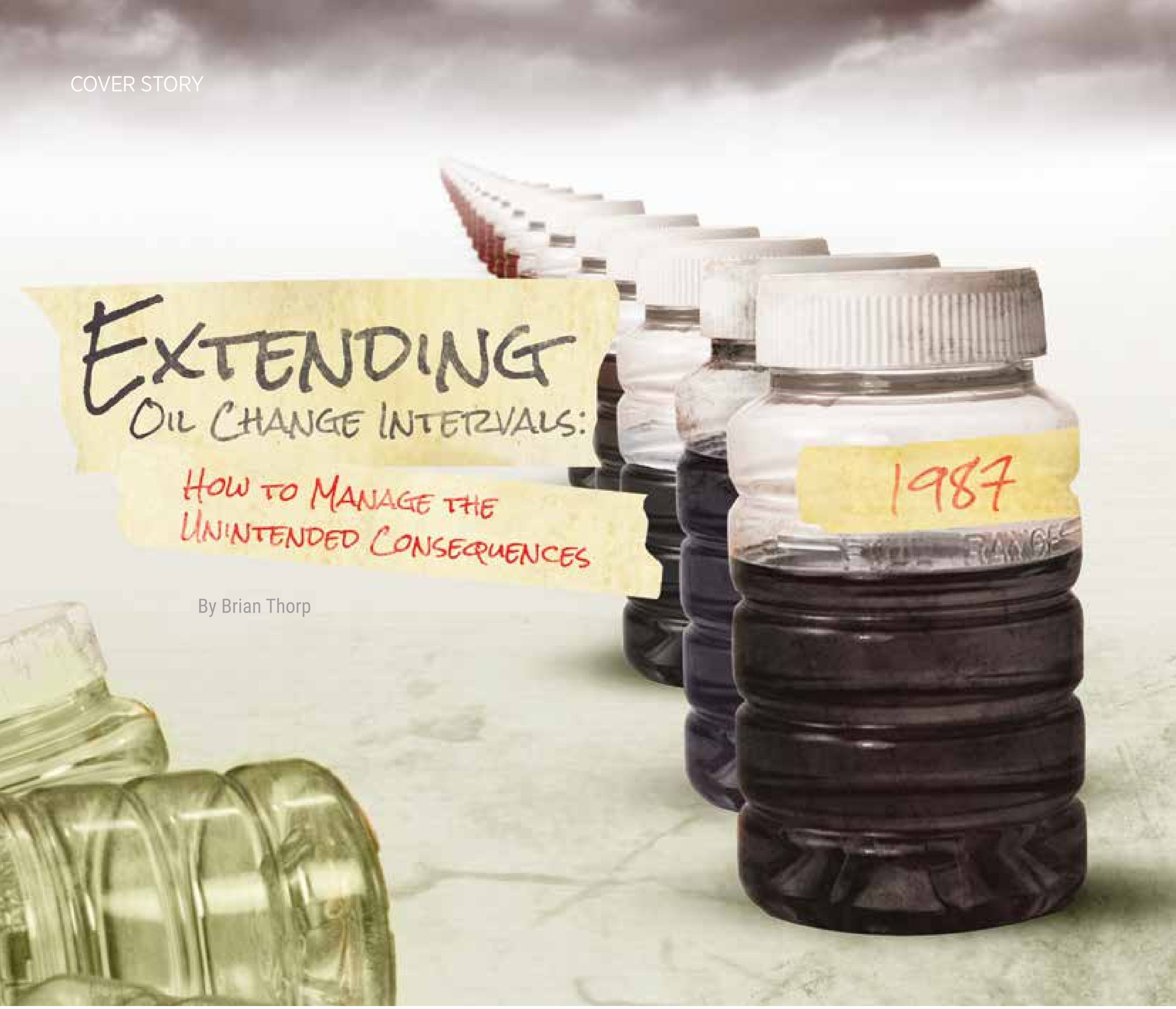


Extending Oil Change Intervals:

How to Manage the Unintended Consequences

By Brian Thorp

The January-February 2017 issue of *Machinery Lubrication* detailed how the Seminole Electric Cooperative near Jacksonville, Florida, was able to extend the life of the lubricants used in its electro-hydraulic control (EHC) systems. This follow-up article will explain the unintended consequences of going 30 years without an oil change.

After 30 years, the facility's phosphate-ester fluid became unmanageable, and a high-velocity chemical flush was completed on the system with a rinse fluid and a new fluid fill. This turned out to be an eye-opening experience, as the fluid became dark soon after the flush. Some believed this was due to the generation of new debris or problems within the system. Others thought the new oil was cleaning the system. Whatever the reason, the new fluid was quickly getting worse, and when you have 2,500 gallons per unit, it must be treated as an asset rather than a commodity.

New Problems

The problems began shortly after the first chemical flush was completed on the second unit and it was returned to service. The new fluid turned black fast. It was so dark that a flashlight could not be seen through the fluid in a sample bottle. The final filter was changed from a 3-micron element to a 1-micron varnish-removal type element. The hope was this filter would help clean up the problems occurring after the chemical flush. This proved to be a problem of its own, as the element could not last even one month before the terminal differential pressure was reached. One of the high differential pressure elements was sent for analysis to identify the composition of the debris that was plugging the element. Once this was determined, a plan of action could be developed to correct the issue.

The filter analysis detected five distinct

This image shows the changes in oil color when electrostatic filtration was started, stopped and restarted.

categories of materials. More than 86 percent was derived from the EHC fluid, which was comprised of phosphate esters and their breakdown products (varnish). Another 8.63 percent was reported as metal/metalloid contaminants associated with acid-scavenging media. An additional 2.11 percent was found to be wear metals or particles consistent with those expected from wear of metallic equipment components, while 1.85 percent was characterized as metal contaminants often associated with foreign lubricant mixing. The final 1.27 percent was classified as halogen contaminants, which can be associated with fluoropolymer breakdown or seawater. Not all of these materials were thought to be current problems with the new oil after the flush. Of course, even with a high-velocity flush, there will still be some buildup or residual material from a 30-year run that the new fluid will clean and remove.

Of the fluid-derived breakdown products, 58.86 percent was carbon. This most likely was caused by microdieseling, which is a pressure-induced thermal degradation. An air bubble transitions from a low-pressure area to a high-pressure zone and through adiabatic compression is heated to very high temperatures. Even though not much heat is transferred between the fluid and the bubble, the temperature within the bubble can reach 2,000 degrees F. When this occurs, it forms submicron-sized soot particles, which can cause the oil to darken.

System Changes

As with any plant, many things were changed, modified and updated over the years. Unfortunately, the lubrication and design engineers did not communicate. Although certain changes to enhance a system might not affect its operation, they can be very detrimental to the fluid. Among the concerns with phosphate-ester fluid include a pressure drop within the system, pressure spikes, inadequate residence time in the reservoir for air release, improperly returned fluid to the tank, and the lack of a downcomer or diffuser on the return line. Unfortunately, these problem areas are not easy to locate within a system and usually are difficult to fix.

In this case, the reservoir was well-designed with downcomers, diffusers, baffles and a large enough volume for proper air-release residence time. There were three submerged screw pumps, each with a capacity of 175 gallons per minute (GPM), along with a constant-pressure regulating valve and three relief valves, one per pump. There were no accumulators in the original system, so two pumps were run continuously to meet system spikes and swings.

With 350 GPM from the two pumps, the residence time in the reservoir was just more than seven minutes. The new oil's air-release time is usually between three to five minutes. After one year, the fluid had an air-release time of 7.4 minutes and was up to 11 minutes before the removal of submicron debris. If there was a spike in the system, the third pump started automatically but did not shut down automatically.

The constant-pressure regulator valve was designed to handle 1,100 GPM. When the valve is not working properly, excess flow and pressure are relieved by the relief valves on each pump. This initially was not much of a problem since the relief valves dumped into a common header that drained into the main return line to the bottom of the tank through a diffuser. Over time, separate dump lines were placed on the relief valves. One remained in the return header, while the other two were flanged right to the top of the tank. When the constant-pressure regulator valve stuck, there was excessive heat generation at the relief valves and additional aeration from the returning oil to the tank.

Prior to the chemical flush, the constant-pressure regulator valve and three relief valves were sent for rebuild and calibration. They are now calibrated annually as needed. During the flush when the tank was drained, new downcomers with diffusers were added to the two relief valves' dump lines. Accumulators were also installed approximately one year after the flush, so the plant can now operate on one pump at 175 GPM, thus increasing the residence time for air release in the tank.

The rest of the system consists of 10 stop valves, 10 control valves, a couple miles of piping, numerous orifices and other fluid-restricting valves. The actuators for the stop and control valves were replaced several

Electrostatic filtration was not deemed cost-effective for the old, degraded fluid.

years ago. Leak-through had not been checked on the old system. The new system has been measured at approximately 50 GPM bleed-through. This flow reduction can only help to diminish the heat-induced problems within the system that are detrimental to the fluid.

Darkening Fluid

The corrected items still did not solve the issue of the darkening fluid. While the ISO codes were excellent (15/13/10 to 16/13/11), the fluid continued to get darker. However, the fluid's color was not the actual problem. The facility needed to know how much submicron debris was in its fluid. Submicron debris has been thought to cause blinding or coating of acid-remediation media, which makes it challenging to control acid generation and maintain the proper acid number.

The prior filter testing had revealed the type of debris, 58.86 percent carbon, which in this case was soot. Two methods can be used to collect submicron debris: membrane patch colorimetry (MPC) and gravimetric analysis. These methods utilize a nitro-cellulose patch, which will have a specific volume of fluid passed through it before being dried and weighed. The MPC method may have a higher patch weight if the system has excessive varnish, since the solvent used can force semi-soluble contaminants to precipitate and be collected on the patch along with the submicron debris. This method primarily uses a color scale to identify the fluid's condition and does not include patch weight. When soot is in the system, a black patch is already assumed, so while color is important, the weight of the patch will be the more valuable information. Therefore, be sure your lab can weigh the patches.

Electrostatic Filtration

Since changing the final filter from a 3- to 1-micron element was impractical, electrostatic filtration was tried. This type of filtration had previously been used with excellent results but was not deemed cost-effective for the old, degraded fluid.

One thing to consider when using electrostatic filtration is the fluid's water content, as it does not function properly when the water level is more than 500 parts per million (ppm). With phosphate-ester fluids being hydrophilic, they can solubilize up to 4,000 to 4,500 ppm water at operating temperature, which can create problems.

In this case, the system had dry headspace purge air installed many years ago. This utilizes a device that dries the air to a dew point of minus 40 degrees F. The air is then blown into the headspace of the reservoir and exits through the existing vent. Phase equilibrium allows the water to be pulled out of the fluid into the dry air and then blown out the vent. This has worked very well. Even in the hot, humid summers of Florida, water levels below 500 ppm have been maintained.

Two types of electrostatic filtration are available for lubricants: balanced charge agglomeration (BCA) and the collector type. BCA initially was tried on the second unit. It consists of a pre-filter and a mixing chamber that charges particles and starts the agglomeration process. Larger agglomerated particles are filtered out in a final or post filter. Although this method reduced the patch weight, no color change was noted in the fluid.

Next, the collector type of electrostatic filtration was employed. With the filtration in service, it took a few months for the oil to begin changing colors and for the patch weight to decrease. A problem then occurred with the filtration unit, which was not fixed for a couple months because of a unit shutdown. Fortunately, during the same shutdown, accumulators were installed on the second unit. This allowed for one-pump operation. Now, not only was the reservoir residence time increased for air release, but the soot generation was also lessened due to adiabatic compression of bubbles within the pump.

When electrostatic filtration was placed back into service on the second unit, the cleanup time to clear oil was greatly reduced. The air-release time also decreased by two minutes. The hope is this was due to the reduction of generated debris rather than the system being cleaned with new oil.

Controlling System Problems

As with most mechanical things, when something goes wrong, it usually is not just one issue but several compounded problems. The quick fix is often just to change the oil, but this case is a perfect example of the oil not being the issue. Instead, it was the system that was causing the trouble. While many of the easy fixes have been made, only time will tell if they are enough to solve the problems that seem to plague EHC systems.

Electrostatic filtration appears to be the best technology for removing submicron debris from the fluid in this system. Although it is always nice to have fluid you can look through, your primary concern should be to reduce and control the problems within the system that create submicron debris, as this can be very detrimental to properly maintaining your oil. ***MLI***

*With operations primarily in the Automotive and Industrial segments, and a leading presence in the open market through a stellar distributor network, Gulf Oil Lubricants supply directly to OEMs and other B2B customers. Gulf Oil Lubricants India Ltd (GOLIL), part of the Hinduja Group, is an established player in the Indian Lubricants Industry. In an interview with **Jhumpa Mukherjee** of **Machinery Lubrication India**, Dr Y P Rao, Chief Technology Officer, Gulf Oil International, talks about his journey in the field of lubricants and what it means & takes to operate in the region.*

Dr. Y.P.Rao joined Gulf Oil International Group in 2004 and has 36 years of experience in the fuel and lubricant Industry. Along with his team, he is responsible for development of over 1500 product formulations and obtaining around 600 Global OEM approvals. Dr Rao is the current Chairman of Lubricants Sectional Committee and he has also been serving as a Convener of Fuels committee of Bureau of Indian Standards for over 25 years. Dr Rao earned his Ph.D. from Indian Institute of Technology, Delhi.

What are your views on technical up-gradation & improvements in lubricant field since you entered this industry?

In today's engines and equipment, lubricants are subjected to very severe conditions due to downsizing and reduction in sump capacities while the power densities increasing progressively. Further, consumers especially commercial vehicle operators and industrial customers continue to demand extended oil drain intervals to reduce the cost of lubrication. During last decade or so, globally engine oils have gone through major technology upgradations to support the changes in engine designs and protect after treatment systems to meet the ever-stringent emission and fuel economy regulations. To improve the air quality, Govt. of India had decided to leapfrog from BS IV to BS VI emission norms by skipping BS V starting from 1st April 2020. To meet BS VI emission norms, after treatment systems became essential in all vehicles. This change calls for a new class of engine oils having lower SAPS (Sulphated Ash, Phosphorous and Sulphur) as none of the engine oils having normal SAPS used in BS IV vehicles are suitable for BS VI vehicles.

Our government is pushing for the growth of electric vehicles in the country. How is Gulf Oil preparing for this shift? And what will be the impact on the sales volume.

Global warming is becoming a bigger issue and that is the major reason why Government is pushing for electric vehicles and also for increasing the electricity generation from renewable sources like Solar, Wind etc. The main reason for global warming is carbon dioxide emitted from burning of fossil fuels. Electric vehicles, besides helping in reducing the green-house gases, would also help in improving the air quality as they don't emit any noxious gases/particulate matter. I strongly believe that electric vehicle will do a lot of good for the country as long as the carbon intensity of grid power is reduced.

Gulf Oil have been studying the impact of electric vehicles on lubricants consumption very carefully. As we are in a business of selling lubricants, we are focussing on the fluids that are required for both hybrid electric vehicles (HEV) and battery electric vehicles (BEV). While HEVs will continue to use engine oils, BEVs do not require any engine oil as there is no engine. However, both HEVs and BEVs will continue to use transmission oils, coolants and greases designed for such vehicles. As the penetration of EVs increases, it will have some impact on engine oils, especially in passenger vehicle and 2-/3-wheeler segments in the next 10 to 20 years. The extent of impact depends on the rate of growth of EVs, which depends on so many factors like cost of battery, range, charging infrastructure etc. Transmission oils will not be the same though existing HEVs/EVs are using the fluids being used in ICE vehicles at present. Very soon these are going to be optimised suiting the conditions prevailing in HEVs/BEVs. We are working on the fluids required for HEVs/BEVs. In electric vehicles the major issue is thermal management as they generate lot of heat. Electric vehicles bearings require grease. Grease also needs to be re-designed. We are also looking at the areas where we can participate in the entire value chain of electric vehicles.

Research & development plays an important role in any sector, more particularly in lubricants. Would you like to tell us about the R&D efforts taken in Gulf Oil?

We believe that the development of differentiated lubricants is extremely important in the highly competitive environment. As a part of this strategy and to meet future challenges, we had expanded our R&D facility and set up a state-of-the art R&D Centre at Chennai in 2018. In India, for the last twelve-thirteen years, we have been having a double digit CAGR while industry grew around 2 to 3% in the same period. The major reason for such a spectacular growth, among others, was the development of long drain oils in both M&HCV and Motorcycle segments and strategic OEM tie-ups. Gulf Oil was the first company to double the drain interval way back in 2006 in these segments and continues to hold a leadership position. These initiatives helped us to reach the position where we are standing today. We continue to expand our foot-print in growing segments like Construction, Mining and Fleet and strengthening OEM tie-ups through differentiated products and services, where R&D plays a very critical role.

How do you support the customers for oil analysis and interpretation services?

Oil analysis forms a very important part of the entire value chain. Condition monitoring plays a critical role to understand the equipment condition and to extract the full value from lubricants. Condition monitoring becomes a central part of providing lubrication solutions to the customer especially when it comes to B2B, fleet, mining and infrastructure customers.

In case of automotive vehicles, we establish the drain intervals by validating lubricants in different operating conditions. In the case of industrial customers, accessibility is very difficult, like in the construction and mining segments. Ten years ago, we launched a portal called 'Gulf Care'. It is the basic platform through which we offer end-to-end oil condition monitoring service to our esteemed customers by providing standard sampling aids, bottles, labels etc. and arranging tie-ups for despatching samples to our laboratories. Customers are provided with log-in facilities through which they can access the historical data and understand the health of their equipment by looking at the used oil properties.

Industry 4.0 is a buzz word today; most of the manufacturing companies are trying to incorporate it. What are your views on this front?

I keep hearing about industry 4.0 and how it evolved from industry 1.0, 2.0, 3.0. Most of the companies started looking at it seriously.

This is not an overnight procedure, defined process and ecosystem is required. Because costs and investments are involved, one needs to see the return on investment. We are also trying to help the industry to move towards industry 4.0.

In addition to lubrication, we are also working towards improving machine reliability. There are different ways of doing that; one of them is reducing human intervention. We are evaluating the opportunities to monitor the lubrication in critical/ inaccessible equipment by employing the latest gadgets. We have tie ups with few international players which help us to implement these ideas. We have already started doing it in India with a couple of customers on a pilot basis. For example, we have implemented certain mechanical devices for our windmill customers which would supply a lubricant in right quantity at right time. So if, let's say, if the temperature of the bearing goes up or the noise levels increases, it activates the device and supply the lubricant. A similar logic is applied to other equipment as well. Likewise we have proposals in place for the major steel customers. There are bigger and aggressive plans moving in that direction.

> What is the gap between 'me' and 'the best' globally? Today in a competitive world, you need to be the best. To assess that gap, try and plan a program which can reduce the gap. To be the best in the world, one should move with that aspiration.

Lack of knowledge at the customer end (like storage handling, contamination control, sampling, testing, disposal, etc.) is a big issue. What do you think on this?

Storage of lubricants plays a very critical role. Before lubricating, if the lubricant gets degraded half of the life is already over. We conduct continuous trainings at various levels for our own employees, sales force, distributors, and B2B customers on how to store lubricants, how to take the samples and how to label the samples. The most common mistake is interchanging of the labels. Like how we pay attention when we give a blood sample, we check and try to see if our name is written properly on the sample bottle. We sensitise our customers on these lines during training programmes and customer interactions.

What are the major product / service differentiators (technically / technologically) that Gulf Oil Lubricants can be proud of as compared to other major and popular lubricant manufacturers.

We are the first to develop and introduce a long drain product into the country, both heavy duty and motorcycle segments. We continue to do that. Similarly, we brought long life hydraulic oils. Hydraulics is one of the major segments in the industrial arena. We have got variety of hydraulic oils depending on the application, depending on indoor or outdoor activity. 'Gulf Care' is a platform where we provide a condition monitoring and other facilities. There are many important features like product knowledge programs and customer's value proposition programs. We are in touch with the customers 24x7. We are into air desiccant breathers and some of the other devices that would help with predictive & preventive maintenance in a more advanced manner than the general practices that are followed in the industry.

What do you have to say to the reliability community? How can one go from basic to benchmark lubrication?

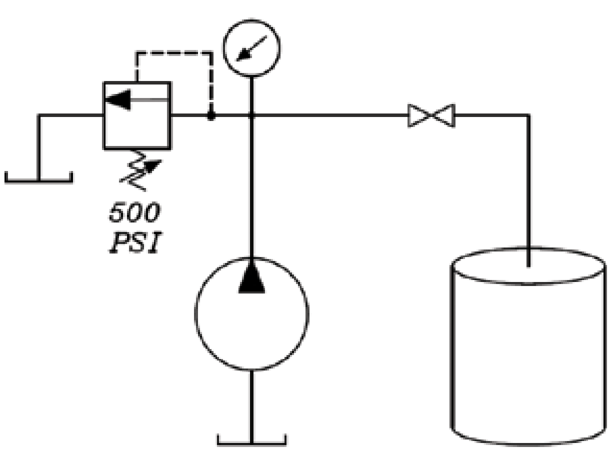
One needs to understand the starting point i.e., what are the best practices for a given industry. You cannot say that cement factory, steel factory, and automobile workshop will work in the same manner. There is a gap analysis. What is the gap between 'me' and 'the best' globally? Today in a competitive world, you need to be the best. To assess that gap, try and plan a program which can reduce the gap. To be the best in the world, one should move with that aspiration. By following a simple basic process and system one can reach that level. Simple things go a long way in getting optimum life from the lubricant and equipment.

In simple layman's term we keep explaining our customers that using the right lubricant, in the right place, at the right time and in the right quantity will be able to demonstrate a value that will be better than extremely expensive and high-end lubricant. We truly believe in this phenomenon. We have experienced better performance by following these fundamental principles. We have developed our own niche across all the segments. Last but not the least, one may have best products and best processes but at the end of the day execution is very important. Faster the execution you are winning the game already. Execution plays a very critical role; probably that is the one of the major reasons of our success.

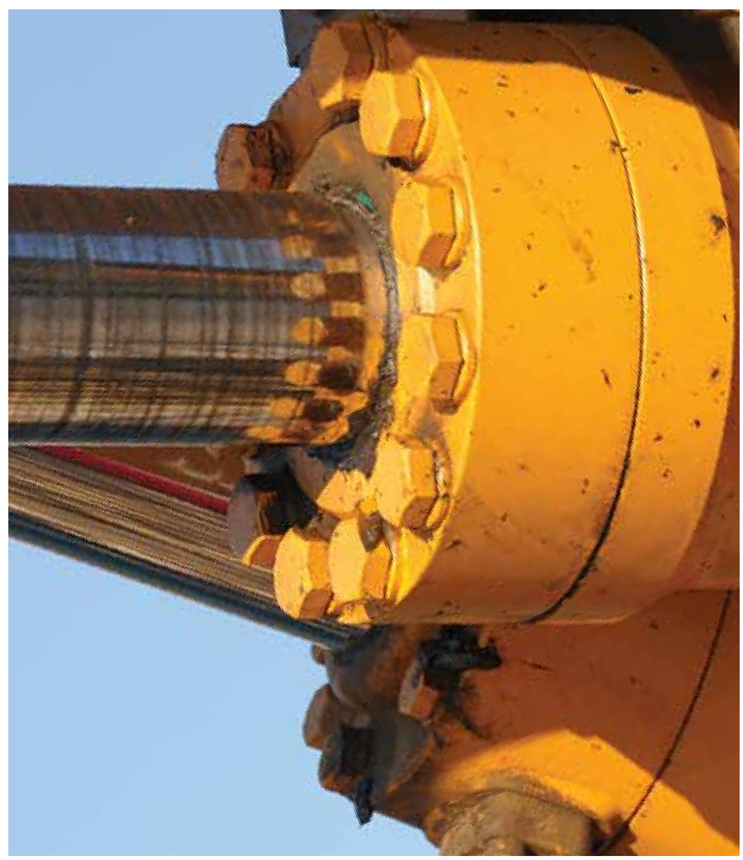
Pressure vs. Flow: **Understanding the Difference**

> "A pressure problem in a hydraulic system is rarely the pump. It is almost always another bad component in the system."

As a hydraulic instructor and consultant, I have met thousands of people whose job consists, at least in part, of the maintenance and repair of hydraulic systems. The number of hydraulic troubleshooters I have come across, however, I can count on the fingers of one hand. For the most part, I have encountered a lot of excellent hydraulic parts changers. These are people who have worked on and around hydraulic systems for so long that they know changing a specific

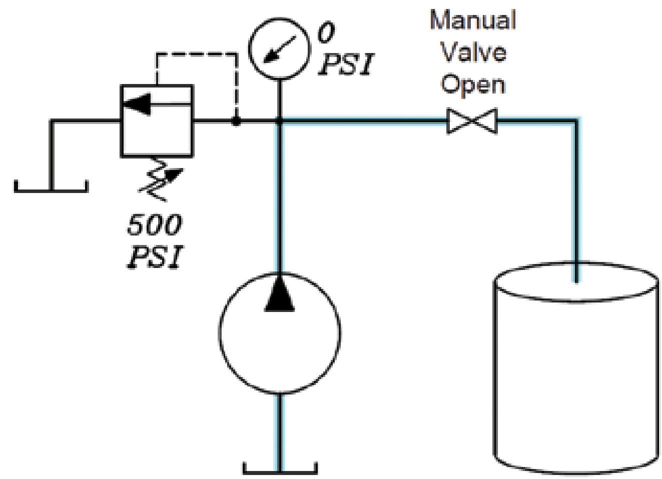


In this schematic, a fixed-displacement hydraulic pump is represented by a circle, with a filled-in arrowhead indicating liquid output.

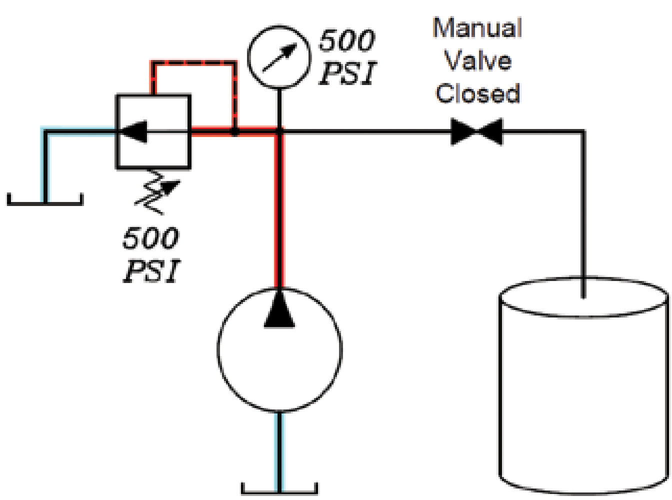


part typically corrects a certain problem. They may or may not know exactly why this is, but they know from experience that replacing this part fixes the problem.

Now I don't mean this in a derogatory way. Someone with that level of experience is valuable, but it isn't troubleshooting; it's parts changing. It works fine whenever changing a part does in fact correct the issue. The trouble



When the pump is turned on, the path of least resistance is to the drum and not through the relief valve.



This schematic shows a closed manual valve, which blocks flow to the drum.

comes when a parts changer changes a part and it doesn't fix the problem. What do you suppose the parts changer's next course of action may be? If you said "change something else," you would be correct.

Frequently, the parts changing process continues until one of two things occurs: either the machine is repaired, and everyone rejoices, or the system is put into such a state that someone must be called. Quite often, that someone is me. While it is possible to repair the system this way, it is also possible to add a problem or two whenever a component is replaced that was not bad. Usually, by the time I am called to help, a considerable amount of parts changing has occurred, and what began as something simple may have progressed into multiple issues which can be very time consuming to diagnose.

Pressure or Flow?

If I had to pick a single concept that keeps most parts changers from becoming troubleshooters, it would be the failure to understand the difference between pressure and flow. It is not uncommon to hear the terms used interchangeably, as though they are synonyms. They aren't. I often hear the complaint that a pump isn't putting out as much pressure as it should, implying that the pump is supposed to deliver pressure.

A common assumption is that if the pressure is low, the pump must be bad. This is not the case. The pump doesn't pump pressure. The pump delivers a rate of flow. The single function of the pump is to take fluid from one place and put it somewhere else. Pressure is the result of resistance to flow. In our training classes, we use the simple schematic shown on page 20 to explain this concept.

A fixed-displacement pump is the simplest type of hydraulic pump. It is turned by a primary mover, generally an electric drive motor or, in mobile equipment, the same engine that moves the machine. The amount of flow is determined by the displacement and speed of the drive motor. By "displacement," I mean the amount of fluid delivered for each full rotation of the pump. On typical industrial systems, the pump is turned at a constant speed and therefore delivers a constant amount of flow. When the pump is started, oil is moved from the reservoir and into the system. The higher the flow rate, the faster the actuator will move.

If you trace the flow from the pump, you reach a "T" in the line. Whenever you follow the flow on a schematic and arrive at a line split, you must track the flow in both directions to determine the path of least resistance. Hydraulic fluid always takes the path of least resistance. If you trace the flow to the left, you encounter a relief valve symbol. The relief valve is represented by a single square with an arrow indicating the direction of flow. Notice the arrow does not touch the inlet or outlet port. This signifies that the relief valve is normally closed and blocking flow.

The "zigzag" line at the bottom of the relief valve symbolizes a spring. A good way to think of a relief valve in a schematic is to think of the spring pushing the arrow up away from the ports, holding it closed. This means that, in order to open the valve, something must push down on the arrow harder than the spring is pushing up. Also, note the dotted line. In hydraulic schematics, a dotted line usually represents a flow path that is somewhat smaller than that of a solid line, typically a drain line or a pilot line. The one shown in the schematics on the left is a pilot line connected immediately upstream of the valve. Whatever pressure is in the main line will be present in the pilot line.

Returning to the spring, notice the diagonal arrow. In schematic symbols, a diagonal arrow means that its related component is variable or adjustable. In this case, the relief valve has an adjustable spring and has been adjusted so that a pressure of 500 pounds per square inch (psi) will develop enough force to compress the spring and open the relief valve. The resistance in this direction is therefore 500 psi.

Tracing the flow to the right, you encounter a symbol for a manual valve. This could be a ball valve, gate valve, butterfly valve, etc. The valve can be open or closed. The notation indicates that it is open, so there is no resistance in this direction. The line terminates into an open drum. When the pump is turned on, as shown in the schematic at the top of page 22, the path of least resistance in this case is to the drum, not through the relief valve. The pressure reading on the gauge is 0 psi.

Clearly, the reason the gauge reads so low is because there is no resistance in the system. However, I have seen many pumps replaced for no other reason than because the pressure in the system was low. Over the years, I have received numerous phone calls that started out, "Well, I have changed the pump, but my pressure is still low. What else should I look for?"

In fact, a pressure problem in a hydraulic system is rarely the pump. It is almost always another bad component in the system. The pump should never be the first component to try but rather your last resort when a pressure problem exists. In the example shown, replacing the pump would deliver exactly the same result.

In the schematic at the bottom of page 22, the manual valve has been closed, blocking flow to the drum. The only remaining flow path is through the relief valve. For fluid to pass through the relief valve, a resistance of 500 psi must be overcome. Once pressure builds to 500 psi, flow is delivered through the relief valve and back to the tank.

On many occasions, I have heard remarks such as, "My pump is putting out 1,500 psi." This illustrates the misconception that pressure originates at the pump. As you can see, what is being read on the gauge is not how much pressure the pump is putting out but rather the amount of resistance currently being overcome in the system. Without a firm understanding of this concept, becoming a troubleshooter is impossible. ***ML***

About the Author

Jack Weeks is a hydraulic instructor and consultant for GPM Hydraulic Consulting. Since 1997 he has trained thousands of electricians and mechanics in hydraulic troubleshooting methods. Jack has also taught radio-wave propagation for the U.S. Air Force and telecommunications equipment operation and repair for the Central Intelligence Agency at American embassies overseas.


Uday Purohit | Neptunus Power Plant Services Pvt. Ltd.

Real-Time Oil Monitoring: **The smarter way to clean your oil**

> "Oil is the lifeblood of critical machines and the only way to keep oil clean is the monitor it 24x7. Oil Filtration without Oil Monitoring is inadequate and counter-productive."

During the two decades that we have been serving the Marine Industry, we have observed that Engineers, in general, do not pay enough attention to oil cleanliness. Oil samples, for Lab analysis, are drawn without much care and attention to detail, samples stay on board for days or weeks before they are landed ashore and once the samples are analysed by the laboratory, it might be weeks before the report reaches the vessel. The story does not end there. The apathy to oil continues. The Chief Engineer at best may spend a couple of minutes before his eyes rest on the 'fit / unfit for further use' advice and then files the report. Rarely do the other engineers ever study it or treat it as a diagnostic tool. Oil sample analysis should be a valuable tool for the ship's engineer to take proactive steps in preventing failures. Getting a report a month after the sample is drawn is akin to telling a dead patient that he had a bad heart!

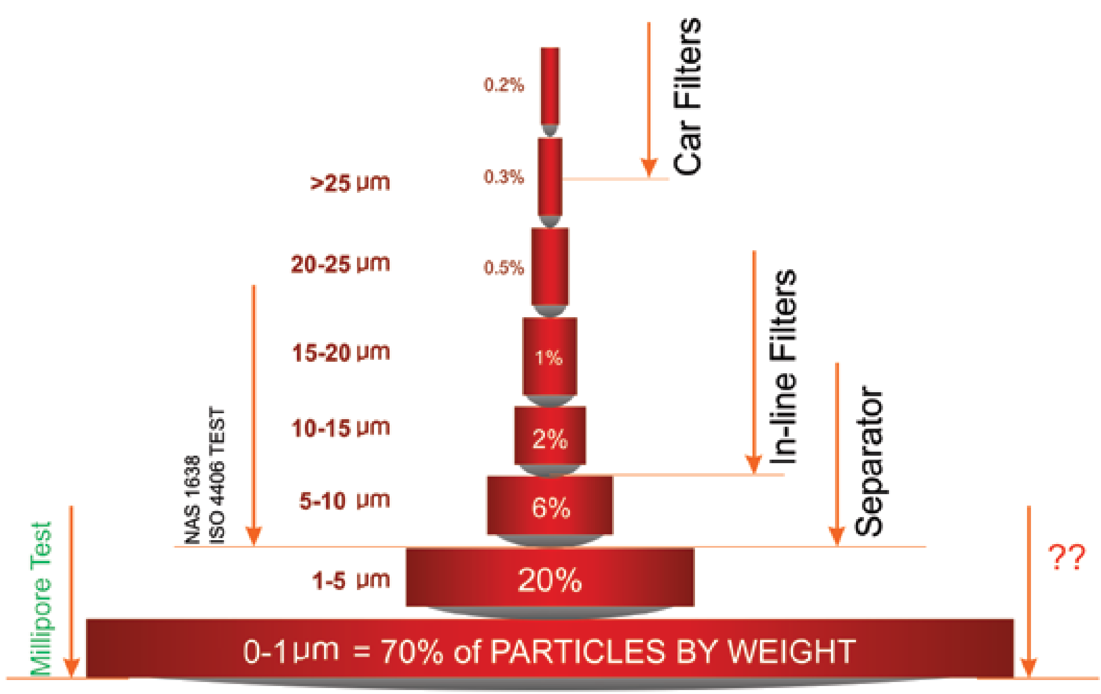


Figure 1: The Oil Pyramid. 90% of particulate matter is below 5 micron. Courtesy Noria Corp.

It is our experience, and this is backed by field tests and independent research data, that keeping your oil super clean ensures a 30-40% savings in Opex cost (oil changes, oil filters and savings in the cost of overhauls). The reliability of the equipment is significantly enhanced.

99% of wear and contaminant particles in oil are below 5micron in size. Online filters in Diesel engines (and most equipment) are about 8-10 microns. Return line filters on hydraulic systems are typically 8 microns. These filters are adequate in protecting moving parts from the ingress of wear particles between rubbing surfaces to prevent abrasion damage. That is their primary purpose. The millions of particles which are 5 micron and less in size are the cause of concern. In the presence of heat, oxygen, and pressure they act as a catalyst and promote rapid oxidation of the oil. The products of oil oxidation are acids, sludge, and varnish. The brown grime you see at the bottom of a hydraulic oil tank is varnish. It reduces the load-bearing capacity of the oil film, promotes accelerated wear, which in turn produces more wear particles and the cycle continues. Varnish, in turn, causes hydraulic control valves (spools, flow control, proportionate control valves etc.) to stick and leads to malfunction of hydraulic systems.

The Solution: Bypass Kidney Loop Filtering Systems

The solution is 'offline' or 'kidney loop filtering systems'. The flow rate generally is calculated to give one pass of the sump volume in about 24 hours. Typically for a sump of 2000 litres, the flow rate in the bypass filter should be 1.5 LPM with a suitable filter size. The flow rate may vary depending upon the ingress of contaminants in the system. There are two types of offline systems – those systems which draw the oil from the main lubricating system and pass it through the offline filters before returning it to the sump, the other being completely independent systems having their own motor-driven pumps. The latter are costlier but are easier to install. Personally I prefer independent systems (with integrated pump and motor) over those that draw oil from the main lubricating oil system. My main concern is that when the equipment is starting or stopping (Diesel engines) lubrication conditions are most severe (maximum wear occurs in moving parts until hydrodynamic lubrication conditions are established), and diverting any amount of oil to the offline filters can only adversely affect the quality of lubrication in the main bearings. The other disadvantage is that when the equipment is stopped the offline filtration is also stopped. In systems with independent pump and motor, purification of oil is a 24X7 process.

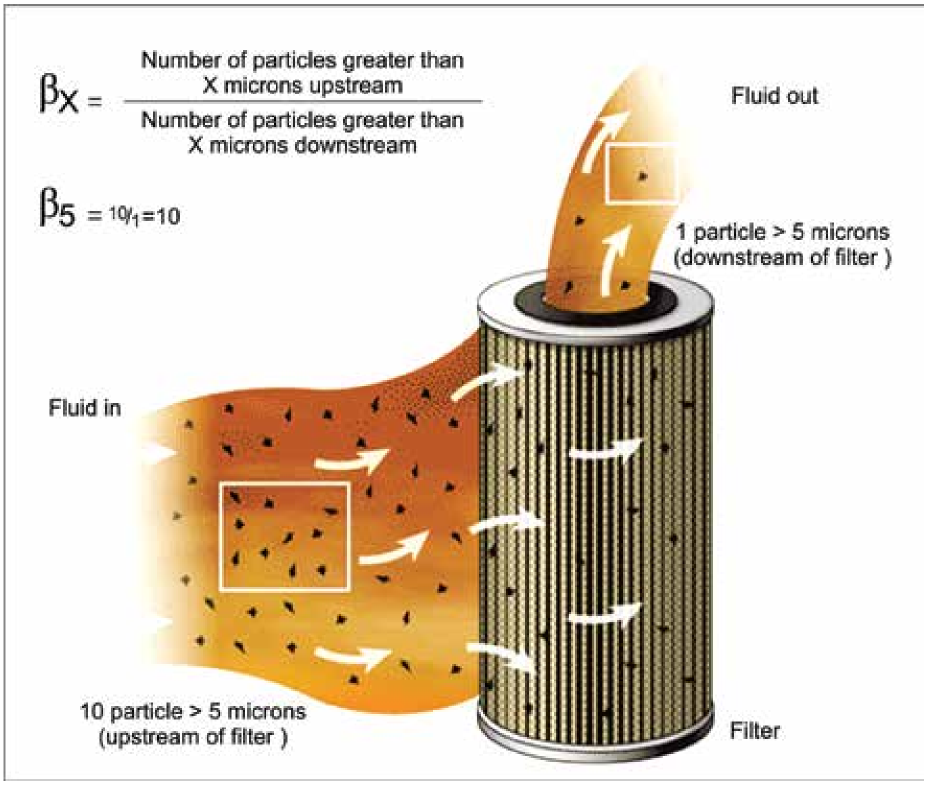


Figure 2: Beta Ratio Explained. Image Courtesy Noria Corp

Beta Ratio (x = particles size in microns)	Effciency
$\beta_x = 2$	50.0%
$\beta_x = 10$	90.0%
$\beta_x = 20$	95.0%
$\beta_x = 75$	98.7%
$\beta_x = 200$	99.5%
$\beta_x = 1{,}000$	99.9%

Figure 3: Beta Ratio and the Efficiency Percentages Courtesy Noria Corp

Filter Rating: The Importance of the Beta Ratio

Filter manufacturers use 'Nominal rating' to describe the filter efficiency. Most online filters have a nominal rating of 8 or 10 microns. This may mean 'most' particles of 8 microns can be trapped by the filter. In reality, both Nominal rating and Absolute rating are meaningless terms. They can be quite misleading. A 10 micron 'nominal rating' filter may allow particles several microns larger to pass through it. Probably the best indicator of filter efficiency is the beta ratio.

For example, $\beta 3 = 230$ implies that for every 230 particles of 3 micron or more

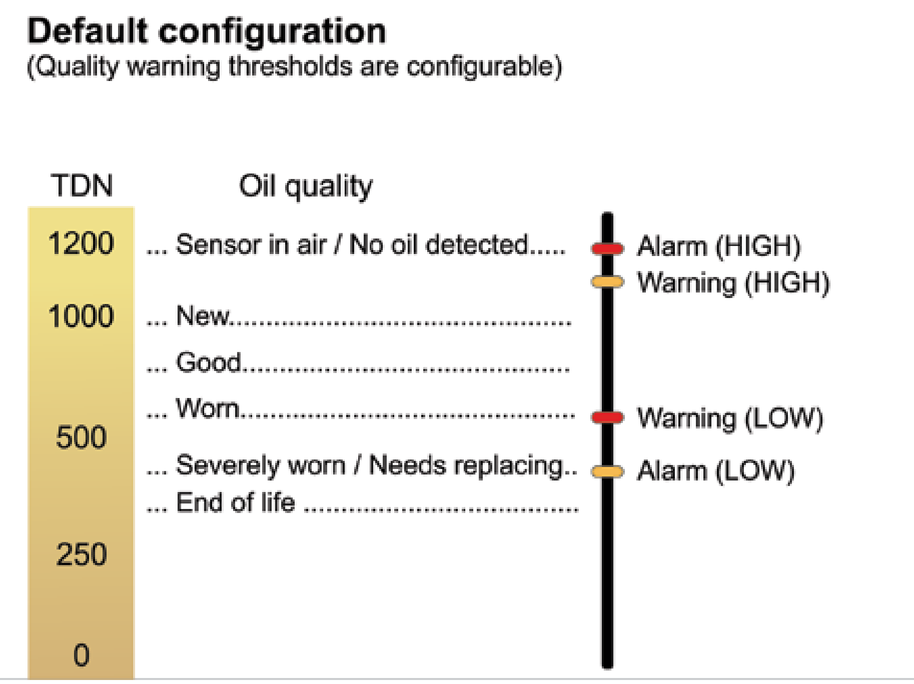


Image 4: Real-Time Display showing Oil Quality with automated alarms to trigger warning for an oil change

1 particle may pass through the filter. A β3=500 is obviously a better filter as only 1 out 500 particles, 3 microns or more will pass through the filter. The dirt-holding capacity of the filter defines, in grams, the number of contaminants it can hold before it is clogged. Filters made from cellulose material can also hold some amount of water. This is particularly useful in trapping water in hydraulic or Diesel engine applications.

Oil Analysis

The results of an oil analysis can be accurate (and therefore useful as a maintenance tool) if the oil sample is consistent. That means it must always be drawn from the same sampling point, preferably where there is a flow of oil. The sampling bottle must be clean (and sealed) prior to use. Drain a few hundred ml of oil before filling the sampling bottle. Unless the label is accurately filled with information, the data is useless. The minimum information required is the identification of the machine, the grade of oil, machine running hours, hours since the last overhaul, hours since oil change and the quantity of makeup oil since oil change. Most engineers do not bother to record the quantity of top-up oil used. This vital information is vital to assess the rate at which oil is deteriorating.

Particle Count

One of the ways of determining the quality of the oil is by understanding the contamination by measuring the sizes of the particles in the respective size brackets as defined by international standards like ISO 4406 or NAS 1638. The NAS 1638 standard gives the engineer an easy way to determine the particle contamination of the oil by the use of a single integer from 0-12. ISO 4406 is considered to be a better standard to gauge particle contamination in oil by specifically accounting for particles between 4μ-6μ, 6μ-14μ and above 14μ. It is important to understand that the NAS level or ISO 4406 standard can only give a partial understanding of the overall oil condition

Online Oil Monitoring

The results of the Oil Analysis can be useful if the report is delivered to the vessel as quickly after the sample is drawn. A 100 hours is the most ideal situation. However, the reality is different due to the logistics challenges that a vessel or offshore installation faces. Very often the oil report finally comes to the vessel weeks after the sample is drawn. Any useful benefit that the Ship's engineer may have had by analysing the report, if it arrived on time is diluted. How useful is it to know that your oil is diluted with fuel oil several weeks after it has been changed?

Online oil monitoring systems appear to be the answer and are now affordable. They give the user a visual indication of the quality of the oil, all in real-time. The more advanced systems now display a rate of oil deterioration and the estimated useful life of the oil. This means that if there is a sudden fuel leakage into the sump or ingress of water, an alarm can alert the Engineer and corrective action can be initiated before the oil is unfit for further use.

Another important reason to install online monitoring systems is that oil change can be extended to extract the maximum useful life of the oil. Often, especially in high-speed engines, an oil change is based on running hours of the equipment and not on the actual condition of the oil. Since the Ship's Engineer now has real-time data of the condition of the oil he can extend oil change intervals. That saves a lot of money to the ship-owner and optimizes the usage of resources. Most of these systems can be integrated

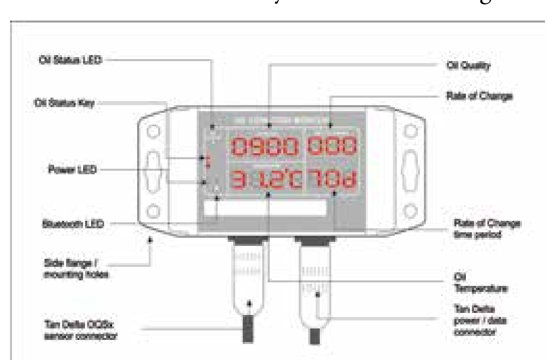


Image 5: Oil Quality Monitor displaying the rate of oil degradation and the useful life of the oil

LEM - MOISTURE Level

Source: Noria Corp.

Current Moisture Level, ppm	Life Extension Factor								
	2	3	4	5	6	7	8	9	10
50,000	12,500	6,500	4,500	3,125	2,500	2,000	1,500	1,000	782
25,000	6,250	3,250	2,250	1,563	1,250	1,000	750	500	391
10,000	2,500	1,300	900	625	500	400	300	200	156
5,000	1,250	650	450	313	250	200	150	100	78
2,500	625	325	225	156	125	100	75	50	39
1,000	250	130	90	63	50	40	30	20	16
500	125	65	45	31	25	20	15	10	8
260	63	33	23	16	13	10	8	5	4
100	25	13	9	6	5	4	3	2	2

1% water = 10,000ppm. • Estimated life extension for mechanical system utilizing mineral based fluids

Example: By reducing average fluid moisture levels from 2500 ppm to 156 ppm, machine life (MTBF) is extended by a factor of 5.

Figure 6: The correlation between moisture level in oil and oil quality. Source: Noria Corp.

with either the ship's control panels or can be connected to the ship's internet for remote monitoring at the head office.

Field Tests with Offline Filter Systems

Choosing the proper bypass filtration system is important. Certain electrostatic bypass filters become ineffective in the presence of even small quantities of water in the oil. Those without inbuilt motor and pump are idle when the main equipment is not working negating the very purpose of having bypass filters. Certain other types clog easily in the presence of moisture in the oil. Our experience is that we have been able to extend the life of the oil by a factor of 5 to 10 times using a properly designed bypass filtration system. That means that the payback period of the additional filtration system is very often less than a year. But our experience indicates that the main advantage of using bypass filtration systems is the prolonged MTBO. The clean oil ensures ideal lubrication conditions and this, in turn, increases the life of components by at least 25%

And finally a word on Oil filling. Most of us presume that new oil is clean, that oil from a sealed drum is fit for use directly in a system. This is far from the truth. New oil has a high particle count, often it is more contaminated than the oil in your hydraulic system. Oil filling into the system must be done through an online oil filling filter no less than 5 micron in size. Ensure that you keep your system tight and leak-free, prevent the ingress of air and dirt. Bypass filtration with online oil monitoring is the best bet to keep your equipment in ship-shape and save big bucks on maintenance costs.***MLI***

About the Author

Uday Purohit is the Managing Director of Neptunus Power Plant Services Pvt. Ltd. Marine Engineer by profession, Uday's area of expertise lies in Internal Combustion Engines and in Machine Reliability. He also serves as the Vice President of the Institute of Marine Engineers (India). Contact Uday at uday@neptunus-power.com

Alejandro Meza | Noria Corporation

Modern Methods for **Monitoring Water Contamination**

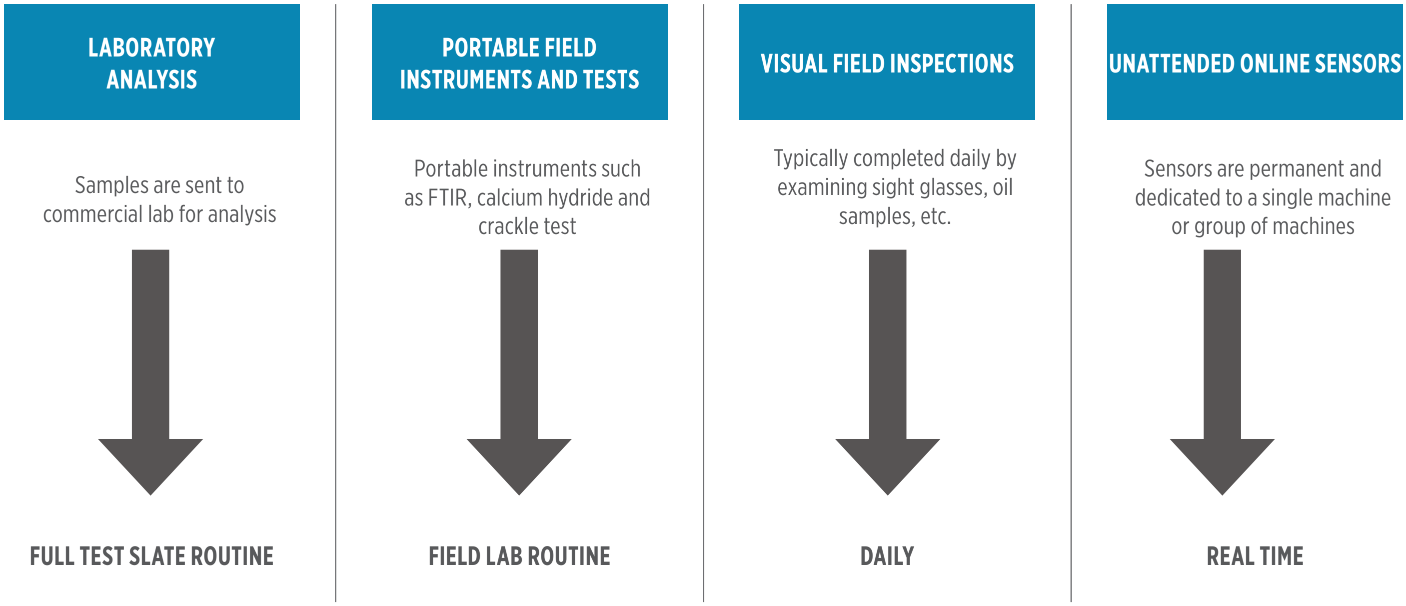
Water is an important resource in many production plants as well as a natural element in the environment. However, it is also an undesirable contaminant when present in lubricating oil or grease. In fact, water is the second most common lubricant contaminant and can cause a significant reduction in the life of machines and components. Therefore, it is critical to monitor water contamination to ensure machine reliability.

A number of different approaches can be used for monitoring moisture contamination, depending on the machine's criticality, the risk of failure and the available resources. These methods include laboratory oil analysis, portable field instruments and tests, visual field inspections, and online sensors.

> "Water is the second most common lubricant contaminant and can cause a significant reduction in the life of machines and components."

Laboratory Oil Analysis

Although laboratory oil analysis remains the most frequently used method of monitoring water contamination, it doesn't



This spectrometer from Spectro Scientific uses FTIR spectroscopy to monitor in-service oil.

necessarily represent the most effective approach in terms of early failure detection. With this method, oil samples are taken and shipped to an external laboratory to perform an agreed-upon test slate. This may also include an occasional or exceptional sample of new or used oil being sent to the lab for a specific purpose, such as quality control of the incoming lubricant or when an issue is suspected. While this approach is useful, the time from when the sample is taken until the report is read can be a limitation, especially if an abnormal condition is present. Among the technologies that laboratories employ to monitor moisture include Karl Fischer titration, Fourier transform infrared (FTIR) spectroscopy, relative humidity sensors and distillation.

Karl Fischer Titration

Karl Fischer titration is the preferred test due to its accuracy and consistency. ASTM D6304 is currently the recommended method. Results are reported in parts per million (ppm) or percentage of water. For high-viscosity lubricants or formulas containing sulfur and other compounds, the test results will be more precise if a vaporizer is used to remove water from the sample. Water may also be dissolved in toluene. This additional step is known as co-distillation. Errors due to the presence of certain additives without vaporization may be 50-100 ppm.

Of course, no laboratory test method is perfect, so some variability in the results can be expected. ASTM methods typically report the variability of each test in terms of repeatability and reproducibility. Karl Fischer titration is no exception. The results of this method generally are more precise and consistent for moisture concentrations greater than 100-200 ppm.

It is important to note that ASTM 1744 (Standard Test for Determination of Water in Liquid Petroleum Products by Karl Fischer Reagent) has been discontinued as an approved test method since 2016. While this test was somewhat easier to manage, it was not as accurate. Still, some laboratories continue to utilize it.

Relative Humidity Sensors

This technology has been employed to measure the moisture content of material in numerous industries for years. Recently, it was introduced to the lubrication field to monitor contaminants in lubricating oils and greases. It is supported by ASTM D7546 (Standard Test Method for Determination of Moisture in New and In-Service Lubricating Oils and Additives by Relative Humidity Sensor). Generally, an instrument heats a sample of test material

Relative humidity sensors, such as this moisture analyzer from Arizona Instrument, offer an alternative to Karl Fischer titration.

Multiple options are available for onsite infrared spectroscopy.

and volatilizes the moisture, which is carried by a dry-air system through a sensor block containing the relative humidity (RH) sensor. Reagents are not used. The results are reported in ppm or percentage/ micrograms of water. Studies on the method's repeatability and reproducibility have not yet been completed.

FTIR

FTIR is a well-known and frequently used resource for lubricants. It can detect the presence of contaminants such as water, fuel and soot, as well as certain additives and oil degradation. While there are several ASTM methods related to FTIR and petroleum products, two are most relevant: ASTM E2412 and D7414. This quick, low-cost test can measure different parameters in oil or grease samples. One drawback is the lower detection limit, which is approximately 1,000 ppm. The results are reported in absorbance units for certain infrared-light wavenumbers. The laboratory may also provide the moisture concentration by percentage or in ppm.

Distillation

In the distillation process, water is extracted from the oil or petroleum product by heating the oil sample, which previously has been mixed with a solvent. The water is evaporated and collected in a trap. The minimum amount of water that can be measured is approximately 0.05-0.1 percent. The procedure should follow ASTM D95. This method does not require complex test equipment, but it is labor intensive, which makes it impractical for routine oil analysis.

Portable Field Instruments and Tests

Field lab analysis involves the use of portable instruments in a workshop or production facility. The technology is the same as that utilized in the laboratory but with a more compact device. Usually only a drop of oil is required, and results can be reported in minutes. Other oil parameters besides moisture content may be detected as well. Cost is the main downside with this approach.

The calcium hydride kit is a common field test device. This test uses a reagent and a solvent (kerosene or toluene) to produce a reaction that generates gas from the existing water in the sample. It primarily measures emulsified and free water. Although low concentrations of water can be detected, this technology seems more reliable for concentrations greater than 150-200 ppm.

The crackle test is another example of a popular field test. It utilizes two drops of oil on the surface of a hot plate to evaluate the presence of emulsified and free water. The minimum concentrations that can be detected are approximately 500-1,000 ppm. With this test, it is important to pay attention to any small bubbles or crackling noise.

Visual Field Inspections

Field inspections for water contamination are mainly visual. Moisture can be detected through a sight glass, bottom sediment and water bowl or oil sample. Keep in mind that only emulsified and free water can be seen, so if it is visible, the concentration is quite high. Establishing inspection routines and protocols as part of your monitoring program will be critical.

Online Sensors

Online sensors can be installed in circulation lines or reservoirs. They monitor water concentration directly by a saturation detector or through an indirect parameter such as the oil's dielectric constant. This strategy may offer the best alternative in terms of early detection of contamination. Online or unattended sensors may also replace some routine oil analysis. For these reasons, there is an industry trend toward using this type of monitoring strategy.

The purpose of an online sensor is to emit electrical signals that are responsive to changes in the physical or chemical properties of the fluid being monitored.

Some sensors can measure water saturation as well as total moisture content.

An online water-in-oil sensor

Most sensors contain small electrodes that are immersed in the fluid. These electrodes generate electrical voltages and detect the oil's response in terms of capacitance, resistance, dielectric constant or current. The measurements are correlated with known changes in the oil's properties, such as water contamination, oxidation, cross-contamination with other fluids and wear debris. Some sensors have multiple measuring components, which allows monitoring of more than one property. Following are a few examples of these types of sensors currently available on the market.

Moisture Saturation Sensors

These sensors detect the dewpoint and percentage of saturation of dissolved water in oil. A water-permeable polymer is sandwiched between two flat electrodes to form a capacitor. Water penetrates the polymer to change the capacitance, which is used to measure the water-in-oil concentration. Refer to ASTM D7546 when utilizing this technology. These are the most commonly used sensors for moisture monitoring.

There are also online water sensors that measure the total water content by percentage or in ppm. They are capable of assessing dissolved, emulsified and free water in the oil. These sensors provide similar information to known lab test results for water content. However, the resolution of the sensors that monitor total water content may not be as fine or precise as the ones used to monitor water saturation.

Dielectric Constant Sensors

This type of sensor measures an oil property that changes with oxidation, contamination or wear debris. Called dielectric constant or relative permittivity, this property is related to an oil's capability to store an electric field. These sensors can detect changes in the oil's condition due to degradation or contamination. They must be set up for the specific fluid conditions in which they will work. Impedance spectroscopy and other technologies are often employed with certain styles of these sensors.

Multi-function Sensors

Multi-function sensors contain more than one measuring element to monitor up to three or four oil parameters, such as dielectric constant, saturation, temperature and conductivity. They may provide more comprehensive data about the fluid they are monitoring. Some even come with connectivity to report results wirelessly to a remote device or cellphone.

While the use of online sensors is promising for the early detection of abnormal conditions and a reduction of labor, some challenges must still be overcome. It will be important for users to determine which oil properties or conditions they wish to monitor and to be somewhat familiar with the different options for monitoring these properties.

Generally, sensors do not measure and report results like an oil analysis lab test. Most must be specified to the fluid they are monitoring. This requires comparing the sensor readings with the normal or abnormal conditions to be monitored in the oil. Laboratory support may be needed to correlate the sensor's electric signal with specific oil parameters. Finally, remember that all sensors do not have the same resolution and accuracy, so get to know your sensor's capabilities, applications and connectivity possibilities.

By using online sensors, field tests, inspections and routine oil analysis, you can detect water contamination and take corrective action earlier with relatively low monitoring costs. While the options are vast, you should be able to find a strategy that best fits your budget and reliability goals. **MLI**

About the Author

Alejandro Meza is a senior technical consultant with Noria Corporation. He has more than 20 years of experience in the lubricant industry, technical services, quality assurance, training, consulting and development in the United States, Brazil, Mexico and the Americas region. Contact Alejandro at ameza@noria.com to learn how Noria can help you identify the best ways to monitor water contamination in your lubricants.

3 Lubrication Myths **Impacting Your Production**

> "These myths can have extreme consequences and yet are easily remedied."

Which lubrication misconceptions are hurting your operations? It's well worth your time to find the answers. Addressing lubrication issues can provide any industrial facility with significant financial opportunities and a rapid return on investment (ROI).

My specialized career as a lubrication expert has allowed me to travel to many different manufacturing facilities, ranging from the steel industry to food and beverage, and everything in between. At several of these plants, I have observed some key lubrication misconceptions worth noting. These myths can have extreme consequences and yet are easily remedied. Following are the top three lubrication misconceptions that can impact your production.

Myth #1: Lubricating industrial equipment is simple and easy.

Fact #1: It is a highly detailed and complex process that requires expertise.

This misconception is deeply rooted in culture, so it's easy to see why this myth is so commonly held. There's an old saying that "oil is oil, and grease is grease." This couldn't be further from the truth. There are endless possibilities for lubricant formulations, and each one is slightly different and affects the machine in its own way. Aside from the correct lubricant selection is the actual application. How difficult can it be to hit a few fittings with a grease gun? The "rights" of lubrication spell it out — put the right lubricant in the right place, in the right volume, at the right frequency and using the right procedure. While this may sound simple, it isn't when you consider the sheer volume, variety and complexity of tasks required to keep industrial machinery properly lubricated.

Start by asking the right questions. Consider how many pieces of equipment you have in your plant. Next, look at how many separate components each one contains that involve lube-related tasks (e.g., motors, gearboxes, shaft bearings, couplings, filters, etc.). How many individual lube tasks are associated with each of these components? Keep in mind that some components may require many different tasks that go beyond simple application of grease, such as checking fluid levels in reservoirs, monitoring filters and seals or taking oil samples. In addition, many of these tasks must be conducted at varying intervals (e.g., daily, weekly, bi-weekly, monthly, annually, etc.). Across several thousand lube points, multiple tasks at varying frequencies can add up fast.

If you haven't performed this type of assessment in your facility, the yearly totals can be a real eye-opener. It is not uncommon for a well-developed lubrication program to have hundreds of thousands or even millions of individual tasks over the course of a year. So, maybe it doesn't sound so simple after all. But let's say you're still not convinced. Perhaps you're in the camp that says, "Lube tasks are lube tasks," so what could possibly go wrong? Plenty. The wrong lubricant could be specified or applied at the wrong interval, or maybe the lube tech simply uses too much, too little or the wrong lubricant. Let's not forget contamination, blown seals, etc. The list of what could go wrong is endless. It only takes one step in the task to miss the mark for the entire system to come crashing down.

Then there's the skill level of lube personnel. The best lube techs are rapidly aging out, and their replacements may not have the same level of knowledge or experience. How well do today's lube techs really know their jobs? More to the point, how well is management supporting them? Do they have access to the right knowledge and tools? According to a survey by the International Council for Machinery Lubrication (ICML), only 12 percent of lubrication personnel from all industrial sectors are professionally certified.

Myth #2: Minimal consequences and benefits are associated with routinely lubricating industrial equipment.

Fact #2: Lubrication has proven to have a significant impact on achieving operational excellence.

This misunderstanding claims that the role lubrication plays in industrial facilities is relatively minor; therefore, it doesn't warrant special attention. But what does research tell us? We know that the average maintenance budget allocates only 1-3 percent on lubrication depending on the industry. Studies suggest that while only a small amount is spent on lubricants and lubrication, this has a much greater effect on a plant's overall performance.

Dr. Ernest Rabinowicz, professor emeritus at the Massachusetts Institute of Technology, estimated that repairing the effects of friction and mechanical wear on industrial equipment costs the equivalent of 6 percent of the U.S. gross domestic product (GDP). Applying this calculation to last year's GDP results in losses of more than $1 trillion.

Researchers and manufacturers agree that the primary cause of friction and mechanical wear is poor lubrication. In fact, according to the manufacturers of machine components, improper lubrication leads to 43 percent of mechanical failures, 54 percent of bearing failures, 50 percent of roller bearing damage and 70 percent of equipment failures.

Inadequate lubrication is not only a common problem but also a severe one. Whatever the total losses may be worldwide, the more immediate concern is how much improper lubrication is costing your organization. Among the factors to consider are your annual spending on bearings, how many replacement bearings are needed in a given year, the cost to replace just one bearing, and the costs involved in replacing your motors and gearboxes. You should also determine expenses from unplanned downtime, repetitive cycles of time-intensive reactive maintenance, lost production, safety issues, environmental impacts and higher energy costs. Added together, these costs are more than likely out of control.

Myth #3: Lubrication is an unnecessary cost to the organization.

Fact #3: A quality lubrication program can provide a substantial financial opportunity.

Maintenance budgets remain on the chopping block. Everyone is trying to do more with less. Staffing levels are way down. Skilled positions are being lost to attrition. Instead, wouldn't it be great if you could just do more with what you already have? That's precisely the opportunity that a properly developed and managed lubrication program provides.

With lubrication best practices and appropriate management tools, industrial facilities can reduce unplanned downtime and reactive maintenance, eliminate the primary cause of equipment failure at its source, achieve higher productivity from existing equipment assets and personnel, and minimize oil waste and environmental costs.

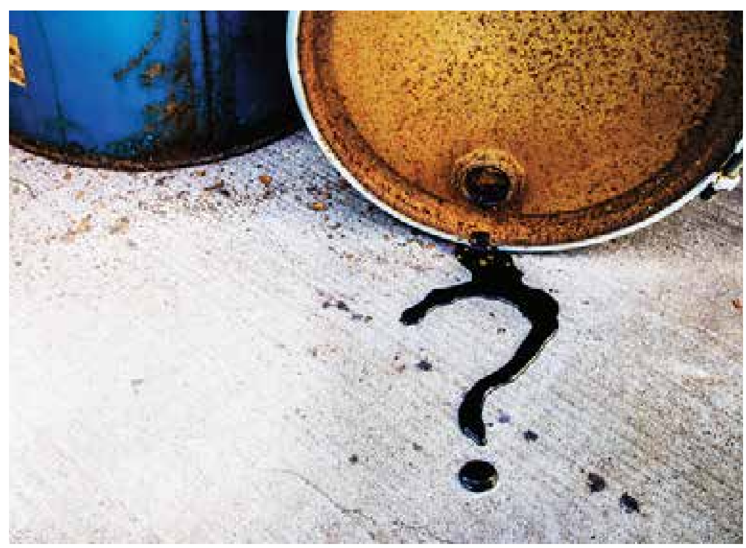
All of these "costs" should be seen as an investment opportunity in moving your lubrication program toward a world-class level. Remarkable ROI has been generated in many of the world's most successful programs, often eclipsing the 1,000 percent mark and realized within the first six months. You can reap these same rewards by arming yourself with simple awareness of the truth about lubrication and by developing a strategic game plan. **MLI**

Keith Spoonmore | Noria Corporation

BACK PAGE BASICS

Oxidation: Why Good Oil Turns Bad

"A bad environment can have devastating **effects on the quality and life of a lubricant.**"



Oxidation could be described as the degradation of good oil gone bad. What was once a stable lubricant is now just sludge and varnish causing havoc in your equipment's system. How does this happen? What was true when your mother said hanging around the wrong crowd was bad is also true with your lubricants. A bad environment can have devastating effects on the quality and life of a lubricant. To keep your lubricant in optimum condition, the bad environment must be identified and steps taken to prevent its destruction.

Lubricants are vulnerable to attack. Most non-synthetic lubricants are comprised of two components: mineral oil and additives. The oil is a group of molecules made of hydrogen and carbon atoms. These atoms have a positive attraction for each other, connecting by a method called bonding. If the right amount of hydrogen and carbon is available, the molecules are said to be saturated. This means they are stable and will not attempt to react with other potentially bad elements.

The problem arises when some hydrogen atoms are not present. The molecule becomes unsaturated and is quite reactive. This can be the beginning of the end for the lubricating oil.

Oxygen

The bad environment comes from an unlikely source: oxygen. Oxygen is the third most abundant element on earth. It is in the air you breathe and the water you drink as well as countless other substances. Oxygen as an element is actually two atoms which bond together and generally are not a major source of problems. If, however these atoms separate, they go looking for another element to bond with and produce a reaction. This separation of the oxygen element is caused by an increase in energy. The separated oxygen atom encounters an unsaturated hydrocarbon, they bond, and the

reaction is devastating. Acids are created which attack the oil, resulting in oxidation. Air is the major source of oxygen needed to make the good oil turn bad.

Heat

The energy needed to separate the oxygen atoms, and to some extent the hydrocarbons, comes in the form of heat. Heat can originate from a myriad of sources, including the mechanical process, the external environment, friction, etc. For the oxygen element to separate, only a small amount of energy is required (approximately 495 kilojoules). This is equivalent to 120 calories, which is about the same amount as a half slice of birthday cake. Hydrocarbons are a bit worse and require less energy. Any increase in heat creates a volatile environment, adding to the potential of oxidation and varnish formation.

78%

of lubrication professionals say oil degradation products such as oxidation and varnish have caused problems for their plant's machines, based on a recent survey at MachineryLubrication.com

Other Bad Environments

Other environments may also affect the life of a lubricant. For instance, water can impede lubricant life. However, this generally is accomplished by degrading additives that attempt to deter oxidation. Water requires a lot of energy to break apart, so oxygen availability is limited. In addition, metals can react with mineral oils, causing sludge. Process fluids may be damaging as well. Process acids can lead to major destruction. Ultraviolet light is another source of energy that can result in oil degradation.

Controlling Oxidation

Preventing the lubricant from a life of oxidation requires minimizing the availability of air and controlling heat. It is important to remember that heat alone will not lead to oxidation. It can only expedite the reaction process between two unstable elements. Since heat reduction or control may be difficult to achieve, controlling air availability is a better option. Following are some actions to better control air and heat in your systems.

Air Control

In circulating lubrication systems, ensure the fittings and connections are tight. Air can be sucked into the lubricant through loose connections. Once inside, there is plenty of agitation to allow the oxygen and hydrocarbons to react. Also, keep your bearing seals in good shape. Air can infiltrate through defective seals, enabling the oxygen and hydrocarbons to react and form oxidation products. On reservoir systems, maintain a positive pressure. Using an inert gas such as nitrogen prevents air from entering the system. Finally, consider oil mist. Although oil mist is mostly air, the temperatures are low enough to prevent the oxygen atoms from separating. It also provides positive pressure to keep external contaminants at a minimum.

Heat Control

Always use the correct viscosity grade. Low-viscosity lubricants allow metal-to-metal contact, which generates friction and results in excess energy from the heat produced. A high viscosity can cause internal friction and lead to similar problems. Your lubricant and equipment manufacturer can help you determine the right viscosity for your application.

Equipment vibration should also be kept at a minimum. Excess vibration can occur for a multitude of reasons and cause increased metal-to-metal contact and heat. Additionally, try to restrict external heat where possible. Use fin fans or covers to inhibit the heat absorbed from the environment. Consider adding coolers to reduce heat buildup in the lubricant.

Avoid Bad Environments

How do you keep a good oil from turning bad? Analyze your lubricant systems, looking for air-entry avenues. Remove these points of entry wherever possible. Find the sources of heat and engineer methods to reduce or control that energy.

Lubricants can have long lives free of oxidation. Equipment optimized in this manner will provide high production rates and minimal downtime. Just stay away from those bad environments. ***ML***

About the Author

Keith Spoonmore is an independent consultant in lubrication and reliability. He holds a Level III Machine Lubricant Analyst (MLA III) certification from the International Council for Machinery Lubrication (ICML). His career spans sales, technical and engineering experience with several major lubricant manufacturers and industrial companies. He currently provides training and technical assessments for Noria Corporation and other independent work. Contact Keith at kspoonmore.ncic@noria.com to learn how Noria can help keep your lubricants in optimum condition.

The "Lube-Tips" section of *Machinery Lubrication* magazine features innovative ideas submitted by our readers.

Make Oil Sampling Easier

When labeling oil sample bottles prior to taking samples, consider identifying the bottle caps as well as the labels. A felt-tip pen works well. This will save a lot of time as you will not have to pick up each bottle to tell which one you need next.

Purge Grease Fittings Before Installing

Purge all new grease fittings with a grease gun before they are installed on your machine. Use the same type of grease that will be used later for regreasing. This practice will remove any dust, burrs or other debris that has collected inside the grease fitting. It will also reduce the risk of cross-contamination between different grease products.

Use Self-Closing Valves

Consider using self-closing valves as the dispensing valves on oil drums that are stored in a horizontal position. A self-closing valve will eliminate the possibility of the dispensing valve being left partially open and draining the entire contents of the drum on the ground or containment pad.

Sight Glass Reading May Be Deceptive

Sight glass tubes can get clogged at the intake and hold lubricant in the tube. Even when the oil or grease level in the equipment drops low, the sight glass may continue to indicate the level is adequate. Use a wire or pipe cleaner brush at each servicing to make sure the sight glass tube is clear from intake to glass. This applies to oil sight glasses that can get clogged from contaminants as well as grease applicators that can get dry grease bridges. ***ML***

Did You Know?

Additional tips can be found in our Lube-Tips email newsletter. To receive the Lube-Tips newsletter, subscribe now at machinerylubricationindia.com

Have Some Tips?

If you have a tip to share, email it to admin@machinerylubricationindia.com

TEST YOUR KNOWLEDGE

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

1. Abrasive wear occurs where?

A) Pistons/cylinders
B) Cams
C) Rolling-element bearings
D) Gears
E) All of the above

2. Sampling non-circulating, splash/bath machine sumps is best done by:

A) Drain plug removal
B) Using a flexible, drop-tube, vacuum sample
C) Using a flexible, drop-tube, vacuum sample from the bottom of the sump
D) Obtaining a mid oil level sample from a fixed rigid tube within the sump
E) These systems should not be sampled

3. Visually checking the color of a used oil sample can indicate:

A) Oxidation
B) Soot
C) Water contamination
D) A change in base number
E) Answers a, b and c

ANSWERS

1. E

Abrasive wear normally occurs in sliding contact applications. However, it is not limited to just pure sliding contact. It is seen in all applications where abrasive particles get between mating surfaces. This includes pistons, cylinders, cams, rolling-element bearings, gears, etc.

2. D

The best method is to install a sampling valve equipped with a rigid stainless-steel tube. The tube should be manipulated to be close to the zone of fluid movement (mid oil level). A minimum clearance of 2 inches from any dynamic or static surface should be maintained.

3. E

Visual inspection can indicate oxidation, as oxidized oils tend to be darker. Soot is a heavy, black substance usually seen at the bottom of a sample bottle. Water contamination also can be easily observed as free water in the bottom of the bottle if the concentration is high. Other oils tend to emulsify, producing a milky appearance.

Two day training program on "Lubricants Blending and Quality Assurance" was conducted at Holiday Inn, Mumbai recently. There were participants from India and several Asian countries like Bangladesh, UAE, Nepal and Iran. The training was a great success as the participants enhanced their knowledge on finer points of Lubricant blending, Troubleshooting, Quality Assurance, Efficient operation of Lube blending plant. This two day training course provides an in-depth understanding of the principles, economics and flexibility of lubricant blending plants. It also covers how to operate a lubricants blending plant efficiently and economically.

Three day training on Essentials of Machinery Lubrication conducted recently in Delhi and Kolkata (India). Essentials of Machinery Lubrication course provide the foundational knowledge & skill sets on different types of lubricants, their specifications, storage applying best lubrication practices and product knowledge. The training was a great success as the participants enhanced their knowledge on various topics like industrial lubricants, machinery lubrication, contamination control and oil sampling. ICML Certification exam was also conducted, where majority of the participants joined the elite group of certified professionals.

For more details on this training program and other trainings, visit - http://lubrication-institute.com/

Indian Oil inks agreement with Cummins; to collaborate for Diesel Exhaust Fluid (DEF) bulk dispensing

IndianOil has signed an agreement with Cummins Technologies for bulk dispensing of IndianOil's Diesel Exhaust Fluid (DEF), branded as IOC ClearBlue, in their advanced engines with SCR (Selective Catalytic Reduction) systems. Mr. Subimal Mondal, Executive Director (Lubes), IndianOil, and Ms. Anjali Pandey, Vice President (Engine Business Unit and Component Business), Cummins Technologies India Private Ltd., signed the agreement at Mumbai recently.

Mr. Mondal of IndianOil, said "With this collaboration, IOC CLEARBLUE is recommended for use in all diesel vehicles that have Cummins engines or any other engines with Cummins SCR technology. IOC CLEARBLUE adheres to the highest quality standards by meeting IOC 22241 and AdBlue certification".

Ms. Anjali Pandey of Cummins Technologies, said "At Cummins, we understand the need of the market. With this initiative, IndianOil's innovation in a diesel exhaust fluid - IOC CLEARBLUE - delivers superior results that ensure emissions controls".

India will shift to BS-VI auto fuel emission norms from 1st April 2020. The automobile companies are effecting several technical changes in diesel vehicles such as provision for fitting diesel particulate filter, selective catalytic reduction (SCR) and exhaust gas recirculation (EGR). The SCR systems shall require DEF, an aqueous urea solution, for effective reduction in Nitrogen oxide emissions. Bulk dispensing of DEF is in line with global trends and offers better cost viability to truck and bus owners, as compared to packed products. The technical knowledge of Cummins combined with the bulk dispensing expertise of IndianOil shall help offer a world-class product to the customers across the country.

UPCOMING EVENTS

☑ Mark Your Calendar

MAY 2020 03 - 07
75th STLE Annual Meeting & Exhibition
Chicago, Illinois, USA

MAY 2020 20 - 21
8th CIS Base Oils and Lubricants Conference
Moscow, Russia

MAY 2020 26 - 27
5th International Metalworking Fluids and Industrial Lubricants Conference
Moscow, Russia

JUNE 2020 09 - 10
Lubmat 2020
Bilbao, Spain

JUNE 2020 14 - 17
NLGI 87th Annual Meeting
Miami, Florida, USA

JUNE 2020 28 - 02
ASTM Committee D-2 Petroleum Products, Liquid Fuels, and Lubricants
Washington DC, USA

AUGUST 2020 30 - 01
Petroleum Packaging Council Fall Meeting,
Nashville, Tennessee, USA

BASE OIL REPORT

India is heavily dependent on oil imports from West Asia. Top three suppliers in 2018-19 were from Iraq, with about 46.6 million tonnes (MT), followed by Saudi Arabia (40.3 MT) and the UAE (17.5 MT). Kuwait supplied 10.8 MT. Together, these countries supplied about 51% of the total of 226.5 MT of oil worth $111.9 billion or Rs 7.83 lakh crore. India's crude oil import dependency on the basis of consumption was 83.8% in 2018-19. Put otherwise, 8.38 of every 10 litres of crude consumed in the country was imported.

India is the third-largest consumer of oil after the US and China. India's efforts in recent years have resulted in diversification of energy sources with the focus on secure, stable and predictable supplies, a third official said, also on condition of anonymity. Efforts have also been made to change the energy mix, with a push for including more renewable sources.

The Indian domestic market Korean origin Group II plus N-60–70/150/500 price at the current level is marginally up for lighter grades and heavier grades. As per conversation with domestic importers and traders prices for N – 70/ N- 150/ N - 500 grades and at the current level are quoted in the range of Rupees 42.95 – 43.15/43.65 – 43.80/48.80 – 48.95 per litre in bulk plus 18% GST as applicable. Discounts being offered for sizeable quantity. The above mentioned prices are offered by a manufacturer who also offers the grades in the domestic market, while another importer trader is offering the grades cheaper by Rs.0.30 – 0.35 per litre on basic prices. Light Liquid Paraffin (IP) is priced at Rs.44.35 – 44.50 per litre in bulk and Heavy Liquid paraffin (IP) is Rs.50.20 – 50.35 per litre in bulk respectively plus GST as applicable.

While in the month of November 2019, India imported 268449 MT of Base Oil, India imported the huge quantum in small shipments on different ports like 162135 MT (60%) into Mumbai, 37295 MT (14%) into JNPT, 20189 MT (8%) into Pipavav, 15983 MT (6%) into Chennai, 10279 MT (4%) into Hazira, 8864 MT (3%) into Kolkata, 6719 MT (3%) into Mundra, 4312 MT (2%) into Kandla, 1631 MT (1%) into Ennore and 1042 MT into Other Ports.

Dhiren Shah
(Editor – In – Chief of Petrosil Group)
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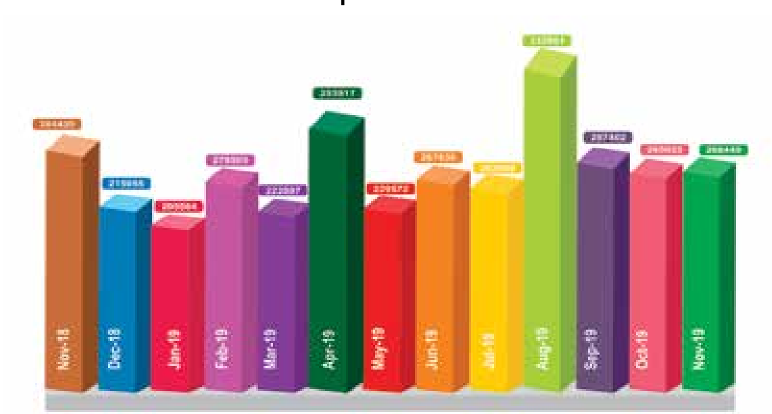
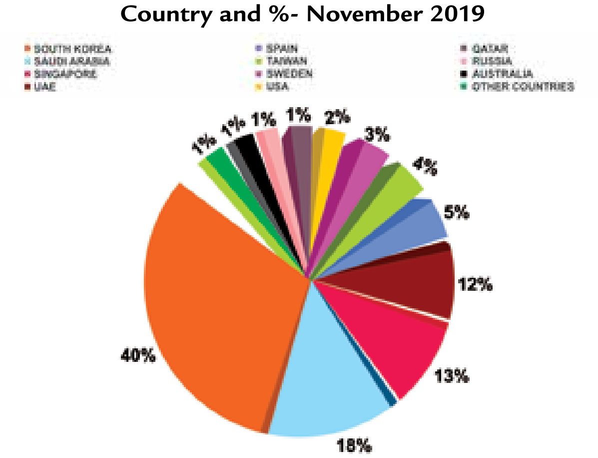
Month wise import of Base Oil in India

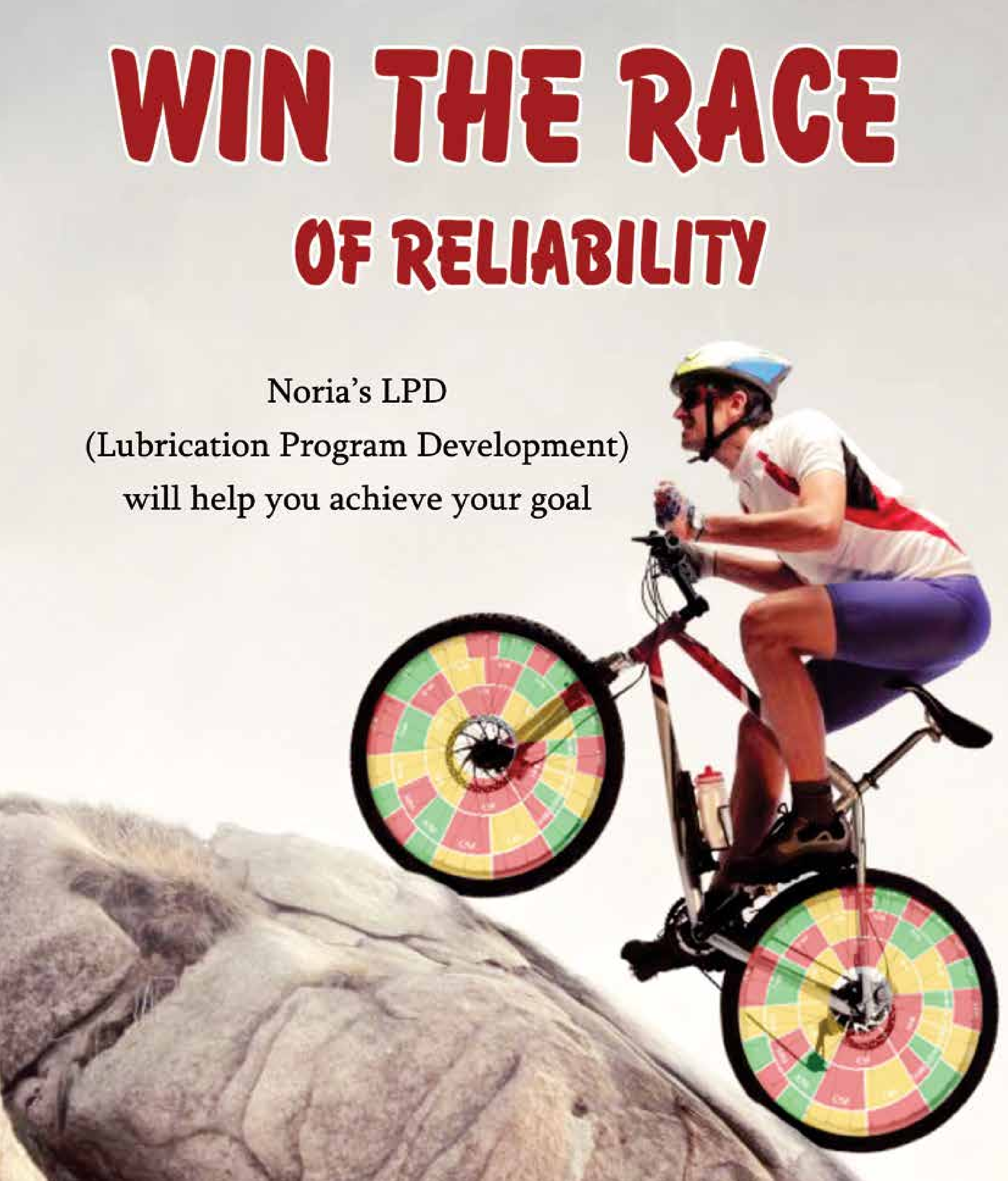


Origin wise Base Oil import to India, Country and %- November 2019



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

Month	Group I - SN 150 Iran Origin Base Oil CFR India Prices	Napthenic Base Oil HYGOLD L 2000 US Origin CFR India Prices	N- 70 South Korea Origin Base Oil CFR India Prices	Rubber Process Oil (Aromatic Extract) (Drums) Iran Origin CFR India Prices
November 2019	USD 565 – 575 PMT	USD 665 – 675 PMT	USD 610 - 620 PMT	USD 345 – 350 PMT
December 2019	USD 545 – 555 PMT	USD 625 – 635 PMT	USD 595 - 605 PMT	USD 335 - 340 PMT
January 2020	USD 550 – 560 PMT	USD 630 - 640 PMT	USD 600 - 610 PMT	USD 340 - 345 PMT
	Since November 2019, prices have decreased by USD 15 PMT (3%) in January 2020.	Since November 2019, prices have fallen down by USD 35 PMT (5%) in January 2020.	Since November 2019, prices have decreased by USD 10 PMT (2%) in January 2020.	Since November 2019, prices have dipped down by USD 5 PMT (1%) in January 2020.


WIN THE RACE
OF RELIABILITY
Noria's LPD
(Lubrication Program Development)
will help you achieve your goal