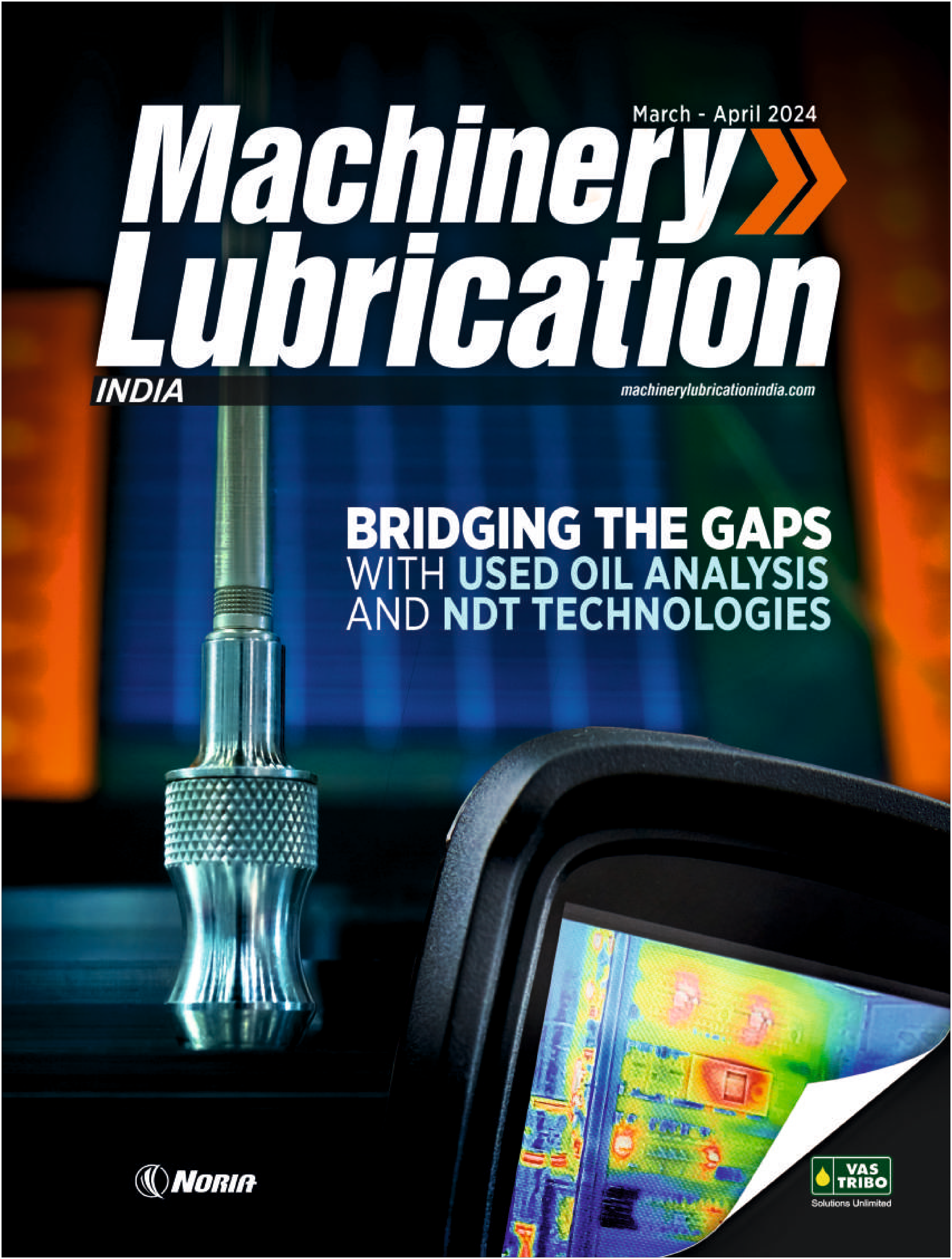
March - April 2024
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Publisher's Note

The shift towards electric mobility in India can benefit the environment by improving air quality and reducing Greenhouse Gas (GHG) emissions. Oil companies are now offering electric vehicle (EV) charging facilities at more than 15,000 petrol pumps across India, helping build an ecosystem to spur the growth of low-emission vehicles. In electric vehicles much less lubrication is needed, but it is still needed for various odds and ends on the vehicle. A robust EV charging infrastructure in India can positively impact the growth of the EV market by reducing range anxiety and enhancing EV adoption. If India can achieve its goals it can also have a positive impact on the country's economy. It can also inspire other countries, thereby ultimately creating a more sustainable and greener future for all.

Then again, for those in the lubricant space, this is also the time to start asking tough questions and to begin to reposition their businesses to be able to face the challenges of the future. Proper lubrication can therefore prove an effective means of pushing business forward due to its positive impact on equipment performance. Matchmaking is important in the world of lubrication. Each type of machinery requires a certain type of lubricant to be effective; they can't just be mixed and matched at random. You should also know how much lubricant is required for the workload of the equipment. Not using enough can result in breakdown but using too much is not cost effective and could even cause machinery to jam.

Proactive maintenance is based on root cause analysis. It is performed while the equipment is in operation, regardless of whether slow down or failure signals have been observed. Appropriate lubrication and cleanliness of lubricants both play an important part here. The challenge going forward for those responsible for managing equipment maintenance is to adopt a new approach that places greater emphasizes on the prevention of mechanical issues and breakdowns by implementing preventive and predictive maintenance strategies, rather than a reactive approach focusing on fixing broken equipment. You simply cannot take shortcut to cultural change within an organization. Today we see many organizations that have already gone through the transformation, while others have yet to begin. Understandably, there has been resistance to tinkering with past routines and practices. Maintenance and business success are interconnected. It becomes increasingly clear that any decisions that can improve the former are likely to benefit the latter.

The cover story talks about used oil analysis. It has long been a tried-and-true method for machine health condition monitoring. However, it does have its limitations. Therefore, embracing the inherent strengths of additional ancillary non-destructive testing (NDT) technologies provides a holistic approach and places your organization in a place to further succeed. Some additional articles covered in this edition includes: Is liquid sandpaper lurking in your machine? ASTM enhancements to microscopic particle identification and documentation, 4 key elements for interpreting an oil analysis report, Top leadership focuses for improved reliability and cost reduction, inspecting a single-point lubricator, lubricant contamination prevention and mitigation, lubrication contamination prevention, why scheduled oil changes aren't enough to mitigate lubricant contamination, engineering reports should be like bad movies, Maintain? repair? replace? The secrets for implementing a clean lubricant program and much more.

We look forward to your support and feedback to enable us to improve the content and layout of Machinery Lubrication India. We welcome readers to participate by sending their feedback & contributing articles and case studies. We look forward to the continued patronage of the advertisers and the subscribers.

Warm regards,
Udey Dhir

IS LIQUID SANDPAPER LURKING IN YOUR MACHINE?

Certain subjects merit emphasis and should be frequently revisited. Contamination control is one such subject. Particles are like a virus, invisible to the naked eye but packing a powerful punch. The most destructive particles are typically less than ten microns in size (for comparison, a thousandth of an inch is roughly 25 microns).

The microscopic size of these destructive particles makes them hard to measure and count. Over time, they keep accumulating in the oil. Even in relatively high concentrations, their presence can remain hidden from view and undetectable to the touch. This explains why they are often referred to as "ghost riders".

Think of ultrafine sandpaper at 1000 grit. The size of abrasive particles that are bound to the paper range from 6.8 - 9.3 microns in diameter. Lubricants with high populations of suspended particles of that size range effectively form a medium with the potential to exact considerable harm to the machine.

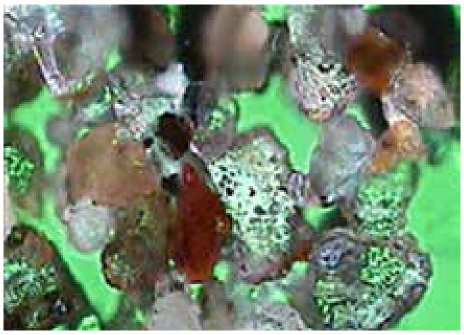

Figure 1. Microscopic view of descriptive silt-size particles that can contribute to the liquid sandpaper effect. Courtesy of R&T.

Compared to larger particles, small silt-size particles easily evade even the finest filters, and larger particles are often quickly crushed into many smaller particles (comminution). As shafts rotate or slide against opposing surfaces (bearings, seals, gears, pistons, cams), microscopic excavations occur (dents, gouges, scratch marks), producing even more particles. Over time, the concentration of these small particles forms a medium that is functionally equivalent to liquid sandpaper.

Think of a belt sander. Even fitted with fine 1000-grit paper, it can polish away vast amounts of metal in short order. Now imagine a heavily loaded shaft rotating at high speed against a journal bearing lubricated with contaminated oil. It's the same thing, and the shaft and bearing get polished. This is called three-body abrasion.

The Causes of Liquid Sandpaper

The smaller the particles in your oil, the more evasive they become. They are difficult to extract by filtration and centrifuges, and they are very slow to settle in tanks and reservoirs, if at all. Small particles easily remain suspended by turbulent oil movement.

We are all aware that particles create more particles. The number of new particles generated from a single ingressed particle depends on many factors, including the:

- Type of machine
- Filtration
- Settling
- Number of frictional zones
- Working clearances
- Operating speeds

Basically, it relates to how many surface

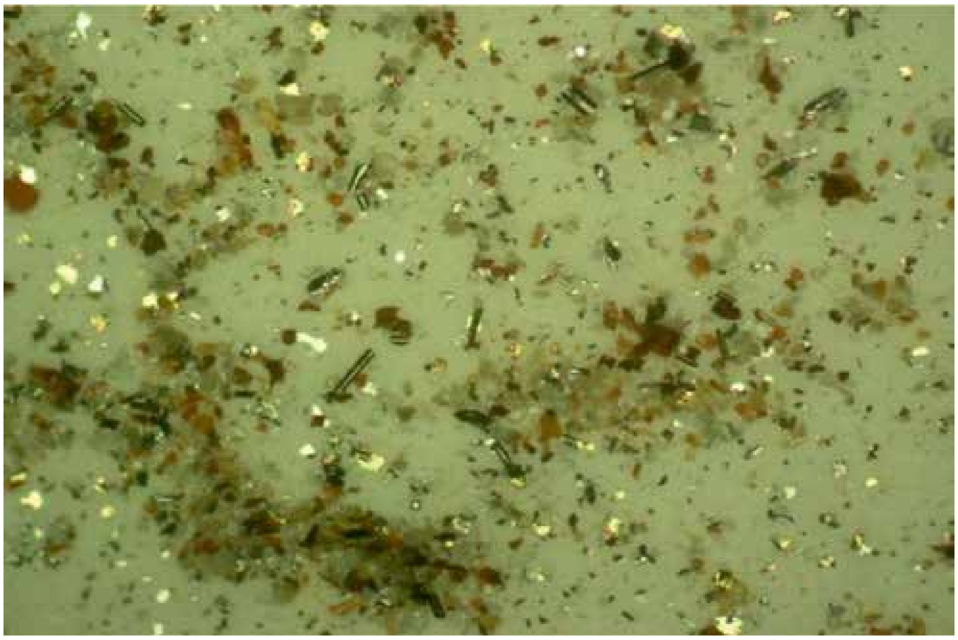

Figure 2. Debris field on a membrane showing the collection of extremely small particles after they were extracted from the oil. Both dust and wear particles are present.

scratches and indentations a particle is allowed to make before being pulverized, settled to the tank floor, or removed by a filter or oil change. If ingressed particles reach the filters quickly, there is less damage, and fewer new wear particles are produced. Conversely, if no filtration or poor filtration is the case, this leads to longer particle residence time in the fluid and, thus, greater damage and production of wear debris.

An average ingressed dirt particle (left in the oil) will generate somewhere between five and 20 new particles (secondary particles). Some of these particles will make more particles (tertiary particles). The situation is self-propagating. Additionally, a single scratch mark from a grain of dirt can produce a corkscrew wear particle long enough to crush into five or more particle segments.

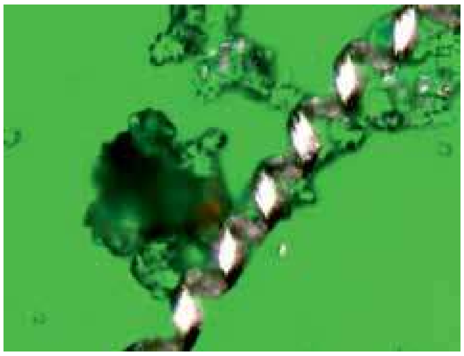

Figure 3. Corkscrew particle formed by abrasive cutting action (three-body abrasion). Courtesy of R&T.

Why Small Particles Matter

The most destructive particle in our lubricants can be characterized by the following features and properties:

- Is roughly equivalent in diameter to be carried into the working clearances of frictional zones (sliding or rolling) of our machines – usually less than ten microns.
- Is harder than our machine's surfaces. Particles of sand and ambient dust will scratch a hacksaw blade. Large particles are more friable (crushable) than small particles.
- Will easily remain suspended due to its small size, turbulent fluid movement, and lack of suitable filtration.
- Has sharp angular edges from comminution.
- Is small enough to bypass seals and enter the headspace of sumps and reservoirs.
- Is small enough to get sucked into drums and totes of oil by the normal siphoning.
- Is small enough to accumulate large amounts of interfacial surface area in contact with the oil and its additives.

All these collectively contribute to liquid sandpaper.

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CORRESPONDENCE
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Operation office :

Editor
213, Ashiana Centre, Adityapur,
Jamshedpur-831013, India
email : support@machinerylubricationindia.com
Tel: / WhatsApp : +91-7004734515

Marketing Office
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Solving the Liquid Sandpaper Problem

Solving the liquid sandpaper problem starts with preventing contamination from getting into the oil in the first place. Exclusion is far cheaper than removal, by a factor of at least ten.

Exclusion means addressing the problem at the source. Take inventory of contaminant ingression sources. For many machines, the inhaling of airborne contaminants into the headspace of drums, totes, and reservoirs is the primary source. Forced convection of air by thermal siphoning, machine-driven air-currents (e.g., movement of gears, plunging oil return-line flow), and cyclical changes in the tank oil level (hydraulic cylinder movement) can escalate the ingress.

Figure 4. Oil drums breathe in dirt and moisture by thermal siphoning due to routine changes in ambient air temperature. When ambient air cools, air, moisture, and particles can be siphoned into the drum's headspace. Over time, contamination keeps building up in the oil. This device, sold by Luneta, enables quick inspection of this siphoning action so that swift corrective measures can be taken.

Air typically enters through:

- Vents and breathers
- Shaft seals
- Unsealed hatches and clean out covers
- Other unprotected machine openings.

Dirty transfer containers, hoses, and funnels are also common sources of particle contamination. During storage, dirt and moisture-laden ambient air passes through bungs on drums and totes. In fact, new oil is a major source of liquid sandpaper contamination.

The cost of contaminant exclusion relates to both retrofitted hardware and routine maintenance tactics for blocking contaminant entry. These costs include such things as:

- Transfer cart filtration
- Proper breathers on machines and lubricant storage vessels
- Improved seals (such as labyrinths)
- Tighter system closures
- Greater awareness and care during internal inspections and part replacements (education and better procedures/tools)
- Routine cleaning of machine exteriors

Figure 5. A high percentage of hydraulic system-particle ingression comes into play with the cylinder wiper seal. When looking at this, it is easy to imagine the liquid sandpaper in your oil. Image courtesy of M. Williamson.

Next, quickly remove particles that do touch the oil, so they don't multiply by crushing and wear debris generation. Fine filtration, especially offline filters, can help. They cost considerably less than full-flow filters per gram of dirt removed.

You can also use a separation booster to agglomerate particles so they can be more easily separated by gravity, centrifugation, and/or mechanical filtration. These fluid conditioning products can effectively polish your oil even at a submicron level before harm is done to the machine and additives.

As a last resort, if your lubricant is packed with liquid sandpaper and the cost of cleaning the oil is impractical, simply change the oil.

Should You Just Let Machines Fail?

Consider this – you come up with a smart plan to get liquid sandpaper under control, including both exclusion and removal. You've carefully studied and engineered the optimum solution. There are costs involved, but as usual, it's a matter of "pay some now or a lot more later." However, management and the bean counters are skeptical and have asked for a financial justification study. This is not your skillset, so you dismiss the idea. Things go back to business as usual.

Ask your self, when was a financial study ever requested to obtain funds to repair a failed machine, especially when plant production was stalled? Sadly, I've heard maintenance folks say they've quit trying to propose proactive measures to management – they claim it's easier to just let the machines fail.

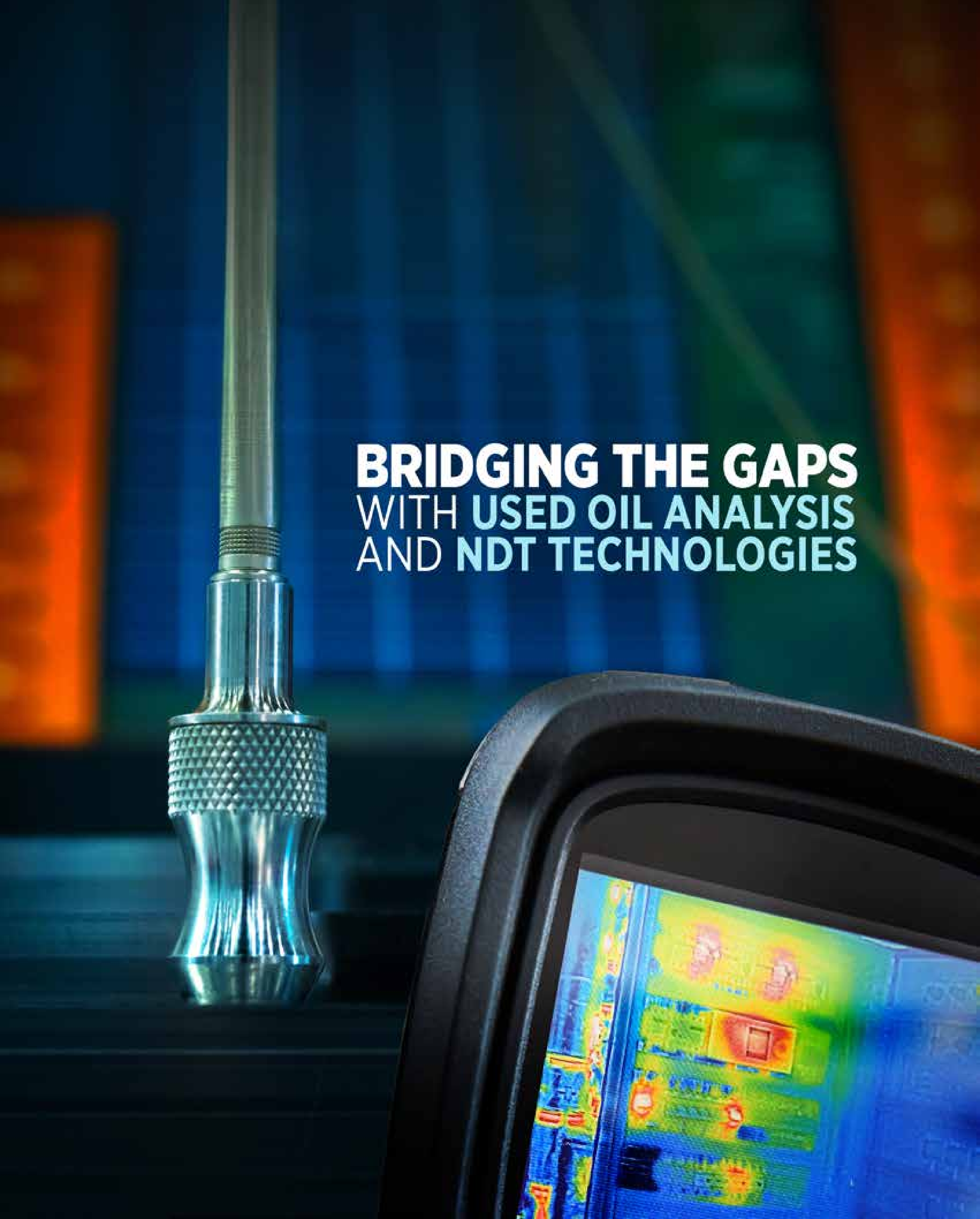
This is like saying it's easier to wait until you have a heart attack rather than proactively make the lifestyle changes needed to avoid heart disease. These differences are often deeply ingrained in management and business culture. Does your organization have the "here and now" folks or those who plan and prepare?

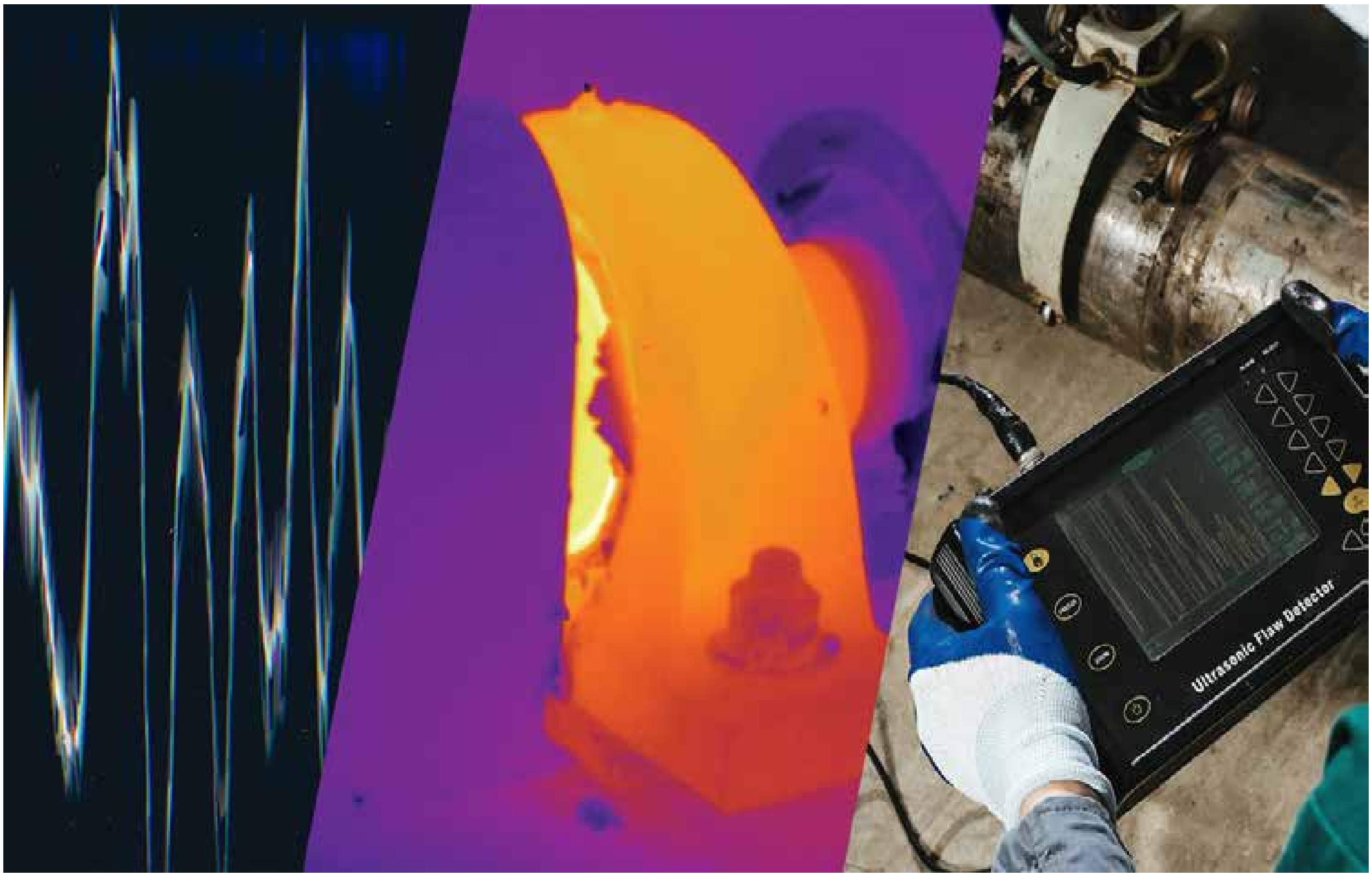
On the bright side, an increasing number of companies are led by managers who do get it. Much of this has been driven by the growing base of documented success stories from organizations and program leaders who have championed change and happily reported their results. They didn't need to be beaten over the head, but rather, they took the initiative and captured the benefits.

About the Author

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

BRIDGING THE GAPS WITH USED OIL ANALYSIS AND NDT TECHNOLOGIES





Used oil analysis has long been a tried-and-true method for machine health condition monitoring. However, it does have its limitations. Therefore, embracing the inherent strengths of additional ancillary non-destructive testing (NDT) technologies provides a holistic approach and places your organization in a place to further succeed.

This isn't an either-or type of consideration. Incorporating elements of each can strengthen the foundation of an end user's current condition monitoring program, regardless of its current stage or level of sophistication.

Non-Destructive Testing
NDT is used to inspect and evaluate materials, components, or assemblies without destroying their service ability while ensuring product reliability, controlling manufacturing processes, lowering production costs, and maintaining a uniform quality level.
Source: ASNT

In this article, we'll discuss the traditional concept of used oil analysis – the "why's", the "when's", and the "what can be improved upon" – compared to the status quo.

In addition, you'll learn about three NDT technologies: vibration analysis, infrared (IR) thermography, and ultrasonics. We'll discuss the various strengths and challenges with each, and most importantly, how these applications complement one another on your journey to operational excellence.

Traditional Used Oil Analysis

Regardless of the maintenance, reliability, or condition monitoring program you have, oil analysis is one of the oldest, most economical, and most effective technologies available, and it should be the base for your entire program.

In my three decades of experience, oil analysis has been the primary tool in my arsenal, allowing me to catch and diagnose impending failures with great success. As with any NDT, it requires end-user expertise; they must have intimate domain knowledge to extrapolate the data and provide insights that can lead to corrective actions and predictable outcomes.

Oil analysis accomplishes many things, but first and foremost, it determines the lubricant's condition and identifies if it's the right one for the application. Next, oil analysis can evaluate and determine the abnormal metallurgical wear and contamination captured in the oil and filter. This allows you to establish alarms, trends, and benchmarks that:

- Improve service intervals.
- Enhance corrective actions.
- Establish exemplary diagnostics.
- Create futuristic prognostics.

See Figure 1 for a basic overview of how to read a typical oil analysis report.

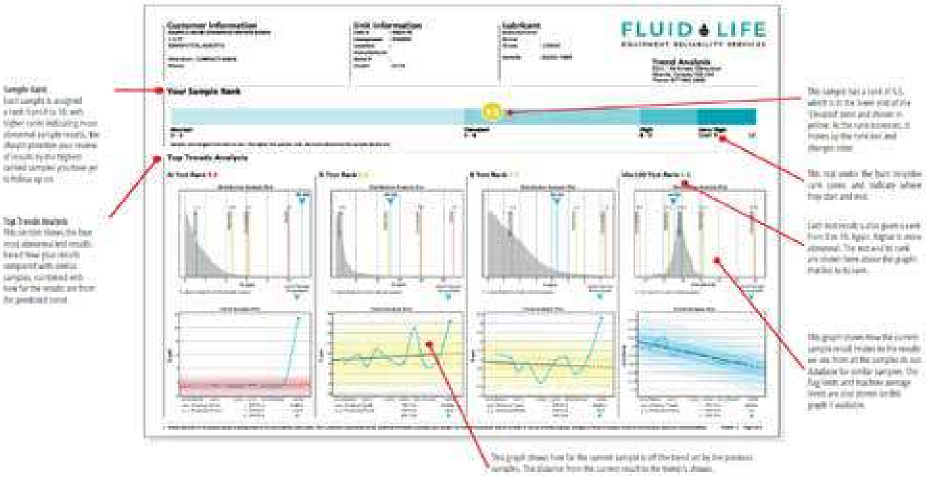


Figure 1: How to Read an Oil Analysis Report

Unfortunately, it's not uncommon to hear the phrase, "It's just an oil analysis." This thought process can cause challenges that impede the successful implementation of a used oil analysis program, including:

- Poor leadership commitment and communication.
- Failure to define what program success is, including program goals and key performance indicators (KPIs).
- Lack of implementation planning, including inadequate training and documentation of consistent processes and procedures.
- Deficiencies in database set-up and administration.
- Unacceptable sample turnaround times and failure to monitor and report issues.
- Failure to promptly act on data and results.

To anyone with this mentality – stop that thinking dead in its tracks, because it's far more than that; it represents the lifeblood of the assets you are entrusted with. You should never neglect, downplay, or disregard testing protocols when managing your equipment's health.

Putting effort into developing a solid routine with your used oil analysis program can have many benefits, including:

- Routine oil sampling.
- Integration with maintenance and reliability programs.
- Documented and standardized sampling practices and protocols (e.g.,schedules and locations).

Performing routine oil analysis presents several advantages for your maintenance department, including:

- Improved planning and scheduling.
- Reduced unplanned maintenance activities.
- Support for your plant improvement initiatives.
- Reduced operating and capital costs.
- Improved equipment reliability and component life.
- Reduced replacement parts inventory and maintenance costs.

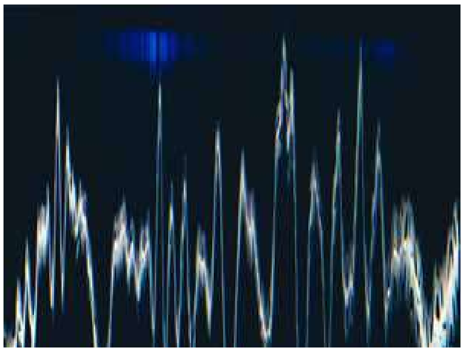
Vibration Analysis

Vibration analysis has been around for decades and is still one of the most effective ways to detect and quantify impending mechanical defects in rotating equipment. This helps to avoid catastrophic in-service failures and keep equipment reliability and production bottom lines as high as possible.

The primary causes of abnormal machine vibration include:

- Imbalance
- Misalignment
- Looseness
- Bearing deterioration
- Gear-related issues

Vibration data can be collected in a variety of ways, including hand-held data collectors, permanently mounted sensors or accelerometers, and even OEM factory-installed



or in-field retrofit options. Data collectors measure the frequency, amplitude, direction, and acceleration of vibrations. Data is then sent to a software application to compile the information and provide the spectral plots, which can be analyzed for common identifiers.

Vibration monitoring is an effective tool that works in conjunction with routine oil analysis. In addition to the benefits of traditional used oil analysis, vibration analysis can:

- Assist in reducing equipment and labor costs.
- Help detect a single source of component failure months in advance.
- Predictably benchmark against similar components.
- Minimize unplanned maintenance and callouts.
- Assist in condition monitoring safety program optimization.
- Be highly effective at intermediate to high-speed component operations.

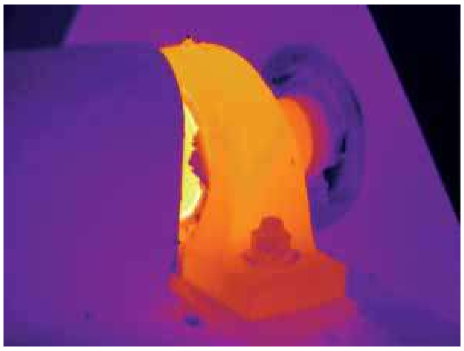
While a combined vibration and oil analysis program can provide tremendous benefits, vibration analysis does have some disadvantages such as:

- Relatively high cost for condition monitoring sensors, data collectors, and software.
- Requires additional space and equipment.
- Poor data collection if inadequate sensor type and installation locations are selected.
- Requires advanced training and testing certifications for technicians to be successful.

- A lack of skilled workforce availability may require you to outsource additional staff.
- The complexity of program setup.

Infrared Thermography

Infrared (IR) thermography uses an infrared imaging camera to detect and monitor infrared energy – or heat – that is invisible to the human eye. Every object that has a temperature above absolute zero will emit infrared electromagnetic energy that can be picked up by IR cameras.



IR thermography has numerous applications and is used in a variety of industries, including:

- Healthcare
- Military
- Firefighting
- Law enforcement
- Industrial machinery maintenance

An IR imaging camera is an extremely valuable diagnostic tool within an industrial plant. Since all machines or components will fluctuate in temperature before failure, the IR camera can detect these anomalies and alert that an issue is occurring.

In my experience, under or over-lubricated components will experience heat issues, and as we know, heat is a lubricant's enemy. This alone makes it an excellent application in a facility.

Previously, I worked with mines and processing plants, and we frequently used IR thermography to capture thermal images of hydraulic cylinders' temperature variance for bypass indications. Images of the radiator cooling systems' hot spots were taken to find inefficiencies and plugged fins. We caught incidents of poor grease lubrication practices on bearing configurations and drive shafts more times than I can mention.

Thermography was also used to look for associated electric system faults with components such as high-voltage cables, connections, and transformers and to locate thermal leaks and overheated regions.

Some of the advantages of using IR thermography in maintenance are:

- It's a no-contact, non-invasive method of monitoring machine conditions.
- No need to stop production from conducting the imaging of the machine or component.
- Data can be gathered on a large surface area in real-time.
- Software is available to complete a more detailed analysis of thermal images.

IR thermography provides real-time data, which can detect issues and trigger a used oil analysis. While this data can be highly valuable, the disadvantages of this technology include:

- The cost of infrared technology is high – not only the hardware (camera) but also software and labor costs.
- To be successful, a technician must have advanced training, the proper certifications, and a deep knowledge of the equipment.

Ultrasonics

When I think of applications for ultrasonics, my memory takes me to the joyful day when my wife and I could see the image of our first child months before he was born. Yes, healthcare is one of many areas in which ultrasound is utilized to improve our lives.

Ultrasound can also help to detect faults, deficiencies, cracks, and generalized failures and defects in equipment or component metallurgy. Ultrasound is especially helpful, for example, on weld inspections or structural integrity. Sound waves are introduced to the part being tested via a piezoelectric crystal transducer that converts electrical current to sound waves.

In my personal career, we utilized this technology to detect cracks in the steering systems of mining equipment, which if left undetected, could have led to equipment failures and the loss of human life. Similar to the other technologies, there are both advantages and disadvantages to be aware of.

Advantages of ultrasonics include:

- Relatively portable.
- Provides consistent, instant results.
- Capable of detecting surface and subsurface defects.
- Only requires limited access to machinery and components.

Disadvantages of this NDT technology include:

- Requires extensive training.
- Potentially difficult to operate on thin materials.
- The individual part geometry being tested can cause complications.
- Requires a relatively smooth surface to couple the transducer.
- The technician must know the velocity of the part and have a reference to calibrate against for equipment set-up.

In Summary

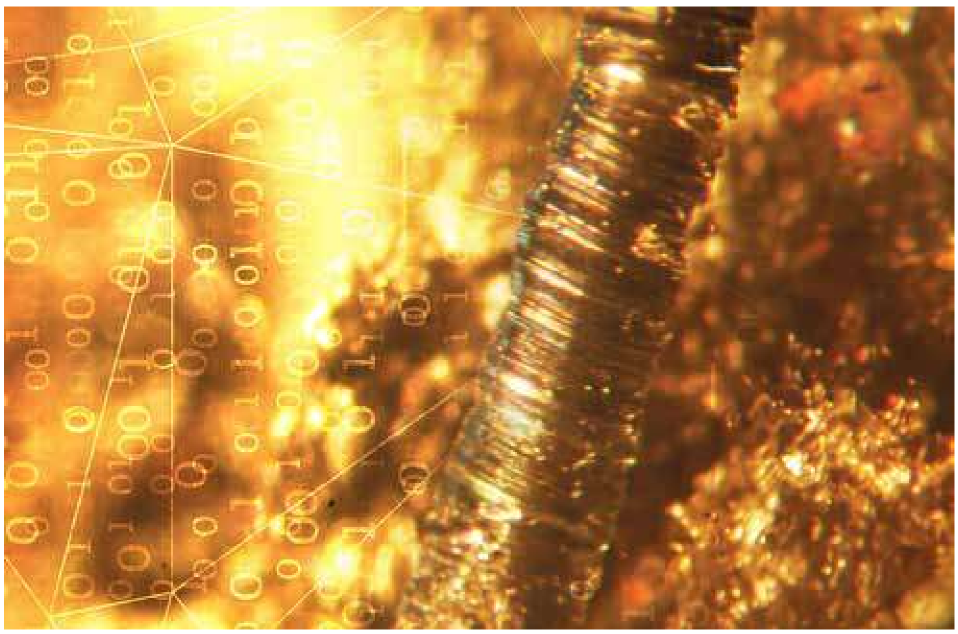
Having an array of technologies available allows a technician to bridge the gaps in analyzing the health of their industrial machinery and components. Traditional oil analysis and ancillary condition monitoring tools can arm them with technology and decision-making abilities to effectively identify, isolate, and remediate problems.

Technology alone does not solve every problem, rather it enhances the combined abilities, education, and experience of the brilliant men and women that lace up their boots and go work day after day in the trenches.

When used together throughout the life of your asset, these technologies can support your predictive and preventive maintenance programs and help to detect issues before they turn into catastrophic failures.

Lisa Williams, Bryan Johnson | Noria Corporation

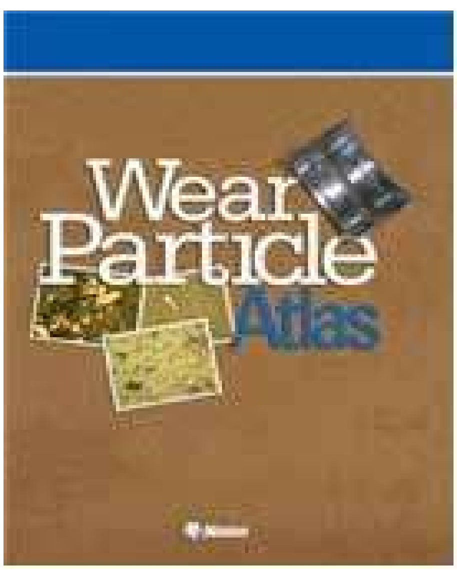
ASTM ENHANCEMENTS TO **MICROSCOPIC PARTICLE IDENTIFICATION AND DOCUMENTATION**



In 1982, Daniel Anderson published his influential book, “Wear Particle Atlas”, which describes, sizes, and classifies particles found in oil.

The particles of greatest importance are wear metals, although other particles, such as fibers and foreign materials, are also identified.

Still widely referenced today, Wear Particle Atlas serves as a foundational reference for the various wear particle techniques currently being developed. This includes both microscopic and digital approaches.



Microscopic particle evaluation requires that particles are deposited onto a static surface and inspected with a microscope. Digital particle identification techniques measure pixels associated with the particles, which are dynamically measured as they flow past a detector array. The American Society for Testing and Materials (ASTM) is actively involved in developing standards to improve the value and utility of both approaches.

Microscopic Evaluation of Wear Particles

Using a microscope to inspect particles extracted from oil samples is a powerful and universally used advanced oil condition monitoring technique. As ASTM standardized this, it found that the classification and identification of particles were not uniformly applied by the end-user community.

As a result, ASTM D7684 was written to standardize the terminology and description of particle shapes, textures, and colors. ASTM D7670 (membrane filters) and D7690 (Ferrography) were written to support test methods that can be used to separate and deposit the particles from the oil onto patch or glass substrates for visual analysis.

While this technique is widely used, there are several problems with this long-standing and trusted method. Microscopic evaluation of particles requires a trained and experienced eye. Knowledge of both particle morphology and machine metallurgy is a requirement for properly executing microscopic particle evaluation.

Adding to the subjectivity of this method, microscopic particle inspection reports are not standardized. Many organizations have processes that produce a report based on a single sample that addresses various particle characterizations using a "few-to-many" scale. This scale describes the density of the distinct types of particles encountered. Other organizations' reports expand on this concept but show previous samples in a tabular format to provide comparative indications of the machine's condition.

A New Concept for Wear Particle Analysis Reporting

To address the concept of standardizing wear particle analysis reporting, members of ASTM D02 CS96 Subcommittee introduced an enhanced concept that has been published in ASTM STP1634 Standard Guides and Practices that Support the Lubricant Condition Monitoring Industry.

The concept of documenting comparative sample particle characterizations was expanded to include a step to identify the present particle types and characterizesi six attributes common to each particle type.

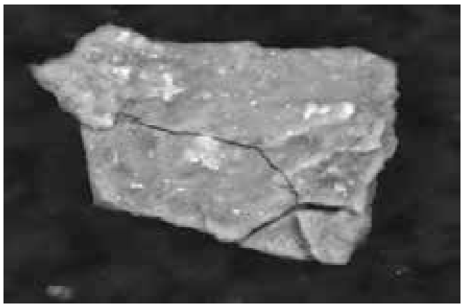
The attributes include the particle's:

- Relative density or concentration of each particle type when compared to other particles being examined.
- Typical observed size.
- Maximum observed size.
- Texture.
- Color.
- Composition.

The results for each particle type's attribute rating are then rolled into a trending tool, which allows the evaluator to monitor for changes in particle attributes and present particle types. These innovative concepts are still under discussion within ASTM.

Particle Counting and the Impact of Digital Imaging

Historical particle counting techniques do not differentiate between hard and soft particles or particles that are either microscopic water droplets or air bubbles. This lack of detail requires statistical assumptions to be made concerning the level and type of damage that a group of particles may cause. Digital tools that allow measurements of particles can identify and size both water droplets and air bubbles.



In some cases, such as air entrainment, water emulsion, or foam, the presence and concentration of water droplets or air bubbles may become of greatest interest. In other cases, hard wear metals are of primary concern as they relate to machine condition. In this case, bubbles and droplets can become misleading information. Being able to discount droplets, bubbles, or wear metals from the population makes digital particle analysis more powerful. The use of a photo array makes these decisions possible.

Digital oil particle recognition utilizes two-dimensional arrays of pixels that comprise particles. A camera is used for this measurement and can be either employed:

- From a fixed position over a static group of particles.
- From a dynamic system where a thin layer of particles flows past the camera and are measured as they pass through the array.

The particle characterizations are made at a pixel level through shape and color. The resulting information is organized by applying a series of rules to determine particle attributes and basic overall shapes. Instrumentation is available on the market to digitally measure particles in oil. ASTM standard D7596 is in place to accomplish this.

The next step needed to improve digital data quality is to develop common technology terminology, definitions, and methodology in how pixel information is assigned to particle types. In doing so, the end user can expect a consistent particle characterization regardless of the technology being used. Improving and standardizing the use of digital imaging for wear particle analysis is an ongoing ASTM effort.

ASTM's D02 committee provides the condition monitoring industry with a voice and place to improve the profession and technology. The D02 CS96 subcommittee manages and authors in-service lubricant condition monitoring standards. The subcommittee's primary responsibility is to develop standards that promote knowledge and innovation while ensuring that appropriate testing is being performed and that the resulting data is correctly implemented.

Questions about ASTM CS96 Subcommittee may be directed to CS96 Subcommittee Chair, Lisa Williams, at lisa.williams@ametek.com/

ASTM International, a global volunteer-driven standards organization, serves a significant role in today's condition monitoring industry. ASTM is known for laboratory test methods that provide instruction used to obtain consistent and reliable data. In addition to test methods, ASTM products include Guides and Practices that provide useful "how to" recommendations, some of which include test acceptance and action-level criteria that can be used to enhance the effectiveness of both common maintenance practices and in the use of condition monitoring test data. ASTM is a source of research and innovation that has and will continue to shape the future of the condition monitoring industry.

Acknowledgments

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Joseph Fotue | Noria Corporation

4 KEY ELEMENTS FOR INTERPRETING AN OIL ANALYSIS REPORT

Years ago, a customer came into my office, visibly upset. He had just received his second oil analysis report for one of his Caterpillar gas engines. The report came back from the laboratory "red" because of a high level of copper found in the analyzed lubricant sample. His first report had suffered the same fate, reporting back with around 120 ppm, even though the engine was under 2,000 total operating hours.

Much of the customer's anger was because after receiving the second red report, he made the call to stop the engine, dismount it, and inspect the bearings. When he did this, he couldn't see any reason for alarm. Unfortunately, this customer's facility was a power plant that produced electricity for its customers, so stopping one engine had serious consequences, including a loss in productivity, wasted manpower and time, and an increased risk of injury. His anger was understandable.

Did You Know?
Across every industry, one hour of downtime costs an average of $260,000.
Source: Aberdeen

We informed him that a red oil analysis report is generally an early warning sign that something is occurring within the engine, but that doesn't necessarily mean that you should open it up. You need to understand the report and consider all the parameters, not just one.

Because of the customer's lack of training, he was expecting to see wear materials in the engine or signs of wear on the bearings. When it wasn't there, he assumed nothing was wrong with his machine. We knew, considering the age of the machine, that not only would wear appearing on the engine be improbable, but that his deficient knowledge had led him to make the wrong call and shutdown his machine unnecessarily.

In this article, I will highlight various points of ignorance I have noticed throughout my career concerning reading and understanding an oil analysis report. If these misconceptions are not corrected, the benefits of an oil analysis program will be negated, and the program will only serve to waste time and money.

Interpreting an oil analysis report is a science, and technicians and engineers must be trained to read them properly and consider all of the parameters. This will help accurately assess:

- The health of the machine (wear metals).
- The health of the lubrication system (contamination).
- The health of the lubricant.

Below are four elements our customer needed to understand in order to interpre this oil analysis report.

1 – The PPM Scale

The concentrations of wear metals and additives in lubricants are given in parts per million (ppm), which corresponds to milligrams per liter (mg/L). Since chemical elements do not have the same density, two elements with the same concentration can have different volumes of wear. One ppm is equivalent to the absolute fractional amount multiplied by one million.

A better way to think of ppm is to visualize putting four drops of ink in a 55-gallon barrel of water and thoroughly mixing it. This procedure would produce an in k concentration of 1 ppm. Some other analogies that may help with visualizing the scale involved with one ppm include:

- One millimeter in one kilometer.
- One minute in two years.
- One second in 11.5 days.

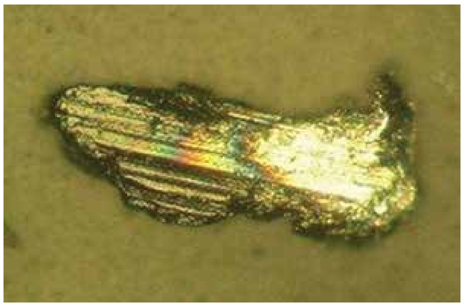
For our case, a concentration of 100 ppm roughly corresponds to 0.0115 cm 3 of copper in one liter of lubricant; this is about 4 microns thickness on a bearing of a 37-liter oil sump engine if we suppose that all the copper present in the oil only comes from a bearing, which is not the case since there are many bearings and other sources of copper in the engine.

The question now is, is it possible to see 4-micron-thickness wear with our naked eye?

The answer is no; the limit of our vision is around 40 microns. In conclusion, a 100-ppm concentration due to wearing metal is generally unnoticeable to the human eye.

2 – Elemental Analysis

Two different methods are used for elemental analysis – the Inductively Coupled Plasma (ICP) Spectrometer (ASTM D - 5185) and the Rotating Disk Emission (RDE) Spectrometer (ASTM D 6595). Both instruments use a high-energy source to excite atoms within a sample.



Elemental Analysis

A test designed to determine the presence of elements in an oil, such as wear metals, contaminants, and oil additives.

Source: Machinery Lubrication

The atoms do not want to be in this excited state, and as energy is reduced, they produce light energy. The emitted light energy is specific to each atom. Therefore, the amount of light energy can be converted to the concentration of each tested element.

The RDE can vaporize particles up to 10 um, while the ICP can vaporize particles up to 5 um depending on the sample preparation.
In all cases, wear metal sizes are under 40 microns.

3 – Sources of Copper

The source of copper in an oil analysis report is not limited to only bearings. If it was from the bearing, we would have also had other materials, such as tin or lead, since the bearing's surface was alloy. This was not the case; the report only mentioned a high level of copper and all other elements were at normal levels.

However, cooler core leaching is a chemical process that has been well-documented as a source of high concentrations of copper.

For new engines with less than 1,500 hours of service life, the cooler core becomes an active reaction site for the zinc dialky ldithiophosphate (ZDDP), resulting in copper sulfides forming on the copper cooler tubes. These sulfides later come off in the oil, contributing to a rising copper concentration that can reach well over 300 ppm. This concentration will become normal when the cooler reaches equilibrium, and this level of copper is generally not dangerous.

4 – Wear Metal Levels Can Stabilize

With our customer, his second oil analysis report was conducted to confirm the results from the first report. The only way the concentration of the wear elements would decrease would be if the engine received a top-off with fresh oil. Since our customer confirmed he did not perform a top-off, one would expect to see an increase in wear materials. However, this was not the case.

The difference in concentration between the first and second samples were insignificant, meaning that the production of copper was stabilizing. This confirmed for us that his problem was the result of a cooler core leaching phenomenon in his engine.

Conclusion

Many great leaders over the past decades have proclaimed, "If you think that education is expensive, try ignorance." Indeed, ignorance is dangerous and can even turn a good program, which should be beneficial to a company, into a great source of annoyance and declining productivity.

Let's take education very seriously and ensure that everyone involved in the process of interpreting an oil analysis is trained and certified. This will help companies realize the exceptional benefits that come from a quality oil analysis program.

TOP LEADERSHIP FOCUSES FOR IMPROVED RELIABILITY AND COST REDUCTION

Here's a scenario that may sound eerily familiar – you have a new reliability initiative. The plans have been drawn, information meetings have been held, and new, trendy terms echo down the halls — but nothing is happening on the plant floor.

Your reliability improvement project is slipping through the cracks. Why does this happen? Often times it's because our focus is on multiple secondary activities instead of what yields results.

Understanding Project Priorities

IDCON recently participated in a preventive maintenance project at a paper mill in New York. Our responsibility was to lead the documentation of preventive maintenance activities.

Our first recommendation was to review the processes in the mill and assign experienced maintenance people to perform inspections immediately instead of starting with documentation rounds. We knew that if inspections start on day one, you get quicker results than if you're waiting on the documentation process.

This recommendation was quickly quashed because the decision-makers at the paper mill wanted IDCON's part of the project to focus only on documentation, not the processes, which we found highly unusual. After receiving our marching orders, we focused on the documentation process.

A few weeks into the project, after the first round was finished, we wanted to make sure inspections were performed and tested, problems were reported, and repairs were executed. Unfortunately (and incorrectly), the decision-makers at the paper mill insisted the processes were not important at this stage.

"It'll be fine," they said before instructing the team to learn how to enter the inspections into their data management system. IDCON's stance was to let them continue to use an Excel format until they were tested and implemented.

You can probably guess what happened.

The team only focused on getting the data into the data system. Nine months later, all of the PMs were documented — and looking great if I do say so myself— but not a single inspection or repair job had been performed. They had, however, hired several specialists to get the PMs into their system.

In other words, consultants had been on site, nearly a whole year's worth of work had gone by, and there were zero results to show for it (except for invoices).

Managing Improvement Tasks

As a maintenance leader, it's easy to lose focus and underestimate the importance of following up to ensure results are achieved and goals are met. Maybe you, like many others, currently have a myriad of urgent improvement projects on your to-do list. If so, you will likely need to:

- Improve planning, particularly daily and weekly planning.
- Improve the spare parts database.
- Improve daily scheduling of maintenance personnel.
- Polish preventive maintenance inspections (documentation and implementation).
- Train personnel in the latest technical developments (especially instrumentation).
- Organize the spare parts store.
- Work with design/construction to ensure new equipment is maintenance-friendly and reliable.

These improvements must occur at the same time as your regularly scheduled tasks, work, and meetings. With all of this to juggle, it's no surprise that maintenance leaders lose focus and become distracted by tasks that won't produce the desired results and improvements.

The 2 Goals of Maintenance Improvement Plans

When it comes down to it, there are only two things that can provide reliability and maintenance improvements. By "improvements", I mean efforts that result in increased equipment reliability and lower production costs. Everything we do with concern to maintenance improvements should focus on two main goals:

1. Preventing failures (prolonging the lifespan of equipment).
2. Having high-quality repairs completed quickly and safely.

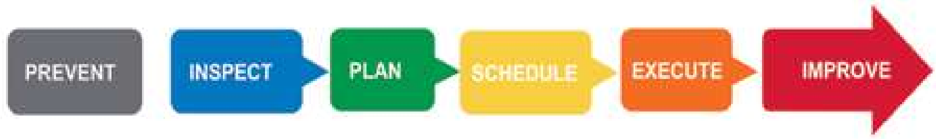
Integrating these goals into the maintenance improvement plan is vital. Executing them successfully will allow you to obtain results, but your actions must always support these two goals. For example, documenting a mechanical inspection in your Computerized Maintenance Management System (CMMS) is important, but that documentation will fail to produce any results unless the inspection is done correctly.

After a well-performed inspection, problems and failures are reported. Then, repairs are planned, scheduled, and executed. In the follow-up plan, after a repair is completed, there should be steps to enable quick and safe repairs of a high quality to reach our end goal.

If we compare simply documenting inspections in the CMMS to tasks that actively improve equipment operations, such as aligning shafts correctly or making sure all lubrication tasks are performed with clean oil, it becomes clear that all these activities add to the life span of our equipment and yield immediate results.

The Improvement Plan Chain

Some tasks are linked together like a chain, especially the activities that lead us to goal number two (faster, better, and more reliable repairs). To work quickly and efficiently, you must have quality inspections followed by clear and prioritized planning and scheduling. The figure below shows "The Chain" that must not be broken.



Improvements must lead to success in preventing failures or performing more efficient repairs (preferably both). It's not uncommon to work on several isolated improvements and begin neglecting failure prevention or well-executed and efficient repairs.

This is why we sometimes end up with zero results; we forget that project plans, leadership, meetings, maintenance systems, inspections, and planning and scheduling are completely useless if we don't have personnel that can (or want to) repair equipment and prevent failures.

Conclusion

At the end of the day, maintenance initiatives must result in failures being prevented and repairs being performed quickly, safely, and at a high standard. As a maintenance leader, you have to communicate goals clearly, assign roles and responsibilities, offer practical support during implementation, and follow up on the improvement projects all the way until they actually happen on the floor. Otherwise, you are just wasting time and money until the bitter end.

TASK-BASED TRAINING |
INSPECTING A SINGLE-POINT LUBRICATOR

What is a Single-Point Lubricator?

A single-point lubricator is a device engineered to attach to a single unit to regularly and automatically deliver a small amount of clean grease or lubricating oil to a specific area. It is often used to keep bearings lubricated but can also be used to lubricate pumps, electric motors, fans, chains and conveyors, among other applications. Manually greasing bearings often result in over and under-greasing, eventually leading to premature bearing wear. Single-point lubricators can be configured to dispense the correct lubricant quantity to a single point for a predetermined period. Single-point lubricators are a popular method of extending the life of bearings and other components and preventing extended downtime due to lubrication-related failures. While there are many types, the most common are spring-loaded, electrochemical and electromechanical.


Figure 1: A spring-loaded single-point lubricator.

Figure 2: An electromechanical single-point lubricator.

Why use a Single-Point Lubricator?

Single-point lubricators are designed to give a consistent, measured and continuous supply of fresh grease or lubricating oil. Some applications are hard to reach, unsafe to get to or may require a lot of excess grease. You will use a single-point lubricator to add the grease more frequently than if you could do it manually. Some suitable environments for single-point lubricators include:

- Harsh environments
- Inaccessible or hard-to-reach areas

Figure 3: An electromechanical single-point lubricator.

- Food processing and pharmaceutical industries
- High-contamination environments
- Remote or unmanned locations
- Automated production lines
- High-vibration environments
- Outdoor installations

It's essential to select the right type of single-point lubricator for each specific environment and application to ensure optimal performance, equipment protection and cost-effectiveness.

Why inspect a Single-Point Lubricator

Inspecting a single-point lubricator is important for several reasons:

- Ensuring proper lubrication: Regular inspection helps ensure that the lubricator dispenses the correct amount of lubricant to the designated point, which is crucial for maintaining optimal equipment performance and reducing friction between moving parts.
- Detecting leaks or blockages: By inspecting the lubricator, you can detect any leaks or blockages that might hinder the lubrication process, leading to inadequate lubrication and potential equipment damage.
- Monitoring lubricant levels: Inspecting the lubricator allows you to check the lubricant level, ensuring there's enough lubricant available for the required application. This helps prevent the equipment from running dry and causing premature wear or failure.
- Verifying lubricant quality: Over time, lubricants can degrade or become contaminated, which can negatively impact their performance. Inspecting the lubricator allows you to assess the quality of the lubricant and determine if it needs to be replaced.
- Maintaining equipment reliability: Proper lubrication is essential for maintaining the reliability and longevity of your equipment. Regularly inspecting the single-point lubricator helps identify potential issues before they escalate into costly equipment failure or downtime.
- Complying with maintenance schedules: By inspecting the lubricator, you-can ensure that you are adhering to the recommended maintenance schedules, which can help extend the life of your equipment and minimize the risk of unexpected break downs.
- Maximizing cost-effectiveness: Efficient lubrication helps reduce energy consumption and overall operating costs. By inspecting the single-point lubricator, you can ensure that it is functioning optimally, which in turn contributes to cost savings for your business.

Inspecting a Single-Point Lubricator

Step 1: Gather the appropriate tools required to perform the procedure

Step 2: Clean the outside of the single-point lubricator with a lint-free, industrial towel

Step 3: Examine the purge point and clean any purge lubricant; clean with a pipe cleaner if there is an obstruction

Step 4: Inspect the single-point lubricator

Step 5: Activate the test function to check performance

Step 6: Verify the timer is adjusted according to the correct lubrication frequency

Step 7: Check for overgreasing and make a note

Step 8: If any abnormal condition is found, report it

Step 9: Check the grease level in the single-point lubricator and report

Step 10: Note the date of the last inspection and confirm the lubricant consumption is according to the time elapsed

Step 11: Note the date and level of the current inspection

(Don't forget to collect all tools used during the procedure, wipe up any spilled lubricant and dispose of all consumables used in the inspection.)

Key Takeaways

- Verify you have the correct single-point lubricator
- Mark the amount with a permanent marker
- Make sure the unit is operating as intended
- Be aware of vibration and temperature
- Keep it clean

This article is based on the "Inspecting a Single-Point Lubricator" video from Noria's Task-Based Training series. To purchase this training course, visit the Noria Store.

LUBRICANT CONTAMINATION PREVENTION AND MITIGATION:
A Guide For Maintenance Professionals

Lubricants are essential for the smooth and efficient operation of many types of machinery, from engines and turbines to gears and bearings. However, lubricants can also be vulnerable to contamination from various sources, such as dirt, dust, water, metal particles, microbes, and chemicals. Contamination can degrade the quality and performance of lubricants, leading to increased wear, friction, corrosion, oxidation, and varnish formation in the machines. This can result in:

- Reduced efficiency
- Increased downtime
- Higher maintenance costs
- Shorter equipment lifespan

The importance of lubricant contamination control – both prevention and mitigation – often goes unnoticed, despite the substantial financial and operational repercussions it holds. It is crucial for maintenance professionals to understand the importance of lubricant contamination control in operations. You can expect this article to discuss the definition and costs associated with lubricant contamination, as well as preventative maintenance strategies for various environments.

Definition of Contamination Control in Lubrication

Contamination control in lubrication is the process of minimizing or eliminating the ingress, generation, and accumulation of contaminants in lubricants and lubricated systems. Contaminants can be classified into three categories:

1. Particulate
2. Liquid
3. Gaseous

Particulate contaminants include solid particles such as dirt, dust, metal shavings, wear debris, and microbes. Liquid contaminants include water, fuel, coolant, and other fluids that can mix with or dilute the lubricant. Gaseous contaminants include air, oxygen, nitrogen, carbon dioxide, and other gases that can react with or oxidize the lubricant.

Contamination control in lubrication involves four main steps:

1. Exclusion
2. Removal
3. Monitoring
4. Management

Exclusion is the prevention of contaminants from entering the lubricant or the lubricated system, including new lubricants in storage. Monitoring is the measurement and analysis of the level and type of contaminants in the lubrication system. Management is the implementation of policies and procedures to ensure effective contamination control in lubrication.

It is important to understand some of the primary sources of lubricant contamination, which include:

- Lubricant production.
- Transportation or storage.
- Human error.
- Changeovers from old to new lubricants (Santie Oil Company, 2022)

The Cost of Lubricant Contamination on Operating Expenses

Lubricant contamination can have a significant impact on the operating expense of a plant or facility. According to a study by the National Research Council of Canada, particle contamination was the root cause of 82% of wear-related failures. Wear-related failures can lead to:

- Increased repair and replacement costs.
- Reduced equipment availability and reliability.
- Lower production output and quality.
- Higher energy consumption and emissions.
- Increased safety and environmental risks.

The cost of lubricant contamination can be estimated using various methods, such as failure analysis, life cycle costing, ROI analysis, or lost output calculations. Regardless of the method used, lubricant contamination can result in significant production losses.

Most manufacturing plants typically spend 1-2% of their total maintenance budget on lubricants, so the cost of a gallon of oil or tube of grease is not the concern – it's the cost of the subsequent issues produced by poor lubrication practices.

Preventive Maintenance Strategies for Contamination Control

The best way to control lubricant contamination is to prevent it from occurring in the first place. Preventive maintenance strategies for contamination control include:

Proper Storage and Handling

Lubricants should be:

- Stored in a cool, dry, clean, and well-ventilated area.
- Kept in sealed containers with labels or color codes to avoid confusion and cross-contamination.
- Transferred using dedicated pumps and hoses that are clean and dry.

Proper Selection and Application

Lubricants should be selected based on the specifications and requirements of the equipment and the operating conditions. "Oil is oil" and "grease is grease"expressions should not exist in a maintenance department. Proper lubricant selection for the application is key, as the wrong type can it self be a contaminant. Lubricants should be changed or replenished according to the OEM recommended schedule or condition-based monitoring.

Proper Design and Maintenance of Equipment

Equipment should be:

- Designed with features that prevent or minimize contamination ingress, such as:
- Seals
- Filters
- Breathers
- Expansion chambers
- Maintained regularly to check for:
- Leaks
- Wear
- Corrosion
- Alignment issues
- Cleaned before opening or servicing.

Mitigation Strategies for Contamination Events

Despite preventative measures, contamination events may still occur due to unforeseen circumstances, such as accidents, malfunctions, or human errors. In such cases, mitigation strategies are needed to minimize damage and restore the condition of the lubricant and equipment.

Mitigation strategies for contamination events include:

Proper Identification and Diagnosis of Contamination

Contamination should be:

- Detected as early as possible using methods such as:
- Visual inspection
- Oil analysis
- Condition monitoring
- Identified by its:
- Source
- Type
- Level
- Severity
- Diagnosed for its impact on the lubricant and equipment.

Proper Removal and Disposal of Contamination

Contamination should be:

- Removed from the lubricant or equipment using methods such as:
- Filtration
- Flushing
- Draining
- Purging
- Disposed of in a safe and environmentally friendly manner according to local regulations and standards.

Proper Restoration and Future Prevention

Lubricants and equipment should be stored in their original or desired conditions using methods such as:

- Replenishing
- Replacing
- Repairing
- Improved sealing
- Improved breathing
- More frequent relubrication

Contamination Control in Critical Applications

Some applications are more sensitive or demanding than others when it comes to lubricant contamination. These include applications that involve food processing, pharmaceutical manufacturing, medical devices, aerospace, or nuclear power.

These industries require higher standards of cleanliness, safety, quality, and performance for lubricants and equipment. Therefore, contamination control in these applications requires more stringent and specialized measures, such as:

- Using food-grade or synthetic lubricants that are resistant to degradation, oxidation, and microbial growth.
- Using filters and breathers that have high efficiency, low-pressure drops, and a high contamination-holding capacity.
- Using oil analysis or condition monitoring techniques that can detect trace levels of contamination.
- Using cleaning and flushing agents that are compatible with the lubricant and equipment.
- Using certification or validation procedures that verify the compliance of the lubricant with the relevant regulations and standards.

Contamination Control in Extreme Environments

Similarly, for critical applications, some environments are more challenging than others when it comes to lubricant contamination. These include environments that have high:

- Temperature
- Pressure
- Humidity
- Dust
- Vibration
- Corrosion

These environments can accelerate the degradation, oxidation, or reaction of lubricants and lead to the formation of sludge or varnish deposits. Contamination control in these environments requires more robust and adaptive measures, such as using:

- Lubricants that have a high viscosity index, flash point, thermal stability, and anti-wear properties.
- Filters and breathers that are resistant to high temperatures, pressures, moisture, and shock.
- Oil analysis and condition monitoring techniques that can monitor for debris and measure viscosity, acidity, and oxidation.
- Maintenance and repair procedures that can prevent or correct thermal expansion, shock, fatigue, and runaway of lubricants.

Conclusion

Lubricant contamination is a serious threat to the performance and reliability of machinery. It can cause increased machine:

- Wear
- Friction
- Corrosion
- Oxidation
- Varnish formation

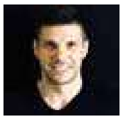
It can also result in the machines having:

- Reduced efficiency
- Increased downtime
- Higher maintenance costs
- Shorter equipment lifespans

It is vital for maintenance professionals to implement effective contamination control practices in their operations. These practices include preventing contamination from entering the lubrication system, removing contamination from the lubrication system, monitoring the level and type of contamination in the lubrication system, and managing the policies and procedures for contamination control.

Contamination control practices should be tailored to the specific needs and challenges of different applications and environments, as some require higher standards of cleanliness, safety, quality, and performance. Certain applications and environments require more robust and adaptive measures to cope with harsh conditions.

By following these practices, maintenance professionals can ensure that their equipment and lubrication systems are protected from contamination and are delivering optimal results.



About The Author

Kuba Bednarz is an enthusiastic Petroleum Engineer with passion for the Oil and Gas sector. He challenges the industry to rethink conventional methods and foster innovation in every aspect. His expertise lies in scrutinizing maintenance protocols and identifying reliability concerns, ultimately paving the way for enhanced processes across drilling rigs, frac fleets, coiled tubing, wireline units, and equipment manufacturing and servicing workshops.

Keith Mobley | Noria Corporation

LUBRICATION CONTAMINATION PREVENTION

How many articles have you read, or seminars listened to, that tout the value of contamination control? If you are like me, they number in the hundreds—if not thousands. One thing about these articles and seminars that bothers me is the word "control".

If you look up the definition of control, it's "a function of management that helps to check for errors to take corrective actions." It implies that we assume contamination is inevitable, and the best we can hope for is to minimize its impact. That just does not ring true and is self-limiting.

My passion is reliability, and that means being risk-averse. Regardless of my position within a corporate organization or in later years as a consultant, eliminating risks has been my prime directive and served me well in my career growth. Because of this passion, the importance of using the proper lubricant, assuring that it is free of contamination, and is dispensed correctly is fundamental to an effective asset management program.

That is why prevention, rather than control, is a far better approach. Prevention is defined as "the act of preventing something from happening." If you want to prevent contamination, read on; otherwise, there are numerous articles on control to choose from.

What is a Successful Lubrication Program?

A successful lubrication program must start with contamination prevention. Most people acknowledge that contaminated lubricants cause accelerated wear, thermal damage, premature wear out, and catastrophic failures of the capital assets that are crucial to the continued reliability and sustainability of their manufacturing and process plants. Unfortunately, this awareness does not seem to translate into effective contamination prevention.

Contamination prevention does not require an advanced degree in engineering or expertise in tribology. A good dose of common sense and a little logic will suffice. Think about how lubricants are purchased, received, stored, and deployed in your plant or facility. What is the potential for introducing contamination in each of these steps? If you go through each, you will begin to see where and why contamination becomes a problem. Here are a few ideas to get your program started.

Assess Your Lubrication Program

Be diligent in your assessment of each step in the process. Do not assume anything. Most of us would assume that our lubricant vendor will consistently follow best practices and ensure a contamination-free lubricant, but we need to understand that they are under the same competitive pressures that we face. Sometimes, these pressures can force practices that increase the probability of contamination.

The same is true once the lubricants are in our possession. We all know that proper storage, labeling, and distribution of lubricants are crucial to the sustainment and preservation of our capital assets, but business pressures too often force deviation from best practices.

The key to this initial assessment is to identify all existing and potential issues, from procurement to disposal, that could introduce contamination and/or strip lubricity from our lubricants.

Stop Paying for Contaminated Lubricants

New lubricants, especially oil, are often the dirtiest in the plant. The containers vendors use for new oil are frequently recycled from previous orders. Reusing bulk containers, typically drums or plastic tanks, is a cost saver for both the vendor and end-user, but it has a high probability of introducing contamination.

Lubricant producers and their distributors are not required to ensure the cleanliness of these recycled containers or the new oil contained within them. Unless the vendor states that the lubricant meets ISO cleanliness standards or it is implicitly part of your purchase agreement, the probability of contamination is high – you are essentially paying for contaminated lubricants.

Some vendors are meticulous in their cleaning and repurposing of drums, others are not. Numerous analyses of incoming lubricants have confirmed that a significant percentage of “new” bulk lubricants are more contaminated than that in your critical machines after hours of use. The only way to be sure that your incoming lubricant is contaminant-free is to test it. If it is contaminated, there are two ways to resolve the issue.

First, never accept or pay for contaminated lubricants. Insist that the vendor replaces or reimburses you for the added expense of in-house filtration. Vendors will quickly get the message and improve their drum reclamation and storage practices. Insist that your vendor provides certification of the cleanliness of any bulk lubricants as part of your incoming acceptance procedure.

Alternately you can filter all incoming bulk lubricants before storing or deployment, but this is reverting to control rather than prevention. The best, most cost-effective approach is to prevent contamination from entering your plant. Filtering all your bulk lubricants can be a significant, recurring cost that can be avoided by simply not accepting contaminated lubricants in the first place.

Filtering lubricants not only has the potential to introduce contaminants, but it can also strip additives from the oil, reducing its overall lubricity. Use care when selecting the degree of filtration used to remove particulate matter. Remember, when using absolute filtration, 99.9% of particulates equal to or greater than the micron rating will be stripped from the lubricant. Make sure that doesn’t include the additives package.

Properly Store Bulk Lubricants

Climate control space is expensive and often limited. As a result, some facilities store their bulk lubricants in unconditioned sheds, open-roofed structures, and other inappropriate locations. From the view point of asset reliability, cost of ownership, and useful life, this is a severe mistake, often made because the decision-makers don’t understand the long-term impact of their space allocation decisions.

The long-term impact of contamination is often hidden by the added maintenance costs and reduced asset useful life that proper lubrication would prevent. Because these recurring costs are hidden, the correlation between lubricant storage decisions and the impact on the total cost of ownership and the return on invested capital is rarely made visible.

Storing lubricants in a non-climate-controlled environment, especially outdoors, directly opposes the principles of contamination control and prevention. Bulk lubricants are a known source of contamination.

For example, petroleum-based lubricants are hygroscopic, meaning they absorb moisture from the air. This is exacerbated by changes in temperature and humidity. This moisture, along with other airborne particulates, will siphon through any openings in the storage vessels and contaminate the bulk lubricant. To prevent this contamination, the lubricants must be stored in an environment that minimizes the potential for contamination by maintaining air purity, moisture content, and temperature.

The optimal way to store and dispense bulk lubricants is the subject of much debate. Some argue that special storage systems with built-infiltration, breathers, and ventilation systems are necessary. Others believe that the vendor’s bulk drums, stored at a downward angle and equipped with dispensing valves in the bung, are sufficient.

Tanks are rarely completely full, and the space above the lubricant level, known as a headspace, is a breeding ground for contaminants. Oil mist, ingested dirt, and water vapor vary based on ambient conditions, and they are always present and generating lubricant contamination.

Headspace water vapor and suspended water in the lubricant continuously seek equilibrium; if moisture ingestion is minimized, free water in the lubricant will vaporize into the headspace, improving lubricant properties. Unfortunately, when the ingestion of moisture is not controlled, the opposite happens, and the lubricant becomes even more contaminated with water.

The final storage decision is driven by cost-benefit. If a high volume of lubricants is used, an investment in a custom system is warranted. But, for most small to mid-sized plants, properly using the vendor's drums will be enough.

Accurately Distribute Bulk Lubricants

The internal reuse of storage containers and improper labeling are other self-induced sources of contamination. Most plants utilize five to fifteen different lubricants to effectively protect and preserve their assets, therefore, a standard procedure for allocating, using, and labeling storage containers is fundamental for effective contamination prevention and ensuring the proper lubricants are used for each application.

Unfortunately, too many plants are sorely lacking in this area. Their work orders, which drive the lubrication process, lack clear identification of the proper lubrication and application method, and they randomly reuse containers, hoses, and other filling accessories. In these cases, lubrication is treated as an afterthought rather than a crucial maintenance requirement.

Conclusion

In the end, eliminating lubricant contamination is a matter of choice. One can continue the never-ending fight to control the myriad of causal factors that permit contamination or permanently prevent the potential by removing them.

Contamination prevention is not rocket science. It just requires the initial effort needed to fully understand the possible sources of contamination and the use of common sense, and a little logic, to eliminate the possibility.

Keith Mobley is a featured speaker at Reliable Plant Conference & Exhibition.

ABOUT THE AUTHOR

R. Keith Mobley has earned an international reputation as a leader in corporate transformations, reliability engineering, predictive maintenance, and process optimization. He is the past Chairman of ASME's Plant Engineering and Maintenance Division and the technical advisory boards of ANSI and ISO, and some of his achievements include being awarded ASME's Fredrick P. Smarro Award for outstanding contribution to engineering, maintenance, and reliability and being a distinguished lecturer for ASME, representing the society in its chapters worldwide. He has an international reputation as a leader in corporate transformation, reliability engineering, predictive maintenance, and process optimization

Joel Scarbrough | ExxonMobil

WHY SCHEDULED OIL CHANGES AREN'T ENOUGH TO MITIGATE LUBRICANT CONTAMINATION

There are few problems more insidious or damaging to large industrial machinery than contaminated lubricant. Potential consequences run the gamut, from subtle issues like increased operating temperature, to more severe issues like machine frothing, total machine failure or permanent structural damage to the equipment. In "System Approach to Contamination Control," Vickers, Inc., found that "proper selection and placement of contamination control devices… eliminates (the root cause of) up to 80% of hydraulic system failures."

In fact, Bearing Maintenance Handbook, SKF, states that proper lubrication and ideal conditions could theoretically result in "infinite life" for bearings, meaning that the sky is the limit in the potential benefits of lubricant improvement. And aside from the obvious lost uptime, this can also result in expensive product integrity investigations to rigorously stress-test the entire work flow.

One factor exacerbating the problem is that early signs of lubricant contamination are so subtle and diverse that they're often over looked by hard working crews. But even if these issues never culminate in the worst-case scenario, the aggregate wear and loss of efficiency over an extended period — and spread across a fleet of machines — can still result in a massive impact on revenue and production scheduling.

While regularly scheduled lubricant-replacement routines are the standard solution to this challenge, modern innovations have made it possible to achieve higher levels of efficiency, reliability and cost-effectiveness with an oil-analysis routine. Such a routine is more adaptive to the specifics of your project and can save compounding amounts of time and money by extending uptime and reducing maintenance costs throughout your equipment.

Causes of Lubricant Contamination

Lubricant contamination comes in so many forms and from so many different soures that it's nearly impossible to anticipate them all. Some of the most common sources are water, heat, air, solid particles and other lubricants. This can be due to the environmental conditions, improper storage and handling procedures, as well as human error.

Impacts of contamination could include:

- Temperature – Stuck LO temp. control valve
- Aeration – Excess silicon from other oils or after market foam additives can increase air release, which can cause pump failure and other operational issues.
- Foam can result from excessive air borne contaminants that can cause poor level indication, along with potential sump overflow.
- Elevated system pressures due to sticking pressure-relief valve
- Restriction in pump suction
- Leakage due to excessive seal wear

Since these problems are recurrent and compounding, they can be easily corrected once identified. However, with routine scheduled oil changes, those problems won't be identified until the company experiences a shorter-than-expected lifecycle for their equipment that can be subject to costly repairs or replacement.

Challenges of Determining if Your Oil Is Contaminated

The most dangerous part of lubricant contamination is how easily it's over looked. While most oil analysis reports can detect the problem and alert users through notifications, those notifications are often vague and indicative of more serious problems. Other signs, like running hot, excessive vibration and maintaining elevated reservoir temperatures, are easily over looked as products of the working environment.

The excessive wear, particularly on bearings, that can result from certain types of contamination can even be invisible until it's too late and the damage requires unscheduled maintenance or even renders the machine inoperable.

Normal Procedures for Preventing Oil Contamination

The traditional method for preventing oil contamination observed by most industrial teams is a scheduled system by which, after a set number of hours of uptime, the machine's oil is drained and appropriate filters are replaced. This system generally prioritizes critical machinery, rotating through them to make sure that the process can continue at an appropriate pace. The advantages to this system are mostly due to its simplicity: teams can predict exactly when the machines will need maintenance and schedule accordingly.

The main disadvantage of routine oil-replacement scheduling is that it allows undetected contamination problems to exacerbate the wear and tear on the machinery. This can potentially cause a minor error to grow into a costly and time-consuming maintenance issue that can disrupt profits and cause missed deadlines. It can also introduce a greater potential for human error, as early warning signs of more serious problems can be overlooked.

Advantages of Analysis

In contrast to preventative oil changes at a pre-set interval, an oil-analysis routine involves periodic sample and analysis of lubricant to identify contamination before the symptoms appear in the machinery. Lubricant distributors usually offer analysis support along with their products. While the added labor of routine analysis might seem like an inefficiency, the system quickly makes up for that work through increased uptime and money saved on maintenance.

One big reason is the reality of human error contributing to lubricant contamination. No matter how rigorous the standards, errors can still be made in the storage and delivery of lubricants, and the small contamination that results often goes unnoticed. The analysis routine identifies those issues very quickly, allowing the contaminated lubricant to be changed out significantly earlier than if held to a simple routine schedule and saving the machinery from potentially costly and time-consuming damage.

Furthermore, the analysis procedure will identify specific contaminants and point to the root issue — perhaps water contamination, likely from improper storage or incorrect lubricant viscosity and typically caused by human or procedural error— and allow that challenge to be resolved before it causes lasting damage or spreads to other equipment.

In short, analysis allows for more preventative maintenance and can help managers get ahead of problems before they manifest in the bottom line.

How Oil Analysis Works

Oil analysis routines are simple maintenance procedures that can be easily integrated into existing maintenance schedules.

The way analysis works is that engineering teams inspect critical equipment systems for abnormal operating conditions and secure oil samples for evaluation of on-site conditions. Those samples are then sent for detailed laboratory analysis.

These checks can be done monthly on critical machines (quarterly checks for less critical machines) with samples sent to the manufacturer for detailed analysis. That full analysis and interpretation gives metrics about the efficacy and purity of the oil, along with in sight about the health of the machine and efficiency of the given project. This, in turn, allows the customer to obtain a relative cost analysis versus the calendar-based maintenance schedule that it's replacing.

When commercial lubrication is contaminated, costs to maintenance add up quickly — not only for the oil itself but also extended downtime and damage to equipment when contaminants go undetected. Most companies are rigorous about their regularly scheduled maintenance, but they're missing a critical piece of the puzzle when they rely on a schedule alone.

Comprehensive analysis gives managers a more complete picture of their lubrication program's effectiveness, creating more flexibility and efficiency while keeping equipment running longer. It's an important part of a safe, cost-effective maintenance regimen for any firm.

ABOUT THE AUTHOR

Joel Scarbrough is a Lubrication Engineer with ExxonMobil Product Solutions Company (A Division of ExxonMobil Corporation). He serves the Greater Houston Area and East Texas.

Engineering Reports Should Be Like Bad Movies

I'm frequently asked to review engineering reports, and I'm continually baffled by how many engineers want to take their readers on a journey instead of getting to the point. They write documents that you must read every single word to work out what they're trying to say. But having a final reveal is never a good thing in any technical document.

Engineering reports should be like bad movies – you need to give the ending away at the beginning.

Why?

People watch movies to be taken on a journey; managers read reports to get information.

This isn't to say that you shouldn't try and make engineering reports enjoyable –you should. But you need to understand the audience, which is not a typical movie-goer. And while you may be proud of your research and analysis, no one wants to read an extensive report on how you got there.

Getting reports right is important. Managers will quickly work out which engineers give them the best information in the easiest way, and these engineers are the ones that managers remember when it comes to promotions, special assignments, and raises.

So here are some tips on writing better reports.

Tip #1: What Does Your Reader Need to Hear?

Simple question, right? But I'm constantly amazed by how often this crucial question is forgotten by engineers.

A report is written to provide information about a decision that needs to be made. If this isn't the case, the report is a waste of time. For example, a manufacturing company may need to decide whether to extend the warranty period of a consumer product. So, let's break this down into what information the decision-maker needs to know:

- How much money will this decision make or lose the organization?

Writing this out helps make it clear in your mind as the author, but it's still too"high-level". We need to break this information requirement down further:

- How much additional revenue will the extended warranty create?
- How much additional warranty expense will I incur?

Now we're getting somewhere. These key factors meet our "high-level" information needs, but we need a little more:

- How many additional units will sell based on the increased warranty period?
- How much revenue is made on each sale?
- What is the current warranty reliability of the product?
- What is the proposed warranty reliability of the product?
- How much does each warranty action cost?

Now we're cooking. You could go further if you wanted, but you see what I mean. By doing this, you know the hierarchy of the information your report needs – you will need this later. This is the first aspect that makes an engineering report good; your manager is focused on making a decision, not reading a long report.

Tip #2: What Do You Want to Say?

Haven't I just worked out what I want to say? No. Everyone wants to say something regardless of who is listening – it's human nature. You need to work out what you want to say and leave it out if it isn't information the reader needs.

For example, you may want to:

- Explain how long and difficult the analysis was.
- Detail the precise method and every single formula you used.
- Provide a historical review of all released products to ensure the reader knows you were thorough.

I hear many of you saying we need to have formulas and historical reviews in reports for due diligence. And you might be right but put them as annexes or appendices.

As with everything in life, there is a balance to be struck. Knowing your own tendencies ensures you don't make the report all about you.

Tip #3: Get Your "BLUF"

BLUF stands for "Bottom Line Up Front". It means that the reader knows exactly what you are recommending after they read the first page, or ideally, the first paragraph.

It took until the final scenes of "The Sixth Sense" for the audience to realize that Bruce Willis had actually died and was a ghost (apologies to those yet to see the movie). This makes for a great movie, but it won't help a manager who is pressed for time and needs to make quick decisions.

While your report may need to be long to contain all the information you identified in the first step, the manager who is reading it may be busy and not have the time. The BLUF needs to address the high-level information requirement. In the case of extending our product's warranty period, we need to answer, "How much money will my organization make or lose with this decision?" If this is not clear in your first paragraph, make it clear.

Tip #4: Executive Summaries Outline What You Are Communicating, Not How the Document is Structured

Too many executive summaries explain the sections of the document they cover. For example, they say that the engineering report includes a literature review, followed by a data analysis, and finally, recommendations. But it doesn't tell us what the report is trying to say.

The executive summary should allow the manager to make a decision. If they can't, you need to rewrite your summary. Hollywood trailers may leave you wondering if the four teenagers will survive their weekend alone at Murder Lake– executive summaries shouldn't. (The teenagers all died horrible deaths, by the way.)

Tip #5: Less is More

When writing a technical document (and let's face it, they're not "fun" reads), don't use lots of big words and long sentences. The simpler, the better. For example:

It can be concluded, based on analysis of historical and actual test data, that the median estimate of the increase in profit based on extending the warranty by one year will be 15%.

This is a horrible sentence. There is no need to say things like "based on analysis"; it's assumed that anything you say is based on analysis. Instead, try:

Extending the warranty by one year will increase profit by 15%.

Hollywood movies tend to be 90 to 120 minutes; there is no such guidance for an engineering report. If you can say all that needs to be said on a single page, do it!

Tip #6: If You Can Take It Out Without It Affecting Your Conclusion, Take It Out

Simple rule here, and it follows from the previous point. If your manager knows the consumer product well, don't include a detailed explanation of its design.Even if your manager doesn't know the product well, will explaining the different modules help your argument about extending the warranty? It might make your report feel more "complete", but as Obi-Wan Kenobi says to Luke Sky walker: "Bury your feelings deep down." Including material that makes you feel better dilutes your key message. Engineering reports are not text books. You aren't trying to educate the reader –you are trying to help them make the right decision. Where Hollywood script writers can elicit audience responses based on dramatic speeches, this doesn't help your report. Remove the dialogue.

Tip #7: If You Don't Have All the Information, Say What Needs to Happen to Get It

This is where tip #1 is important. A reliability engineer may not understand how warranty periods impact sales. We know that products with longer warranty periods are more attractive to customers, but how many additional sales will this translate to? This is where the marketing department needs to help.

Let's say that you're a reliability engineer writing this report, but you can't speak to the marketing team; you still need to work out whatever information you can.For example, you might be able to calculate that:

Increasing the warranty by one year will likely need an 8.8% increase in sales to be cost-neutral.

Brilliant! This means the manager knows that if his marketing team estimates a 12% increase in sales, they should extend the warranty period. Conversely, if the estimate comes back at 4%, then the warranty period should stay the same.

While many Hollywood franchises are trying to create the need for sequels, your engineering report shouldn't. If you don't have all the information, make the "sequel" concise and clear by focusing on what they need to know and how to interpret the information.

Tip #8: Don't Forget Risk

As a rule, movies need a definitive resolution. We need to know if the romantic leads work through their issues and live happily ever after. Arnold Schwarzenegger needs to always beat the bad guy, and there can't be any doubt about this.

In the real world, this isn't always possible – reliability engineers deal with uncertainties. We won't ever know the true reliability of a consumer product because we don't have that much data. Even so, we don't throw our hands in the air and give up.

So, we need to communicate it. We may need to say things like:

Increasing the warrant by one will likely need an 8.8% increase in sales to be cost-neutral. A 9.1% increase in sales is needed to be 95% confident of cost-neutral.

It's not good enough to include your best guess; the decision-maker needs to understand what the chances are of losing money.

Tip #9: Hollywood Does Get It Right When It Comes to Drafts

Movies that have their screen plays reviewed and redrafted are typically better for it. So, finish your report a week before it's due, then don't look at it for a few days. I guarantee when you look at it again, there will be parts you won't believe you wrote. Go through all the considerations above, then get someone who isn't an expert on the topic to read it.

Personally, my sentences in the first draft tend to be too long because I don't focus on sentence structure right away, otherwise, I'll interrupt my train of thought.

Sentence structure comes later for me, and I continually astound myself at how stupid I sound in my first draft (my wife doesn't get astounded by my stupidity anymore, but that's for another article/counseling session).

Tip #10: Last, But Not Least – Practice

Gary Player is a former golfer who once said: "The harder you practice, the luckier you get."

Don't shy away from practicing. don't shy away from having your work reviewed by someone who is better than you at writing, and don't be devasted by constructive criticism.

MAINTAIN? REPAIR? REPLACE?

When considering the life of any asset, the question arises: *what types of interventions should be planned to keep it operating or to restore operation in the event of its failure?*

Organizations that manage critical infrastructure rely on a wide range of asset types to provide their services. These asset populations can include millions of assets of varying complexity and cost. Modeling asset condition and the related probability of asset failure is non-trivial and costly. Therefore, assets that require modeling are those whose failure will cause significant expense or risk to an organization, or where the cost of replacing the asset is high.

The goal is for organizations to maximize the value of their capital and operational expenditures over time. To do this, the risk of an asset failing to operate as desired must be modeled. Risk is defined as the probability of failure of an asset at a given point in time multiplied by the consequence (s) of such a failure. Models are classified into two categories:

1. Those that calculate asset condition and resulting probability of failure
2. Those that calculate the costs (both to the organization and society) of such failures

The benefit realized by performing an intervention on the asset at a given time is the predicted reduction in risk achieved by improving the asset condition, compared to not doing anything. The benefit is compared to the cost of the intervention to better understand the cost of action vs. inaction. The time at which an intervention provides the best value considers possible constraints such as limits on expenditure, performance KPIs, resources, etc.

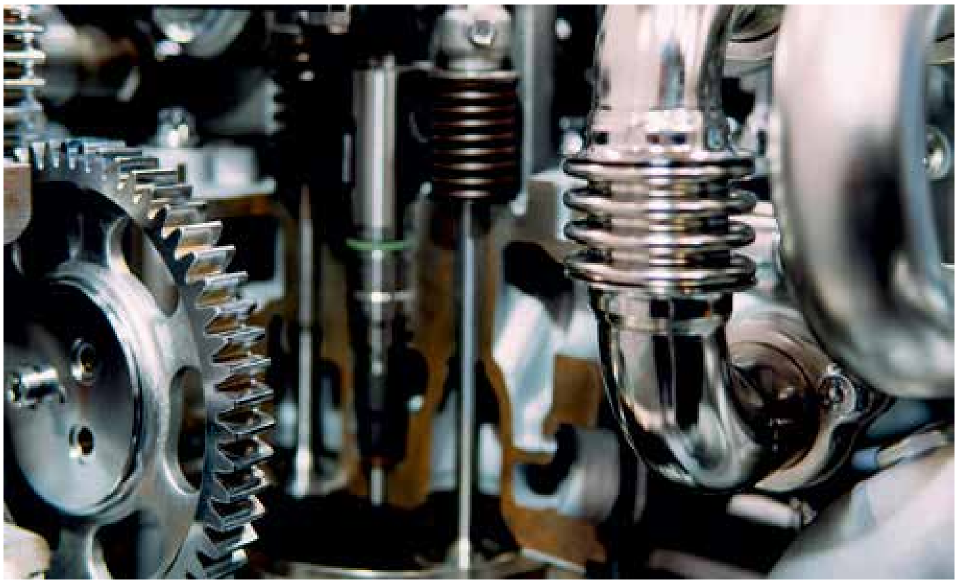
A simple risk model is one where the reduction in risk of the asset is achieved by replacing it with an identical one. This is unrealistic because in all but the simplest cases, it makes more sense to repair the asset to restore operation. For instance, we don't replace the family car when the starter motor fails, assuming that the rest of the car is in good condition; where as if the garden hose leaks, it may well be justifiable to get a new one!

To better model diverse types of intervention such as maintenance, repair, and replacement, we must understand the effects of the interventions on an asset's condition.

Some assets may be adequately modeled as a single unit if the intervention affects the overall condition of the asset. However, complex assets may require modeling of major subcomponents if a maintenance activity only improves the condition of a subcomponent.

For example, a car may be modeled as the overall vehicle, or composed of an engine, transmission, and bodywork. If we maintain the brakes, this will reduce the safety risk but will not increase the reliability of the engine. A model that treats the car as a single unit will sacrifice information; the safety risk may be understated at the expense of the reliability risk or vice versa.

For this reason, it's important to treat asset subcomponents as separate assets with their own asset types. In the car example, the asset might be represented by an engine, transmission, and bodywork — each with its own condition, probability of failure, and cost models.



Different approaches can be used to express the relationship between age, condition, and probability of failure. These include using health and probability of failure curves as well as industry-proven models, such as the Common Network Asset Indices Methodology (CNAIM) that was developed in the UK by Distribution Network Operators and adopted by the regulator Ofgem.

One important consideration is the trade-off between the fidelity of a model and the cost of creating and maintaining the model. High fidelity requires complex modeling of components, detailed and accurate data, along with higher costs associated with model development, data acquisition, and maintenance for both the software and data. Simpler models are cheaper to develop and require less data to be collected and maintained.

Once the granularity of the models required to represent an asset type is established, the next issue to consider is the nature of interventions that can apply to the asset. These can include:

- **Inspections:** These can be of varying complexity and can be qualitative or quantitative.
- **Maintenance:** Maintenance can be of varying degree and frequency. For example, in a car we may do an oil change every 5,000 miles or replace the timing belt at 100,000 miles, etc. These activities are intended to maintain the equipment in good operational condition, balancing cost of maintenance against cost of failures.
- **Refurbishment, rebuilds:** These actions may be needed to restore asset condition to an acceptable level. Some of these actions may only be done a limited number of times in the asset's life (e.g. there are a limited number of times cylinders in an engine can be rebored).
- **Replacement:** Eventually an asset may not be restorable to an acceptable level of health and replacement may be needed. An asset can be replaced with an identical asset but can also be replaced with one of a different type that has similar functionality. Replacement with a different type may be due to regulatory requirements, technological obsolescence, and the availability of new and emerging technologies.
- **Interventions:** Some interventions may be mandated by regulation and must be completed before a given date. These interventions provide anchor points in time, around which other discretionary interventions may be scheduled. In many cases, such actions are required because of safety over environmental risk considerations.

To determine the best approach, organizations should define multiple intervention types and apply different strategies to identify the optimal mix of interventions and their timing. For example, the same intervention can be repeated, enabling the planner to understand the impact of a single intervention type on the asset over time. Alternatively, different intervention types can be repeated on a fixed schedule.

Leading Asset Investment Planning solutions, like the Copperleaf® Decision Analytics Solution, enable organizations to:

- Leverage existing information to model risk, reliability, and other metrics for assets pre and post intervention
- Create, analyze, and compare asset sustainment strategies — to maximize value while proactively managing risk
- Bundle asset interventions to reduce cost and service interruptions

Want to learn more about how to create optimal asset intervention strategies? Check out this on-demand webinar:

Leveraging AI-Powered Optimization to-Bundle Asset Interventions and Reduce Outages

The Secrets For Implementing A Clean lubricant Program

If you could find an investment that guaranteed a return 40 times greater than your initial investment, you probably wouldn't pass it up. According to the Institute of Mechanical Engineers, that's exactly the return organizations can expect when they invest in quality lubricants and best-in-class lubrication practices.

For every $1,000 those organizations invest in the right lubricant and the right handling, they can expect cost reductions of $40,000 in the form of increased reliability.

A proper lubrication program begins with meeting all three of the lubricant specifications for your organization's equipment:

1. Viscosity
2. Performance
3. Cleanliness

Achieving the first two depends primarily on selecting the right lubricant. It's important to choose the lubricant that has the correct viscosity and the right blend of base oil and additives to provide the performance you need.

You Control Lubricant Cleanliness

The third specification – lubricant cleanliness – is almost entirely up to you. While choosing a lubricant with the right cleanliness specifications is an important start, actual cleanliness depends largely on how your organization stores and handles the lubricant.

Interestingly, cleanliness is a factor many organizations overlook in the lubricants they buy and use. Many sites have failed to establish new lube cleanliness specs and overlook cleanliness when managing lubricants. But without addressing cleanliness, you cannot achieve an optimal lubrication and reliability program.

Contamination is a Significant Problem

Lubricant contamination is widely recognized as the leading cause of lubricant related equipment failure. According to Noria, 82% of mechanical wear is caused by particle contamination in lubricants. In addition, dirt and contaminants are the leading cause of hydraulic system failures.

The types of contaminants causing the greatest damage are microscopic and can only be detected through fluid analysis. Examples include dirt particulates, moisture, varnish, and gases. Such contaminants not only damage equipment but may also reduce the performance of and shorten the intended life of the lubricant.

Organizations seeking to eliminate defects caused by equipment wear over time should be aware that lubricant cleanliness is a critical factor in wear. Starting clean by selecting the optimal lubricant for the application, changing it at the correct interval, and managing fluid cleanliness levels will all have a substantial effect on reducing and eliminating defects and improving the reliability of the entire plant.

A lack of understanding about cleanliness and pressure to reduce costs may lead some organizations to settle for lower-quality lubricants, but any cost savings are more than offset by the cost of lower productivity, premature component failure, and shortened service intervals.

Developing a Lubrication Reliability Strategy

Given the importance of lubricant cleanliness, as it relates to performance and equipment wear, organizations seeking best-in-class practices must adopt an effective strategy for lubrication reliability.

The heart of any lubricant cleanliness strategy involves what's called "starting clean", and that begins by selecting lubricants that meet your equipment's requirements for viscosity, performance, and cleanliness. The next step involves obtaining a baseline assessment of the cleanliness of the new oil at an analysis laboratory (including an ISO 4406:2021 particle counting analysis).

Starting clean also requires reviewing your practices and equipment. For example, it's important to monitor the process through which you transfer lubricants from storage and into equipment to ensure there are no opportunities for contaminants to enter via maintenance action. This includes a site's operational discipline to maintain cleanliness by using breathers to manage the flow of air into and out of your tanks and moving to caps that are more effective at sealing. You also need to be certain your new equipment is free of other potential contaminants.

Did You Know?

The act of excluding a gram of dirt or debris will only cost 10% of what it will cost to filter it out once the lubricant is contaminated.

Source: Machinery Lubrication

A proactive strategy for lubricant cleanliness may seem like extra work and expense, but any investment of time and money you make in ensuring cleanliness should deliver a significantly higher return in the form of longer equipment and part life and less maintenance-related downtime. Start clean, and be sure your lubricants meet equipment manufacturers' cleanliness specifications.

The Secret to a Clean Lubricants Program – Eliminate Contamination Defects

By evaluating your current program and testing the fluid cleanliness of your lubricants currently in use against your fluid cleanliness target, a baseline can be established. It is also a good idea to conduct fluid cleanliness testing for the lubricant's chain of custody. This means testing it each time it's touched.

A comprehensive lubricant contamination defect elimination strategy will address these five areas where cleanliness defects may arise:

1. **Product Selection:** Set new lubricant cleanliness targets, and ensure it's achieved at the start.
2. **Product Storage:** Store lubricants indoors and away from environmental exposure.
3. **Design Installation:** Avoid manufacturing debris that may be built inside new equipment.
4. **Maintenance Action:** Utilize approved lubricant tools, top-offs, and change-out procedures.
5. **Operational Discipline:** Manage stored and in-use lubricant airflow with breathers.

Implementing a Clean Lubricants Program

After the defects are understood, it's time to develop an implementation plan. There is no one plan that works for all businesses, as a wide variety of variables exist. To simplify, I've identified ten steps to implement a clean lubricants program:

1. **Develop a Transition Plan:** Use your baseline and chain-of-custody testing to understand where contamination is coming from.
2. **Select Lubricant and Cleanliness Targets:** Work with your OEM and/or lubricant supplier, or utilize ISO 12669, to establish the recommended cleanliness level.
3. **Have the Lubricant Delivered "Certified Clean":** Ask your supplier to deliver the lubricants clean or evaluate do-it-yourself program options.
4. **Prepare Storage Area:** Install breathers to manage the airflow of lubricants.
5. **Update and Confirm Handling Procedures:** Implement the appropriate tools, such as top-off containers and eliminating funnels.
6. **Update Lubrication Programs and Manuals:** Update or write your Standard Operating Procedures (SOP).
7. **Update Procurement System:** Evaluate the minimum stock criteria in accordance with historical purchasing habits, lubricant shelf life, and lubricant rotation.
8. **Monitor Fluids with Used Oil Analysis:** Implement a fluid analysis program and trend the data. Look for wear rate reductions, in addition to particle count. This data can feed into and contribute to developing a predictive maintenance program.
9. **Assess "Keep Clean" Tools and Services:** Evaluate your goals against the fluid analysis data. If they are being achieved, move on to Step Ten. If not, go back to Step One and retrace the lubricant chain of custody to identify where additional tools or services are required to keep the lubricant clean.
10. **High Five the Team:** You did it! Now, it's time to celebrate and acknowledge the hard work.

Rebecca Zwetzig was a featured speaker at the 2021 Reliable Plant Conference and Exhibition, hosted by Noria. To learn more about the yearly conference, visit conference.reliableplant.com.

RIL TO INVEST RS. 5,000 CRORE IN COMPRESSED BIOGAS PLANTS (CBG)

Reliance Industries Ltd (RIL) is gearing up to expand its footprint in sustainable energy with ambitious plans to establish more than 50 compressed biogas (CBG) plants within the next two years, at a projected investment exceeding Rs.5,000 crore. This development is in line with the company's commitment to advancing environmentally friendly energy solutions. According to industry insiders familiar with the matter, RIL aims to accelerate the deployment of CBG plants, tapping into the burgeoning market for green fuels. CBG, derived from waste or biomass sources, shares similar properties with compressed natural gas (CNG) and offers versatile applications across automotive, industrial, and commercial sectors. The decision to ramp up CBG production aligns with RIL's broader strategy outlined by Chairman Mukesh Ambani, during the company's annual general meeting last August. He had announced ambitious plans to establish 100 CBG plants within a five-year timeframe, underscoring RIL's steadfast commitment to sustainable energy initiatives and reducing carbon emissions. As the global drive towards renewable energy gains momentum, RIL's significant investment in CBG infrastructure underscores its proactive approach towards addressing environmental challenges while capitalizing on emerging opportunities in the green energy sector.

BPCL TO SET UP FIRST-EVER GREEN HYDROGEN PLANT IN AN INDIAN AIRPORT

BENGALURU, Feb 14 (Reuters) - Indian refiner Bharat Petroleum Corp Ltd (BPCL) will set up the first-ever green hydrogen plant inside an airport in the country.

BPCL said it would build and operate a 1,000-kilowatt green hydrogen plant inside Cochin International Airport, which will contribute land, water and green energy resources. The initial output will be used to power vehicles in the airport, which is in the southern part of the country, BPCL said.

Green hydrogen, produced from water using renewable energy sources, is recognised as a future fuel and aligns with carbon-neutral strategies. Indian companies are investing billions of dollars to reduce emissions to meet the country's goal of net zero emissions by 2070.

India is also expanding the use of biofuel in its transport sector to achieve this goal. BPCL plans to invest $18.16 billion over the next five years to grow its oil business and expand its renewable energy portfolio as it aims for a 2040 net zero goal.

CASTROL POWER1 COLLABORATES WITH MTV FOR INDIA'S ULTIMATE MOTOSTAR TO PROMOTE MOTORSPORT TALENTS

Castrol Power1, supported by Castrol India, has collaborated with MTV for India's Ultimate MotoStar to promote motorsport talents on a national platform. The initiative is a hunt for India's next Moto Racing talent. According to the brand's statement, it has received an overwhelming response from biking enthusiasts from across the country. The brand's statement revealed that almost 9000 biking enthusiasts have already completed registrations. While talking about the initiative's purpose and its encouraging response, Rohit Talwar, Vice- President- Marketing, Castrol India, stated, "We invested in Castrol Power1 presents India's Ultimate MotoStar on MTV to provide a platform for talented individuals to showcase their skills and pursue their passion for racing. There is growing interest in motorsport in India, and Castrol Power1 India's Ultimate MotoStar can be the ideal platform for India's talented young riders to showcase their talent and enhance their bike skills, allowing them to fast-track their racing career. It will significantly accelerate the development of future racing stars and catapult them into the global arena. "We are pleased to see an encouraging response coming in from a wide range of cities, including tier II and III cities like Porbandar, Siliguri, and Bhilai. This reaffirms our belief that motorsport talent exists in every corner of India, and it is our mission to nurture and support this talent," he further added. The participants will undergo multi-phase selections, starting with regional auditions in Mumbai, New Delhi, Kolkata, and Chennai in March 2024. Top 18 would be skimmed from contestants nationwide during the auditions phase, who will then participate in a training program led by Rajini Krishnan, at the Kari Motorway in Coimbatore. The winners will get the opportunity to further hone their skills at the Castrol Honda LCR MotoGP team facility in Europe.