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10 Common Grease Problems

and How to Solve Them

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Publisher's Note

In the relentless theater of the Indian manufacturing sector, plant managers have long treated lubricants as a generic consumable utility—a baseline fluid bought by the barrel, poured into the machine, and largely forgotten until the next scheduled downtime. That era of casual negligence is officially dead. As we navigate the intense operations of May and June 2026, the domestic industrial landscape finds itself facing a double-edged economic sword. Global geopolitical blockades have severely disrupted supply chains and pushed crude oil prices higher, culminating in sharp retail fuel price hikes across major Indian metros this month. Concurrently, gold has shot past unprecedented, astronomical highs per ten grams on the Multi Commodity Exchange as investors panic-buy safe-haven assets.

But while the financial world looks to bullion to protect their capital, industrial leaders need to look closer to home, focusing directly on the liquid gold flowing through their hydraulic lines, gearboxes, and turbines. When the raw input cost of base oils skyrockets, flushing out oil prematurely or allowing contamination to destroy a machine charge is no longer just a minor maintenance oversight; it is an act of financial negligence. For years, many Indian plants have masked poor practices under the guise of preventive maintenance, changing oil based on arbitrary calendar days rather than actual fluid condition, or tolerating dirty storage environments because of a mistaken belief that the machine's onboard filter will catch everything. At today's macroeconomic rates, that passive strategy is a slow corporate suicide. True sustainability on the plant floor does not come from passive environmental slogans or generic awareness campaigns. It comes from an aggressive, zero-tolerance approach to machine friction. If you want to survive this inflationary squeeze, your operational mandate must shift completely from buying lubricants to extending fluid life indefinitely through absolute contamination control and molecular purification.

This edition of Machinery Lubrication India is designed to serve as your comprehensive tactical playbook for this transition, moving away from abstract theory to provide a high-velocity toolkit for survival. Our primary focus in this issue is our COVER STORY, "10 Common Grease Problems and How to Solve Them." In the peak of the Indian summer, grease is your primary line of defense, yet it remains the most misunderstood asset on the plant floor. We break down the absolute mechanics of how grease degrades, confronts extreme thermal stress, and fails when mixed incompatibly—giving you clear, actionable pathways to eliminate premature bearing failures.

Complementing this central theme, the rest of this issue provides critical cross-disciplinary support. We address laboratory diagnostics with Bennett Fitch's guide on "Selecting the Right Oil Analysis Lab," paired with field practices on proactively preventing contamination. For specialized operational environments, we explore "Selecting Lubricants for Pharmaceutical Facilities" and look at data center infrastructure in our feature on coolant families. We bridge this to strategic plant management through tactical advice on "Shifting from Preventive to Predictive Maintenance," backed by an empirical "Case Study" demonstrating the exact financial results achieved through a reliable lubrication program. Finally, we break down critical performance parameters in "The grease test that predicts failure before it happens" and safeguard the human machine by confronting "Digital Fatigue."

It is time to stop viewing lubrication as an isolated cost center managed by a technician with an oil can, and start treating it as an asset management strategy driven by engineering data. Let the bystander complain about the rising price of oil; let the elite practitioner extend the life of their machines, secure their operational resilience, and rescue the corporate bottom line.

We advance together.

Warm regards,
Udey Dhir

Bennett Fitch | Noria Corporation

SELECTING THE RIGHT OIL ANALYSIS LAB

When you go in for a blood test, do you want to be told what your red and white blood counts are, what your platelet or hemoglobin levels are, or what the mean corpuscular volume is? Unless you're a medical doctor, probably not.

You rely on a reputable doctor to analyze the blood count report and tell you if you're healthy. If he spots concerns, does he say, "You're unhealthy," and that's it? No. You expect him to act with urgency to figure out why you're not healthy and what can be done to make you better. You expect him to ask a battery of questions to help pinpoint the root causes and explain the problem at hand. That's why we have doctors and not just blood counts or healthy/unhealthy alarm limits. We need a true diagnostic methodology to help us stay healthy.

Just like blood analysis, oil analysis is undoubtedly complicated. First, someone is tasked with ensuring samples are collected in just the right way to minimize human interference in the results. This requires training. Then, laboratory technicians are rushed to process the sample through a gambit of instruments. They must use precise and consistent methods to avoid the potential interference from such things as previously run samples or variations in sample agitation technique. This calls for a lot of training.

Once the lab tests are completed, the job isn't finished. You should expect a skilled diagnostician (just like a doctor) to analyze the results, uncover the clues behind the raw data and produce clear recommendations to address any concerns. This last step is probably the most important reason why oil analysis is performed.

It also is arguably the most difficult and often the most overlooked part of it all. This article will offer selection principles necessary to ensure your oil analysis laboratory is giving you what you need to keep your machines healthy.

The End Goal of Oil Analysis

When several end users were asked about the ultimate goal of oil analysis, the most common responses included determining if or when machines were going to fail, detecting incipient machine failures earlier, knowing when to perform an oil change on time, understanding contamination levels and optimizing machine reliability at the lowest possible cost.

While the actual responses varied, a unified answer to the question can be surmised. That is, the end goal of oil analysis is to aid in the optimization of plant-wide reliability by proactively monitoring various indicators within the oil of individual machines. This should be what motivates each plant to design its oil analysis program effectively. This same motivation will also be the deciding factor when evaluating each aspect in selecting and working with a laboratory.

Selection Principles

A laboratory likely will not excel in every aspect of oil analysis as you might hope. In order for it to be competitive, the lab may concentrate its efforts on those areas most valued in the market. The problem is many people are often too focused on price and may unknowingly fall short of their end goal by overlooking some of the most important oil analysis principles.

To capture the scope for evaluating an oil analysis laboratory, selection principles can be grouped into five categories: preparation, regulation, interpretation, communication and evaluation.

1. Preparation

- Sample shipping time/distance to the laboratory
- Provide certified-clean bottles and labels
- Support with sampling methods
- Test slate availability and selection assistance

Preparation includes all things leading up to the laboratory obtaining the oil sample. Choosing a lab that is located close enough to where samples can be delivered within 24 hours or as soon as possible from when the sample was drawn is a must.

The laboratory should supply certified-clean bottles that are selected based on cleanliness targets and the type of oil to be collected. Lab personnel should be knowledgeable about bottle types and when it is appropriate to select one over another.

Along with the bottles, sample labels should be provided requiring the collection of relevant data for the machine, lubricant, environment and maintenance practices. Without this information, the laboratory will not be able to fully interpret the results. The lab may also furnish special packaging materials to facilitate safe and effective shipping of the oil.

If you are new to oil sampling, your laboratory should offer support on the best practices. This will include how often to sample, where to draw a sample and what type of extraction tools should be utilized.

One of the first steps in developing an oil analysis program is understanding which tests should be performed for each equipment class based on the criticality of each machine. This will involve routine testing (potentially performed in-house) and exception testing (for when results come back questionable or abnormal). Your lab should be able to provide the required tests and assistance for optimizing test slates. The more you measure, the more you can analyze and the more potential opportunities ultimately arise.

2. Regulation

- Instrument testing standards validation
- Operating technician certification
- Sample handling process (e.g., agitation)

Most oil analysis test methods are not straightforward but will necessitate having regulations to carefully follow. The regulations may come from standards provided by ASTM, ISO or other comparable standardization organizations. These test standards define the generally accepted procedure, the proper application of the test, the method's repeatability or reproducibility,-calibration requirements and other pertinent data. The laboratory may even choose to follow a modified version of a test standard based on the lab's preferences. It is critical to understand which standard the lab will use for the required tests as well as the measures taken to ensure the operating technicians are conforming to those standards. There should also be minimum requirements regarding the operating technician's certifications to perform all necessary tasks

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within the lab (though outside of the actual test standards).
The lab's sample handling processes before and even after the tests are performed will be crucial. Find out how quickly samples are processed for analysis, the sequence of tests and how the remaining sample is stored for potential exception testing. At times, laboratories must take additional steps outside the scope of the testing standards to improve the accuracy of the results,such as the method to effectively agitate the sample prior to analysis or a quick physical inspection of the oil as the initial indicator of a potential concern.

Additionally, each laboratory may decide (and is expected) to go through an extensive self-assessment based on generally accepted standards for maintaining and managing a lubricant testing laboratory. In recent years, ASTM D7776-12 (Self-Assessment of Quality System Practices in Petroleum Products and Lubricant Testing Laboratories) has been developed to better outline the specific criteria that should be reviewed. If possible, end users should request any documents that can provide the results of laboratory self-assessments and the methodology and criteria that were employed.

3. Interpretation

- Three categories of oil analysis
- Statistical trends and calculations
- Multiple data point correlations
- Maintenance history considerations

If only raw data from the oil analysis tests is presented in the final report, it can be quite confusing and overwhelming for end users who have little to no interpretation experience. To achieve the end goal of oil analysis, there must be a comprehensive interpretation of the data. The interpretation stage can be challenging to summarize, as each oil analysis test provides different forms of data. Nevertheless, some general guidelines should be followed during the interpretation of routine oil analysis.

First, the overall results should focus on verifying or identifying the three oil analysis categories: fluid properties, contamination and wear debris. Second, tests performed on a single sample will not be Sufficient to obtain quality results. Developing statistical trends of specific data points and calculations across multiple data points will likely be required to determine if there are any concerns. Perhaps the most important comparison will be against the baseline sample results (new oil test results from the same batch of the used oil result).

The various trends developed for each sample point along with the collected maintenance history and understanding of the machine's criticality will allow cautionary and critical alarm limits to be set. The lab should offer assistance in establishing these limits, but they must be in agreement with the plant's overall reliability objectives.

Another thing you must consider is whether your laboratory's interpreters are familiar with the types of machines from which the oil samples were obtained. If they are not, make sure a specialist is involved to give you the diagnostic skills your machines require. Remember, providing oil analysis data and providing a good explanation of the data are two different things.

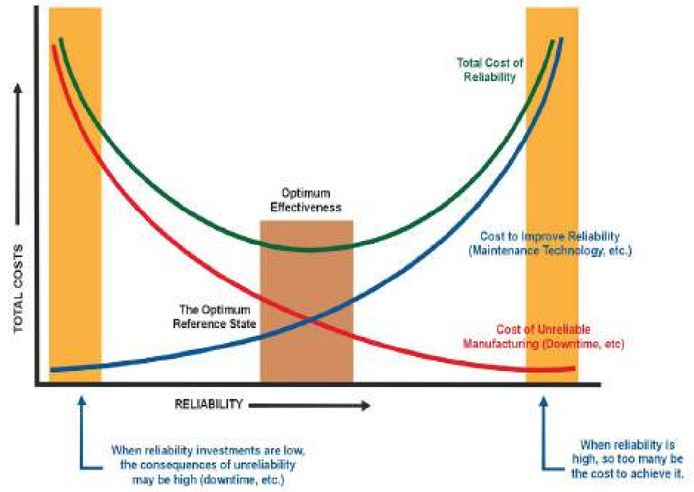
32% of lubrication professionals are not confident in the validity of their oil analysis data, according to a recent poll at MachineryLubrication.com

4. Communication

- Quality, user-friendly report presentation
- Software integration
- Urgent notification of critical results

After the interpretation has been performed, you should expect your lab to effectively and quickly communicate the results in a quality, user-friendly report. You should see supporting graphs, highlighted concerns, pictures and written interpretations in addition to the complete raw data. In recent years, it's common for all reports to be routed through a cloud-based software to allow you to easily scan multiple reports and modify charts and trend graphs to suit your needs. The last thing you want is the important details to get lost in the jumble of data or to spend too much time trying to make complex interpretations yourself. While it's always wise to make your own interpretations (since you are most familiar with your machinery's history), you don't want to have to spend an unreasonable amount of time doing so.

Every minute matters when your machines are in distress. Your laboratory should be prepared to immediately contact you if there are any critical concerns. This may be via call, text, email or whatever method works best for you. When it comes to these critical notifications, do not rely on the standard delivery methods for your oil analysis results,



as you may overlook their urgency. For example, if you normally receive all oil analysis results by email, you may not perceive the urgency of an email about a critical concern because it might be seen as a typical report in your inbox, likely delaying its review.

5. Evaluation

- Exception test recommendations
- Root cause investigation
- Assess other condition monitoring results
- Customer-focused support

After critical alarms are triggered and urgent notifications are sent, subsequent communication from the lab should help you evaluate the problem at hand and make quick decisions. The laboratory should assist you in determining exception tests that could provide more information about any concern identified by a routine test. This further analysis should include techniques like microscopic analysis, which can be obtained from any remaining oil from the original sample. More oil may also need to be drawn from the machine. These exception tests are intended to confirm, deny or provide more details in order to find the root cause of the issue. With this data and more in-depth examination into the recent events of the machine's operating conditions, investigation reports and other condition monitoring technologies, remediation recommendations can be formulated.

In many cases, the laboratory may be able to provide the investigative assistance you need to get to the root cause of a potential failure. Know your lab's full capabilities and set your expectations accordingly. The laboratory should be passionate about detecting and solving problems, and share your end goal of aiding in the optimization of plant-wide reliability by proactively monitoring various indicators within the oil of individual machines.

At What Cost?

Each of these oil analysis selection principles can be refined by considering the optimum reference state (ORS) of each machine or, more importantly, your plant's overall reliability objectives. If price was not a concern, you would simply choose a lab that could deliver on all of these principles. Unfortunately, price eventually must be a concern.

So when does the price of oil analysis outweigh its returns? First, you must consider the impact of a potential failure for any of your machines, including the resulting cost of parts, labor and lost revenue from a production interruption. Then, depending on the magnitude of this impact, you must decide how much you would be willing to spend to avoid the average incident, regardless of whether there is a history of failure. In almost every circumstance, a single catch that avoids the average failure would more than justify the typical cost of an oil analysis program for an entire plant.

Oil analysis services are generally competitively priced in the market. Nevertheless, beware of the potential shortcomings of very low-cost or even free oil analysis programs, such as those provided by a lube supplier. Even if the oil analysis is free, it still costs you time and money to collect samples and manage results. If the oil analysis program isn't created with your end goal as the focus, you may not be giving yourself any sort of advantage. You may be better off spending a few extra dollars to guarantee you get the value you're trying to achieve. Asking the questions specified by the selection principles will help ensure this. As the optimum reference state suggests, there is an optimum effectiveness zone that is a balance between the cost of an investment (like oil analysis) and the cost of unreliable operation. The total cost of reliability will be the lowest at this optimum effectiveness zone.

So while price must be taken into consideration, it should not be your top priority. Consider price only after you can verify your satisfaction with the level of service and quality the lab offers in each of the selection principles as it relates to your end goal. Like most things, it is often retrograde between price, service and quality, where two of the three are achievable at a desired level. Do not sacrifice the necessary levels of service and quality for price. The attainment of your end goal is depending on it.

10 Common Grease Problems

and How to Solve Them

Identifying lubricant problems can be tricky even when dealing with oils — and it gets even tougher with greases. While oil analysis is fairly standard in most industrial settings, in-service grease analysis remains rare and harder to interpret. Grease products often share similar basic data points like NLGI grade and dropping point, but critical details like base oil type, thickener chemistry, and additive content may not even show up on technical data sheets. Physical traits such as viscosity, tackiness, water washout resistance, and spray-off behavior are equally important but often go undocumented.

It's even harder once the grease is in service. Grease analysis options exist — like ASTM D7918 (Standard Test Method for Measurement of Flow Properties and Evaluation of Wear, Contaminants, and Oxidative Properties of Lubricating Grease by Die Extrusion Method and Preparation) or specialized wear debris testing — but they aren't widely used. Since grease operates mostly out of sight, inside bearings and housings, it's easy for issues to sneak up unnoticed until there is a major failure. Proactive grease sampling and monitoring should be part of a good preventive maintenance (PM) program, but it's still the exception rather than the rule.

Changing grease isn't something you want to take lightly. Before you swap products, it's critical to understand what's happening in your system. A few examples where trouble can start include:

- Mixing greases unintentionally because someone grabbed the wrong grease gun.
- Equipment speeds increasing due to operational changes without evaluating if the grease can keep up.
- Rising operating temperatures stressing the grease beyond its rated limits.
- Storage conditions changing — hotter warehouses or outdoor locations causing grease degradation.

Most grease performance problems don't boil down to chemistry alone — handling, application methods, and operating conditions play huge roles too. Let's walk through some of the most common grease issues and how you can fix (or better yet, prevent) them.

1: Oil Bleeding Out of Grease

If you see oil leaking out of a grease — either during service or storage — that's called bleeding. Heat, vibration, or simple gravity can cause the oil to separate from the thickener structure.

Solution: Switch to a grease with a more stable thickener. For instance, upgrading from a basic lithium grease to a lithium complex or even a calcium sulfonate complex grease will usually improve mechanical stability and reduce bleeding.

2: Grease Caking Up

Grease that dries up or forms a hard cake is often suffering from excessive oil separation, evaporation, or compatibility problems between thickeners. It can also be caused by overgreasing sealed housings.

Solution: Try a grease formulated with a synthetic base oil, which resists evaporation better than mineral oils. You might also need to adjust your PM intervals — shortening purging cycles for open systems or lengthening intervals for sealed ones.

Alert: Beware of Grease Compatibility Problems!

Mixing incompatible greases can either have no noticeable effect (best case), cause the grease to turn into a runny mess and leak, or harden into a crusty, rock-like material. The biggest culprit behind incompatibility is thickener chemistry, but base oil and additive incompatibility can also play a role.

If you're unsure whether two greases are compatible, it's safest to assume they aren't. Always purge old grease as much as possible and monitor equipment temperatures closely after any changeover. Even products using the same thickener family (like lithium complex to lithium complex) can behave differently depending on formulation.

3: Grease Won't Flow Through a Centralized System

Grease that's too cold, too thick, or too tacky may clog lines or never reach critical components. Ideally, centralized systems need a softer grease — think NLGI 0 or NLGI 1 — with minimal tack ifiers. You can also review data sheets to determine if any pump ability tests were performed to provide insight on the ability of the grease to flow through lines.

Solution: Inspect storage containers for oil pooling, indicating separation. If needed, move to a lower-NLGI-grade grease or one with a lighter base oil viscosity. Always match the product to your system's design specifications.

4: Other Dispensing Problems

Cold or improperly stored grease can cause air pockets in tubes and poor flow from bins or drums. Not using follower plates in drums can lead to wasted product, too.

Solution: Use newer grease cartridges with notched seals to prevent air lock. If you're using steel totes or large drums, ensure they have proper follower plates and incentivize your team to aim for at least 98% product usage.

5: Grease Fails or Runs Out Prematurely

When grease breaks down too fast, the root causes often include heat, bearing speed, mechanical impact, or chemical contamination.

Solution: Lower the operating temperature if possible, improve contamination control, and select greases with higher viscosity base oils, more tackifiers, or a higher NLGI grade for better mechanical stability.

6: Premature Bearing Wear

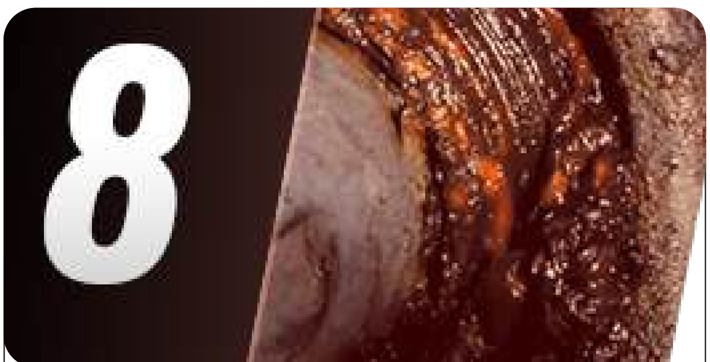
Bearings wearing out too early can result from mechanical issues like overloading, misalignment, incorrect sizing, or poor lubrication practices — including using grease with too low a base oil viscosity or lacking extreme pressure (EP) additives.

Solution: Conduct a full failure investigation. Examine loading, alignment, grease selection, and re-lubrication practices before jumping to conclusions. It's often a combination of factors, not a single cause.

7: Grease Washing Out with Water

Water washout is a common headache for shielded bearings or equipment exposed to wash downs, rain, or process water.

Solution: Upgrade to a grease designed for wet conditions. Calcium sulfonate greases offer excellent water resistance, followed by calcium complex and aluminum complex types. Lithium complex greases are decent but may struggle in very wet environments. Always look for “hydrolytically stable” formulations.



8: Grease Turns Dark or Black

Grease that darkens often signals oxidation, bearing debris contamination, or overheating. In extreme cases, stray voltage or electrostatic discharge inside the bearing can cause arcing damage, visible as fluting or pitting.

Solution: Do a sniff test for burnt smells, check machinery grounding, and inspect bearings for arcing marks. If needed, send a sample to a lab for contaminant analysis.

9: Grease Turns Milky

If grease turns milky, water contamination is usually the culprit. Some thickeners naturally absorb water, while others resist it better. Mild contamination doesn’t always ruin grease, but it will usually shorten its service life.

Solution: Eliminate the water source. Choose a grease that either sheds water well — like an aluminum complex with polymer additives — or emulsify es it effectively, like a calcium sulfonate grease.

10: Bearings Overheat

One of the most common causes of bearing overheating is simply overgreasing. Excess grease increases internal pressure, destroys bearing seals, and leads to higher operating temperatures. Lubricant starvation, though less common, can also cause overheating.

Solution: Add small amounts of grease at a time and monitor temperature changes. If temperatures drop, increase the greasing frequency slightly. If they rise, purge excess grease and reduce the fill amount. High-speed bearings may need a grease with a lower base oil viscosity.

Bonus Problem: Oil Pools in Storage

A little oil pooling in a grease drum or keg is normal — especially after transportation or heat cycling. But excessive oil separation can signal trouble.

Solution: If bleed is minimal (up to about ¼ inch), simply stir the oil back in. However, if the grease looks heavily separated or runny, discard it.

Final Thoughts

Grease problems can be frustrating because so much happens out of sight, deep inside the machine. But by paying attention to small warning signs — like temperature changes, grease consistency, color, or leakage — you can catch issues early.

Always work with your lubricant supplier and OEM to select the right grease for your application. Before switching products, verify compatibility with a controlled trial and monitor performance closely. Sometimes a heavier grease or higher-viscosity oil can mask underlying mechanical problems, but unless you fix the root cause, failures will come back.

HOW TO IDENTIFY AND PROACTIVELY PREVENT LUBRICATION CONTAMINATION

The most crucial part of any lubrication program is having a proactive process to identify and control contamination for vital equipment. By defining the contaminants commonly found in industrial equipment, a program can gain insight into how these contaminants enter equipment to better protect critical machines.

4 Common Types of Contamination

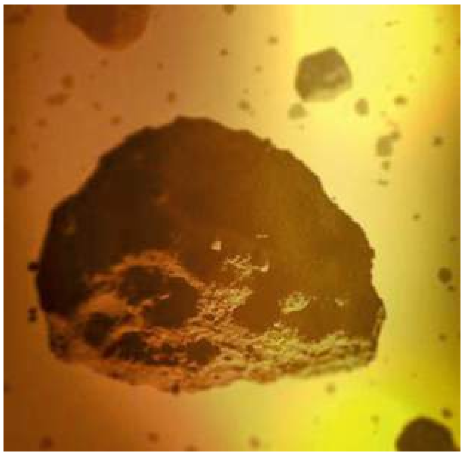
In the industrial setting, four common types of oil and grease contaminants are:

1. Particles
2. Water
3. Air
4. Heat

Particle Contamination

This contamination is the largest cause of industrial machinery contamination failures and severely affects equipment uptime. Particles include dirt or contaminants found in or near the equipment's environment and other debris and materials created in the equipment after contamination occurred.

Particle-induced wear significantly contributes to the wear and failure of oil and grease-lubricated equipment in industrial settings. The forms of particle wear are abrasion, erosion, denting, and surface fatigue. Internal particle wear within the equipment can cause additional failure modes such as abrasion, cavitation, and corrosion. If left unchecked, this vicious cycle will cause machinery to fail.



Particle contamination is characterized by size, shape, angularity, material, and hardness. Knowing the number of particles and their sizes in a lubricant helps gauge the current condition of equipment. For example, a large number of small particles suspended in an oil can be more damaging to critical equipment than larger particles.

There are three ways particles get into oil systems:

1. Particles are left behind in new equipment during assembly. Examples include welding slag, filings, casting debris, and dirty hoses.
2. Particles, including dust, dirt, and other foreign debris, enter equipment from the operating environment. This is commonly caused by inadequate air

filtration and poor sealing.

3. Particles are generated during equipment operations. Examples include mechanical wear, hose and filter fibers, and corrosion wear.

Oil analysis and particle counting are critical for machine health. Once a sample is sent to a lab, the number and size of the particles can be identified to better define the equipment's current condition. Conducting oil analysis on all new equipment is also advised to form an accurate condition baseline for future contamination concerns.

Water Contamination

Water contamination can come in several forms: dissolved, free, and emulsified.

Dissolved water is found in new oils. The water is thoroughly mixed into the oil and cannot be seen by the naked eye. The amount of water dissolved depends on the additives and base oil type. As the oil's water content increases, microscopic water droplets become suspended and cloudy in color.

Free water has a higher density than oil, allowing it to settle at the bottom of a reservoir or container. When hot, the contaminated oil can appear clear to the naked eye, but after several hours of cooling, the oil will look cloudy.

Emulsified water occurs when the amount of water has exceeded the maximum level at which the oil can dissolve, known as the saturation point. The tiny water droplets disperse and become suspended, giving the oil a hazy appearance. A variety of additives can negatively influence this type of contamination by causing a chemical reaction. When this type of water contamination occurs, a detergent or contaminant in the oil must serve as a demulsifying agent.

Water contamination in oil can:

1. Break down base oils and some additives.
2. Remove some oil additives from the oil.
3. Create acids and sludges.
4. Encourage bacteria growth.
5. Create foam and air entrapment in the oil.
6. Increase electrical conductivity.
7. Increase viscosity.

Water contamination in a machine can result in:

1. Rust and corrosion.
2. Loss of oil-film strength.
3. Increased cavitation.
4. Possible filter damage or premature plugging to filters.
5. Catastrophic failure.

Air Contamination

Air contamination can present in four primary forms: dissolved, free, foam, and entrained.

All industrial oils contain some dissolved air. This contamination does not damage most equipment except pumps, which contributes to the oxidation of the oil's additives.

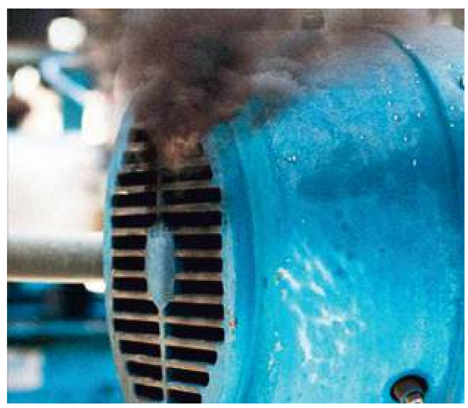
Free air contamination is a pocket of air trapped in a higher region within a machine's oil lubrication system. When this happens in a hydraulic oil system, it can cause system pressure to drop and lose its prime at the pump, making system response time sluggish.

Foaming is observed as air bubbles on an oil's surface. In contrast, air entrainment concerns air bubbles that remain suspended within the oil tank or reservoir. These last two types are hard to distinguish and often work hand in hand, causing major concerns with industrial oil systems for several reasons, including:

1. Making oil levels challenging to determine.
2. Contributing to higher rates of oxidation.
3. Causing cavitation and related wear.
4. Resulting in poor control of hydraulic systems.

Heat Contamination

Heat is also considered a form of contamination due to its ability to create solid sludge and varnish deposits. If not monitored correctly, heat can become a silent killer for industrial equipment overtime.



In most heat-treated industrial equipment situations, this can be found when temperatures exceed manufacturers' requirements. Most general equipment like this has nitrogen generators installed to help keep the oil from "sooting." Also, periodically scheduled oil changes will help dismiss this condition altogether.

Controlling Contamination

There are many ways to prevent particles and other contaminants from entering oil, including:

1. Store oil in clean and dry environments.
2. Only move lubrication in sealed containers.
3. Transfer oil into equipment through hoses with only quick disconnect couplers using filter carts.
4. Do not use reusable funnels or open-fill ports.
5. Only use lint-free cloth during cleaning and after flushing already contaminated equipment.
6. Remove old-style goose necks and tap and spin vents, breather caps, and other older-style vent plugs that are not filtered. Instead, use desiccant filter breathers with a minimum rating of 3 microns.
7. Ensure all reservoir hatches and inspection plates are sealed correctly.
8. Install better shaft sealing mechanisms.
9. Install accordion-style rubber boot seals on hydraulic cylinders.
10. Utilize clean and properly serviced filter cards labeled to prevent cross-contamination.

Lubrication Storage

Proper lubricant storage can help prevent contamination and extend the lubrication shelf life. When storing lubricants, a few basic rules to follow include:

1. Keep lubricants clean and dry by storing them indoors and temperature-controlled.
2. Ensure all lubricants are correctly labeled to prevent cross-contamination and that the proper lubricant is used.
3. Ensure all lubricant containers are properly and tightly sealed to prevent water, dust, and other airborne contaminants from entering.
4. Utilize the "first-in-first-out" (FIFO) method , noting the date the lubricant was received and the best-by date.

Lubricant Handling

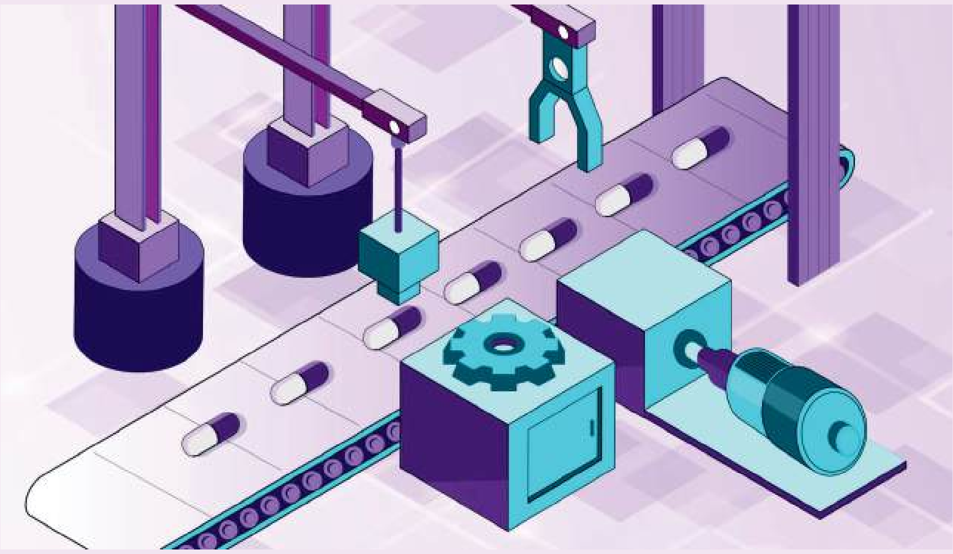
Handling lubricants presents a host of opportunities for contaminants to enter a facility's oil. General rules when handling lubrication include:

1. Inspect all new lubricants received for cleanliness and water content.
2. Check that all new lubricant drums have intact plastic warranty seals.
3. Stored lubrication containers should be rotated so the older stock is used first.
4. Lubricants should not be stored for longer than five years, keeping in mind that drums and pail scan be stamped with their filled date and not their expiration date.
5. Transfer lubricants from drums into sealed and marked plastic containers in a clean working environment.
6. Lubricant top-up containers should be inspected once a month for internal cleanliness, checking for possible sediment.
7. Keep the lubricant storage area neat and orderly at all times.
8. Drum pumps should be labeled for a specific lubricant and threaded completely into the top of the drum.
9. Use lubricant pre-filtered through filter carts when oil is being transferred into equipment,making sure to use quick-connect couplers during lubrication filtering and oil changes.
10. Filter carts must be appropriately labeled to the specific type of lubricant they are being dedicated to.
11. Quick-connect couplers should be sized differently to help prevent cross-contamination of lubricant.

Grease and Grease Gun Lubrication Handling, Storage, and Application

1. Do not self-pack grease guns by hand.
2. Properly label or color code grease guns to prevent lubricant cross-contamination.
3. New grease guns should be calibrated for the amount of per-stroke grease being dispensed.
4. Grease guns create a lot of pressure when pumping grease in grease-fill tubes. Periodic inspections of bearings are needed to ensure the grease tube has not popped off and the bearing receives the proper amount of grease.
5. Store tubes of grease vertically with the plastic removable cap on top.
6. The grease manufacturer determines grease storage life and, most times, is marked on the grease tube.

SELECTING LUBRICANTS FOR PHARMACEUTICAL FACILITIES



Over the past few years, there has been an increasing interest in the use of food-grade lubricants for machines operating in the pharmaceutical industry. While these lubricants can be beneficial, several other factors must be considered.

Modern machinery used in the production of pharmaceuticals generally requires minimal or even no lubrication, particularly in sections of the production line where the product or its packaging is processed.

However, other machines with chains or moving components near the production line may need lubrication, and the lubricant recommended by the equipment manufacturer might not always be classified as H1 food grade or certified according to the ISO 21469 standard.

In these cases, it must be determined whether the machinery should be lubricated with conventional lubricants or if there are specific requirements for selecting an appropriate lubricant.

Lubricant Requirements

Lubricant selection should begin by considering the lubrication needs of the component or machine in terms of the load, speed, viscosity and application method. Once these parameters have been defined, additional requirements must be taken into account, such as food-grade properties.

While the use of food-grade lubricants is widely accepted in pharmaceutical facilities, these H1-registered or ISO 21469-cetified products are primarily intended for food-processing plants and applications in which there is incidental contact with food.

The U.S. Federal Drug Administration (FDA) provides regulations and good practice recommendations regarding pharmaceutical manufacturing equipment and lubricants within the Code of Federal Regulations (CFR). In 21 CFR 211.65, it states: "Equipment shall be constructed so that surfaces that contact components, in-process materials, or drug products shall not be reactive, additive, or absorptive so as to alter the safety, identity, strength, quality, or purity of the drug product beyond the official or other established requirements."

The document further stipulates: "Any substances required for operation, such as lubricants or coolants, shall not come into contact with components, drug product containers, closures, in-process materials, or drug products so as to alter the safety, identity, strength, quality, or purity of the drug product beyond the official or other established requirements."

From this information, it can be concluded that machine operation should be free of lubricants in sections or components where exposure to a pharmaceutical product or its packaging may occur. Keep in mind this regulation does not specify that lubricants should not be applied in machinery utilized for pharmaceutical production, but rather that lubricants should not come in contact with the drug product.

Moreover, while lubrication routes would not be expected in equipment sections that are exposed to the product or its packaging, it is possible to lubricate isolated machine sections.

The FDA's Good Manufacturing Practice Guidance for Active Pharmaceutical Ingredients offers additional information on lubricants used in the manufacturing process: "Any substances associated with the operation of equipment, such as lubricants, heating fluids or coolants, shouldn't contact intermediates or APIs (Active Pharmaceutical Ingredients) so as to alter the quality of APIs or intermediates beyond the official or other established specifications.

Any deviations from this practice should be evaluated to ensure that there are no detrimental effects on the material's fitness for use. Wherever possible, food-grade lubricants and oils should be used."

This last statement allows for the use of food-grade lubricants in exposed areas of the machine. However, this should be addressed and documented properly. The FDA also permits the use of lubricants in a manufacturing facility or in isolated machine sections when there is no risk of contact with the pharmaceutical product or its packaging.

When a lubricant is needed in an area that is exposed to the drug product, the potential impact should be analyzed to ensure it will not be detrimental to the product's intended fitness for use. This requirement is stricter than the criterion for food-processing machines, which allows a maximum lubricant contamination of 10 parts per million.

In general, sealed-for-life or non-lubricated components should be the first choice for machinery components. Food-grade lubricants are a good option for isolated production machine components that need lubrication. Of course, proper cleaning and sanitizing practices will be required after the application of lubricants within the production area.

Lubrication-Related Requirements

In CFR 21.211, the FDA provides guidance regarding lubrication practices and machine maintenance used in the manufacturing, processing and packing of pharmaceuticals. It emphasizes the importance of maintaining clean equipment and establishing written procedures, including lubrication procedures.

31% of lubrication professionals do not know when a food-grade lubricant is required, according to a recent survey at MachineryLubrication.com

If a lubricant change or lubrication issue could impact product quality, written records are required to be kept relating to the affected product batch. However, routine maintenance such as lubrication does not have specific record-keeping requirements.

Lubricant Selection

For effective lubricant selection in pharmaceutical facilities, one of the first steps should be to classify machines by the application. For support services equipment not located in the production area and that have no potential contact with production machinery or the product/packaging, it is possible to use H2 lubricants, which are not intended for food-grade (incidental contact) applications.

These types of machines would include pumps, compressors, gearboxes and hydraulic systems involved in the supply of water, compressed gases and energy. Most lubricants (non-H1) in the market fulfill H2 requirements, while only a limited number have a formal H2 registration. If compressed air line for production machines requires lubrication, an H1 lubricant would be a good choice.

Machines or machine components that are situated in the production area but with a physical barrier blocking exposure to the locations where products and packages are processed have no formal requirements for lubricant selection. However, food-grade lubricants may be preferred to maximize safe maintenance practices related to the production machines.

For components like sliding ways, chains or conveyors that have the potential to contact drug products or packaging, further analysis is recommended to identify the components' true lubrication needs. Determine whether these pieces must be lubricated, and if so, what lubricant type, application method and frequency would be suitable. For instance, a chain can be lubricated with oil, grease or dry spray.

Clean-room applications may demand the sterilization of tools and machine components. If lubrication is needed, it may be necessary to use not only food-grade quality but lubricants previously sterilized through thermal treatment (autoclave) or gamma irradiation. In these cases, lubricant selection should include additional performance requirements such as high oxidation, chemical or radiation resistance. Special storage and handling procedures may also be required.

Whenever possible, switch to sealed-for-life or non-lubricated components to eliminate lubrication tasks as well as potential lubricant contact. Typically, the pharmaceutical industry utilizes relatively smaller machines and components than other sectors.

The equipment also tends to operate in controlled environments. These favorable conditions facilitate the conversion to a sealed-for-life or non-lubricated asset. This recommendation is intended for production areas, but it can also be beneficial if implemented across the facility.

In certain circumstances, an ISO 21469-certified lubricant may be preferred over a lubricant registered as H1 food grade. While both classifications involve food-grade lubricants for incidental contact with products, the ISO certification "reviews the level of quality control applied to the formulation, manufacturing, distribution and storage of the lubricant to ensure it complies with the highest standards of hygiene." Both classifications are managed by NSF International.

Finally, be sure to follow the established protocols for change management and keep a record of all lubricant conditions, analysis, decisions and actions taken. For official recommendations and regulation interpretations, contact the appropriate federal organization. The FDA's Division of Drug Information may also offer further assistance.

SHIFTING FROM PREVENTIVE TO PREDICTIVE MAINTENANCE

New technology is empowering maintenance teams like never before, offering unprecedented efficiency, visibility, and precision. This industrial maintenance revolution is fundamentally changing our approach to achieving equipment reliability.

Historically, preventive maintenance (PM) was an ideal method for maintaining equipment. It involves regularly scheduled servicing and inspections to prevent equipment failure based on time or usage intervals. While it helps reduce unexpected breakdowns, this strategy isn't tailored to the actual condition of the equipment, often leading to unnecessary maintenance or overlooked issues between checks.

Predictive maintenance (PdM), on the other hand, uses real-time data collected by sensors to monitor the health of equipment continuously. By detecting early warning signs of potential failure, PdM enables maintenance teams to address issues only when necessary, minimizing downtime and extending asset life. The transition from preventive to predictive maintenance is more than just an upgrade—it's a strategic transformation that drives greater efficiency, reduces costs, and maximizes machine uptime.

The Limitations of Preventive Maintenance

While preventive maintenance has been a reliable strategy for reducing equipment failure and downtime, it falls short in today's fast-paced, tech-driven world. PM operates on fixed schedules or predefined intervals, regardless of the actual condition of the equipment or facility. While this approach works for basic upkeep on non-critical equipment, it introduces several inefficiencies and challenges for more critical components.

1. Over-Maintenance and Unnecessary Downtime

Preventive maintenance operates on a time-based schedule, often resulting in interventions that are not always necessary. This approach can lead to over-maintenance, where equipment that is still in good condition undergoes unnecessary servicing, wasting valuable time and resources. Additionally, the regular scheduling of maintenance often requires equipment to betaken off line, causing production interruptions and avoidable disruptions to operations and output.

2. Reactive Elements

Despite being proactive in nature, preventive maintenance often fails to detect issues that arise between scheduled checks. Small but critical problems can develop unnoticed, worsening overtime and potentially leading to significant equipment failures. Without real-time monitoring, these issues are often discovered only after they have escalated, resulting in delayed repairs that could have been avoided with earlier detection.

3. High Costs and Resource Inefficiency

Preventive maintenance demands substantial planning, scheduling, and resource allocation,which frequently surpass what is necessary for the actual health of the equipment. Routine inspections and servicing, while intended to prevent failure, can significantly increase operational expenses, even when equipment is functioning optimally and doesn't require attention. Parts are often replaced according to a fixed schedule rather than actual need, resulting in premature disposal and heightened costs that could have been avoided with a more condition-based approach.

4. Lack of Real-Time Insights

Preventive maintenance does not leverage live data, which limits its ability to adapt to dynamic changes in equipment performance or operating conditions. Maintenance schedules are typically based on assumptions or visual inspection rather than real-time insights, often resulting in missed opportunities for optimization. Furthermore, preventive maintenance strategies generally lack the capability to analyze equipment performance trends or predict potential failures, leaving gaps in addressing emerging issues before they escalate.

Predictive Maintenance: A Smarter Approach

Predictive maintenance uses real-time data, advanced analytics, and machine learning to predict when equipment is likely to fail. By using sensors to monitor machine condition, this approach allows maintenance teams to address issues before they lead to costly downtime or damage. Predictive maintenance not only reduces unplanned disruptions but also extends the life of assets and optimizes resource allocation.

With that said, different assets require varying levels of monitoring based on their criticality and operational importance, and Asset Watch provides tailored solutions to meet these needs. For Tier1 assets—highly critical equipment where unplanned downtime or failure can result in significant financial losses or safety risks—continuous vibration monitoring is the ideal approach. This method ensures real-time, 24/7 data collection and analysis, allowing teams to detect anomalies and respond instantly to emerging issues. By providing a constant stream of data and analysis,continuous monitoring delivers the highest level of protection for essential assets.

In contrast, Tier 2 and Tier 3 assets, which are less critical to overall operations, are better suited to route-based vibration monitoring. This approach involves periodic data collection by maintenance personnel or automated systems at scheduled intervals. While not as immediate as continuous monitoring, route-based monitoring is a cost-effective way to track the condition flower-priority equipment while still identifying potential issues before they escalate.

Predictive Maintenance Made Easy with End-to-End Condition Monitoring

Asset Watch is at the forefront of the shift to predictive maintenance with an end-to-end condition monitoring solution. This solution continuously monitors vibration and temperature data on critical equipment through their Vero® remote sensors, with dedicated Condition Monitoring Engineers (CMEs) analyzing the data to detect early signs of wear or potential failure. CMEs then provide maintenance teams with prescriptive recommendations, enabling timely interventions before issues escalate.

Asset Watch's dedicated Condition Monitoring Engineers communicate with your plant's program leader to identify and solve equipment issues.

By combining advanced sensor technology with robust data analytics, the system provides maintenance teams with actionable insights through a centralized platform. If maintenance teams are attentive to the system's alerts, this technology can help maintain uptime, optimize maintenance schedules, and extend asset life.

Ensuring Accuracy Without Alert Fatigue

One of the biggest challenges in predictive maintenance is ensuring data accuracy while avoiding alert fatigue. Alert fatigue occurs when AI models generate alerts based on false positives, or flag minor fluctuations or non issues as potential failures. Maintenance teams are bombarded with excessive or irrelevant notifications from their monitoring systems, making it difficult to distinguish real issues from false alarms. This overload of alerts can lead to frustration, wasted time, and, in the worst cases, critical warnings being ignored.

Asset Watch combines advanced AI with human expertise, so maintenance teams receive only the most relevant insights. Unlike other AI models that rely on unverified data inputs, Asset Watch's AI is trained by CAT III+ engineers. This approach results in a 99.9% accuracy rate, meaning team scan trust the alerts they receive without being overwhelmed by false positives or irrelevant notifications.

Holistic Monitoring for Better Insights

Using multiple condition monitoring strategies in combination provides a more complete view of equipment health, and Asset Watch is leading the way in this area. Aside from tracking vibration and temperature through sensors, Asset Watch also offers comprehensive oil analysis services,which include everything from sample collection to timely expert recommendations.

Vibration analysis helps identify mechanical issues such as imbalances or misalignments, while oil analysis reveals insights into lubrication quality, wear metals, and contamination levels that can indicate early signs of failure. What sets Asset Watch apart is its ability to integrate both sets of data into a single platform, where their experts analyze the combined information to pinpoint the root cause of equipment issues more accurately. This holistic approach enhances predictive accuracy, improves troubleshooting, and enables more proactive, targeted maintenance interventions.

Once the oil sample is collected, your lubrication tech will scan the sample's QR code to automatically link all critical data to the Asset Watch platform, then carefully pack and ship your samples to the lab for analysis.

Embracing the Future of Maintenance

As artificial intelligence continues to advance, predictive maintenance is becoming increasingly intelligent and intuitive. Solutions offered by Asset Watch harness leading hardware, machine learning, and human expertise to detect patterns, predict failures, and provide actionable insights. Asset Watch goes a step further by integrating multiple condition monitoring methods, such as vibration data and oil analysis, into a single unified platform. This comprehensive approach simplifies operations and gives maintenance teams clarity in equipment health.

The shift from preventive to predictive maintenance is more than just a technological evolution—it is a strategic imperative for organizations aiming to stay competitive in an increasingly data-driven world. **Learn how Asset Watch can help your organization boost uptime.**

CASE STUDY:
Results Achieved Implementing a Reliable Lubrication Program

Company Overview

VLI is a company that has been in the market for over 10 years. We work with general logistics,like grain transport, siderurgy products, fertilizers, etc. VLI is an industrial unit that owns five port sand nine warehouses and has a large quantity of equipment (reduct ors, bearings, electric engines,etc.). It requires constant maintenance, including mechanics, structure, and lubrication processes.

Before, the port and warehouse maintenance used to be just corrective. The budget was spent on failure and repair, and time was used to correct mistakes instead of being used to monitor and improve processes. However, in just four years, VLI was able to implement a reliable lubrication program that raised the port unit initial ASCEND™ assessment score from 24% to 90%. The mainsteps will be presented here to explain how this remarkable evolution was possible.

Introduction

Reliable lubrication is essential to ensure the efficient and long-lasting performance of machines and equipment. It involves using suitable lubricants and correct application to reduce friction and wear, prevent corrosion, and maintain the proper functioning of mechanical components.

Reliable lubrication not only extends the life of equipment but also helps prevent unexpected failures, thus minimizing maintenance costs and increasing productivity. In this context, carefully choosing lubricants and implementing effective lubrication practices are fundamental to ensuring efficient and safe industrial operations.

From that, the main phases of the project can be seen below:

1. Defining the engineer responsible for corporate project management.
2. Defining the local project manager responsible for the project at each site.
3. Diagnosing and evaluating the processes involving lubrication.
4. Obtain all information about the equipment and elaborate on the lubrication plan.
5. Teaching all employees involved in the lubrication program.
6. Elaborating on the regulations and corporate standards, from the lubricant selection to its disposal.
7. Follow up on the lubrication maturity development monthly.

A target was established based on the first score obtained in 2020 of 24%. The unit had a period of just over a year until the next lubrication maturity diagnosis to achieve this objective,implementing best practices.

From this, the methodology is guided by the following topics: selection of lubricants, reception and storage, handling and application, contamination control, oil monitoring and analysis,environment, ecological disposal, and energy efficiency.

The implemented practices will be addressed in this article, and the main indicators related to the project will be presented.

Development

1. Training

People trained in lubrication play a fundamental role in the maintenance of machines and equipment. They ensure that lubrication systems are properly managed, which extends equipment life, reduces maintenance costs, and increases operational efficiency.

One of the first project learnings: "It's necessary to provide knowledge to people. They don't know that they don't know." Due to this affirmation, the first project action was training people directly involved with lubrication.

Since 2018, an average of 70 employees for Level 1 incapacitation have been trained: machine lubricant technician and machine lubricant analyst. Besides, the Level 2 training is also defined annually by following the training matrix according to the company's lubrication policy.

Based on the corporate lubrication policy, a matrix of training and certifications is followed for each unit of the company. The VLI - Vitória unit stood out by managing to certify 100% of the lubrication team, including maintenance leaders, analysts, and performers.

Another important learning lesson is that it's necessary to train and involve all the maintenance,operation, and industrial cleaning teams, at least in lubrication fundamentals. They don't work with lubrication directly but live with the machines daily.

An equipment intervention usually made by a mechanic, like a motor removal from a gear motor,can result in oil contamination if he doesn't take basic care. A bearing cleaning activity, done in the wrong way, can condemn the grease inside. If you put lubrication items on the route inspector's checklist, you gain a significant partner in identifying problems.

2. Leadership Involvement

At VLI, all the maintenance managers and supervisors were trained in MLT1. Putting leadership inside a classroom for four days for technical training with an exam at the end is not common. But it was very powerful and assertive. It worked like an immersion in lubrication, and much more important than passing the exam, it changed their minds about how important and critical this process is for the business run by them in the plants.

Besides training, another vital action related to leadership was to turn lubrication into part of the Maintenance Leadership Committee through a lubrication subcommittee. This meant having two leaders directly linked to the subcommittee and having lubrication as a topic discussed bi-monthly among all managers and general managers.

Giving them knowledge and showing them the work in progress resulted in receiving their support. And it was imperative for the project's evolution. The VLI - Vitória plant was recognized for receiving the greatest support from the leader and the one that showed the most significant evolution in maturity. This indicator represents the importance of training the entire team involve din the process.

3. Lubricant Supplier Selection

Having a lubricant supplier offers a series of benefits for industrial operations. Firstly, it ensures consistency in the lubricant quality, which is essential to maintain equipment performance and reliability.

Furthermore, by working with a single supplier, it is possible to establish a solid and collaborative relationship, resulting in better commercial conditions, specialized technical support, and personalized services according to the company's needs. Another important point is the simplification of inventory and logistics management, as there is a reduction in the variety of products to be monitored and stored.

Finally, a dedicated supplier can offer training and education programs for maintenance staff,ensuring they can use lubricants effectively and maximize the benefits to the equipment. The objective here was to structure the purchasing process to have quality products delivered in an acceptable time and a concrete technical support program to help us with decisions –consolidation, changes, and optimization – and on studies and problem solutions.

LVI worked to evaluate three parameters in particular when it came to selecting a lubricant supplier—product, service, and logistics.

3.1 Product

Grading technical parameters by performance importance, we eliminated suppliers that didn't meet the minimum product requirements. With the ones who met those minimum requirements –as viscosity index, four ball, Timken, foam test, and others – we did a quantitative ranking after giving weight and score for each parameter and product. This helped identify which products were most suitable for our applications.

3.2 Service

In the contract technical specification, we listed four necessary service groups beyond the lubricant supply itself.

- Technical Support: Engineering support, especially for choosing the best lubricant for each application, product changes, and consolidation.
- Failure analysis support: In case of lubrication failure, an expert helps to find the root cause.
- Problems solution: If the lubricant is considered the root cause of the problem, the supplier must help find the solution (for example, change a type of lubricant or an additive package).
- Laboratory analysis: They have their own laboratory and make the same retests or punctual analyses to confirm product composition.

3.3 Logistics

This third parameter is crucial for VLI due to the plants' distribution throughout the country. There are sites more than 2,000 km apart. Therefore, our supplier must have a good distribution structure and logistical plan to supply products within an acceptable time frame.

We defined two logistic parameters:

1. Delivery time: maximum 10 days for any plant.
2. Logistic structure: at least one distribution center for each Brazilian region where VLI has ports or warehouses.

4. Lubrication Room

That's an important investment. It is the first care with the lubricant, where it will be waiting and prepared for use. The plant received the investment to build up the lubricant room following all minimum requisites defined by the corporate policy. This included a closed space with:

- Solid walls and ceiling
- An air-conditioning system
- Sealed floor
- Containment dike (dimensioned for the lubricant volume)
- Firefighting equipment.

Everything is always extremely clean.

Before and After: Lubrication Room

The VLI - Vitória unit structured a complete lubrication room, with storage tanks equipped with filters and breathers to clean the lubricant before its application, a little field laboratory to make initial oil analyses, cabinets for the application equipment and spare parts, and a complete Key Performance Indicator (KPI) visual management.

5. Method of Execution and Application

Handling and applying lubricants using accessories and good practices can significantly improve efficiency and safety. Here are some applied patterns:

1. Use appropriate tools: Use accessories such as grease guns, lubrication pumps, and automated distribution systems to ensure precise and uniform application of lubricants.
2. Pre-cleaning: Before applying the lubricant, make sure the surfaces are clean and free from dirt and residue. This helps prevent lubricant contamination and improves lubrication effectiveness.
3. Correct amount: Use flow meters and regulators to ensure that the right amount of lubricant is applied to each lubrication point. This avoids waste and provides adequate lubrication.
4. Apply at the correct temperature: Some lubricants require specific temperatures for effective application. Make sure the lubricant is at the correct temperature before applying it.
5. Regular maintenance of accessories: Keep lubrication accessories clean and in good working order. Perform periodic inspections and replace worn parts to ensure consistent performance.
6. Team training: Ensure that the team responsible for applying lubricants is properly trained in best handling and application practices. This includes correct use of accessories, safety procedures, and preventative maintenance.

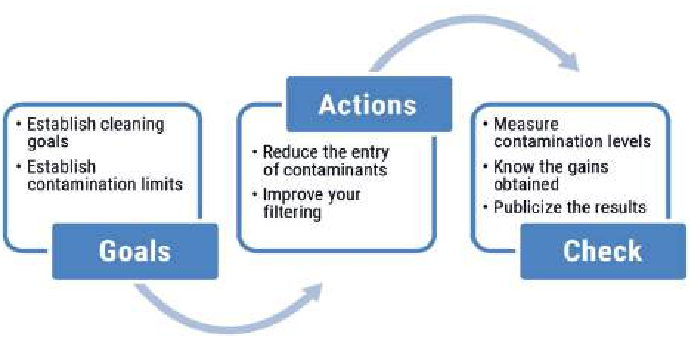
7. Documentation and traceability: Keep detailed records of lubrication activities, including the types of lubricants used, quantities applied, and lubrication intervals. This helps ensure compliance with maintenance requirements and makes it easier to identify potential problems.

By following these good practices and using the appropriate accessories, it is possible to guarantee an effective and safe application of lubricants, contributing to the equipment's extended useful life and optimized performance.

Accessories and Application Devices

6. Contaminant Removal and Exclusion

The purpose of implementing good practices for lubricant contamination control is to create a solid strategy to guarantee the quality and integrity of oils and greases installed in equipment through the exclusion and removal of contaminants, ensuring greater longevity of installed lubricants and elimination of the main root causes of failures of lubricated components, directly adding reliability to productive assets.



Phases Implemented in the Contamination Control Program

To guarantee the Success of the Program and the Projected Results, 03 main phases were structured:

- Defining the contamination control strategy based on the criticality of the equipment and costs.
- Defining what type of accessory will be installed on each equipment, according to criticality.

Improvements to Already-Installed Accessories

In the first image with galvanized steel, the shielding oxidized quickly in the area where fertilizer products were operated. As an improvement, the accessories were replaced with stainless steel parts, keeping the parts more durable and reducing the entry of contaminants.

Thus, cleaning objectives were defined by the type of equipment, using recommendations from the manufacturer's manuals and the experience of the professionals. Furthermore, decisions and Modifications should be aligned with predictive maintenance. It is crucial as it changes alarm limits, trend lines, and even the sampling method or condition.

7. Proactive and Predictive Maintenance

A proactive oil analysis program is essential for the early identification of wear, contamination, or failure issues in industrial equipment. This allows corrections to be made before significant damage occurs, increasing equipment reliability, minimizing unplanned downtime, and reducing maintenance costs. Regular monitoring of lubricating oil also contributes to optimizing oil change intervals and improving equipment energy efficiency.

Furthermore, a consistent analysis program allows for oil change interval optimization, avoiding unnecessary changes and reducing maintenance costs. It also contributes to energy efficiency, as lubricating oil of adequate quality reduces friction and wear, resulting in lower energy consumption.
In summary, investing in proactive maintenance is essential to max-

imize the reliability, efficiency,and useful life of industrial equipment and reduce operational and maintenance costs. Currently,the unit analyses are performed at the company's facilities (Field Laboratory) or by an external laboratory service. The practices used for implementation are described below:

1. Selection of Machines for Condition Monitoring and Lubricant Analysis Program.
2. Selection of the Test Package for the program.
3. Lubricant analysis data source selection: on-site laboratory, external laboratory, and online sensors.
4. Sampling.
5. Selection and integration of inspection and condition monitoring tasks.
6. Definition of sample condemnation limits.
7. Scope of condition Monitoring and analysis of Lubricants.
8. Definition of main and secondary indicators for the oil analysis program.

Field Laboratory

The tests currently carried out in the field laboratory are:

- Kinematic Viscosity (40°C)
- Crackling Water (%)
- TAN (Total Acid Number)
- Membrane Particle Counting by Comparison (ISO 4406)
- Kit Analisador de graxa

8. Environment and Lubricant Disposal

When lubricants reach the end of their useful life, they must be disposed of in accordance with local laws and regulations, following all VLI policies in its Ports and Terminals in Brazil regarding the disposal of lubricant waste and materials contaminated with lubricants, including cloths and any other absorbent material.

However, lubricant leaks are common during equipment operation and must be contained and eliminated as quickly as possible. All leaks must be mapped, documented, and repaired based on their volume, cost, or a combination of both. All lubricants disposed of in a used oil container must be recorded and identified, as well as the total volume of oil discarded per environmental laws.

Excellent lubrication, focused on reliability, requires that procedures be implemented to reduce the disposal of contaminants and that this be carried out in accordance with current environmental laws.

Before and After: Lubricant Disposal Deposit

Final Considerations and Results

At the beginning of the project, most people didn't know how big and important it would be.

Revolutionizing VLI lubrication gave the company a different vision of asset management,maintenance, and reliability. Even those who had many years working with mechanics,maintenance, or engineering received a lot of new and valuable information. This signify cant evolution and all those changes brought big results.

Some quantitative gains can be seen below:

- Savings of $27,414.28 with filtration, preservation of investments in maintenance stops, and oil analyses
- .35% increase in equipment availability. 72% reduction in the number of formal leak notifications.
- 100% of the plant's lubrication team professionals and maintenance leadership are certified.
- 98.1% adherence to lubrication plans in 2023.
- 90% adherence to the ASCEND Lubrication Maturity diagnosis.

Talking about qualitative gains, we can highlight:

- Security, reducing work in height, work in closed space, and hands accident risk.
- Ergonomics, improving lubrication points access and making extensions.
- Employee satisfaction, recognizing the employee's efforts with meritocracy, valuing their evolution.
- Engagement, valuing protagonism, making people owners of their process, responsible for it.
- Environmental, giving correct destination to used lubricants, treating leaks and spills, and changing products (for example, biodegradable oils).

All these results, added to ASCEND results, proved the project's effectiveness and impact. Today, VLI is a benchmark in lubrication excellence practices, and the lubrication concern keeps growing and becoming more adept in its culture, reliability, and asset management culture.

Samarth Shah

THE GREASE TEST THAT PREDICTS FAILURE BEFORE IT HAPPENS

How the FAG FE8 test puts grease through conditions tougher than almost anything it will face in the real world — and why that matters for any machine that has to keep running.

Every spinning machine — from the wind turbines that power the grid to the gearboxes inside a steel mill or the rollers in a paper plant — relies on the same small, unsung component: the bearing. Bearings let things rotate smoothly. And what keeps a bearing from grinding itself to dust is a thin coating of grease.

Most of the time, this grease does its job invisibly. But in heavy industry, bearings are asked to do brutal work: huge loads, slow turning speeds, high temperatures, and years of continuous operation. When grease fails under those conditions, machines fail — and a single bearing failure in a wind turbine or a steel mill can cost tens of thousands of dollars and shut down production for days. So how do engineers know, before they pump a grease into an expensive machine, whether it can actually handle the punishment? They use a test called the FAG FE8.

A Stress Test Designed to Hurt

Think of the FE8 the way doctors use a treadmill stress test. You're not interested

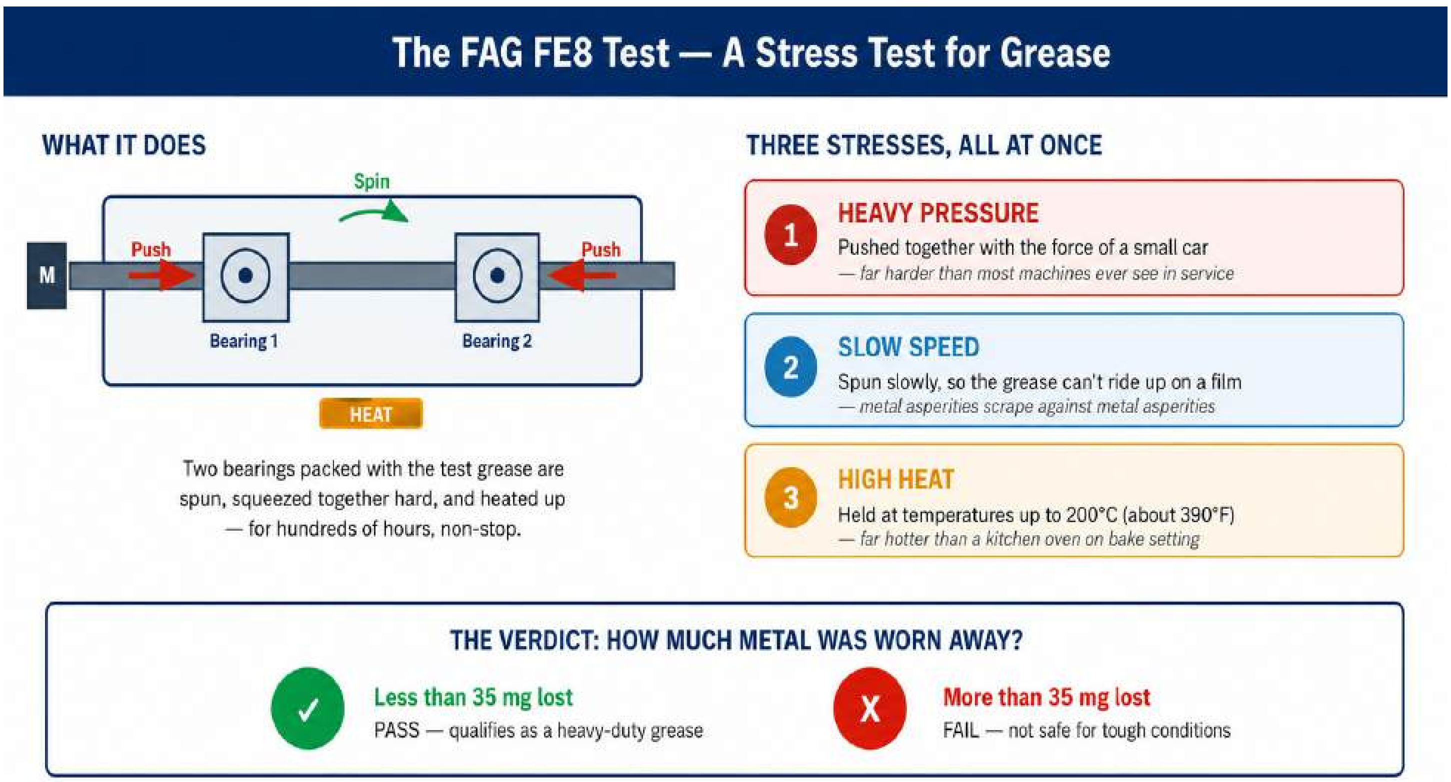


Figure 1. The FE8 test in plain terms: three stresses applied at once, with the verdict measured in milligrams of metal lost.

in how well someone walks at normal pace — you want to know how their heart copes when pushed to its limits. The FE8 does the same thing for grease.

Inside the test machine, two bearings are mounted facing each other on a shaft. A grease sample is packed in, and then three things happen at the same time: the bearings are squeezed against each other with enormous force, the shaft is spun slowly, and the whole assembly is heated to temperatures hotter than a kitchen oven. The test runs for hundreds of hours straight.

That combination — heavy pressure, slow speed, high heat — is deliberately worse than what most real machines experience. The logic is simple: if a grease survives this, it will almost certainly survive the real world. If it fails here, it would have failed in service eventually, and the test caught it before it cost anyone a bearing.

Measured in Milligrams

After the test ends, engineers take the bearings apart and do something almost laughably low-tech: they weigh them. The bearings were weighed before the test, and now they're weighed again. The difference — measured in milligrams — is how much metal the grease failed to protect.

Under the international rule book (a German standard called DIN 51819), a grease that loses less than 35 milligrams of metal during the test earns the label of a heavy-duty grease. Anything more, and it's considered unsuitable for tough conditions. That 35-milligram number isn't arbitrary — it was calibrated decades ago against real bearings from real machines, and the threshold has held up because it matches what happens in the field.

The 35-milligram figure is the headline, but a full FE8 report documents much more: how the cage wore, what the raceway surfaces looked like under inspection, how the grease itself changed during the test, and whether the rig had to be shut down early because temperature or vibration ran away. A grease that just barely passes on wear but caused premature shutdowns is not the same as one that ran cleanly to the end.

Why Simpler Tests Aren't Enough

The grease industry has plenty of other tests. The dropping point test heats a grease until it starts to drip; the four-ball test rubs four steel balls together until they weld; the cone penetration test measures how stiff or soft a grease is. These tests are fast, cheap, and useful — but here's the catch most data sheets don't mention: they were never designed to predict how a grease will perform inside a real machine.

ASTM, the body that writes the standards for these tests, says so directly. The official standard for the dropping point states the result has "only limited significance with respect to service performance." Major grease manufacturers describe it the same way — a quality-control tool, not a performance predictor. The four-ball test has its own issues: it uses point contact between balls, not the rolling motion of a real bearing, and published research has shown that small changes in test settings can swing a grease's apparent performance by 50% without changing the grease at all.

These tests are useful for confirming that a grease has been made consistently, batch after batch. They are not, and were never meant to be, evidence that a grease can survive in a working bearing. The FE8 is. It puts the grease inside the exact thing it has to protect, under conditions worse than reality, and asks the only question that matters: did the bearing survive?

This is why every major bearing manufacturer, every serious wind turbine company, every railway, every steel plant, and every automotive transmission maker insists on FE8 results before approving a grease for critical use. The simpler numbers tell you the grease is consistent. The FE8 number tells you whether it works.

What This Means in Practice

- If you maintain industrial equipment, ask grease suppliers for their full FE8 report — not just whether it 'passes,' but at what load, what temperature, and how much wear was measured.
- If you specify lubricants for a plant, treat the FE8 number as one of the most reliable predictors of how a grease will hold up in heavy service. Other tests are useful screens, but the FE8 is the one cited when something goes wrong.
- If you're just curious, remember that the reason your washing machine, your car, and the local power grid keep working has a great deal to do with whether the grease inside their bearings has passed tests like the FE8.
- In an era where unplanned downtime is one of the most expensive things that can happen to an industrial operation, the unglamorous, decades-old FE8 test remains one of the most powerful tools we have for catching problems before they become disasters.

About the Author

Samarth Shah is a highly skilled individual with qualifications in Law and Business Management. However, his true passion lies in expanding the reach of Molygraph Lubricants on a global scale. He has played a pivotal role in leading international business teams and marketing teams and has successfully established a wide network of channel partners across the world. Contact Mr. Samarth Shah at samarth@molygraph.com.

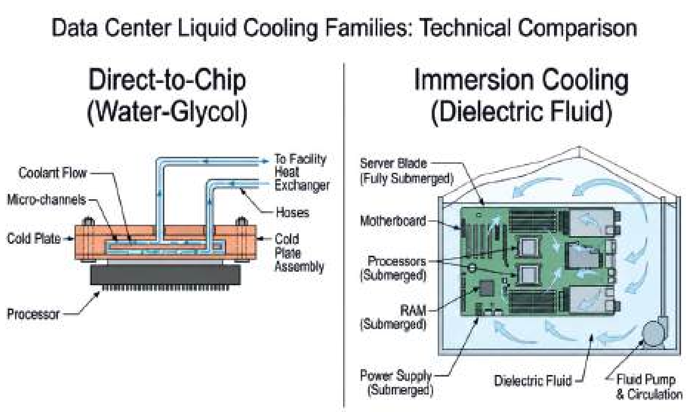
Jitendra Dubey

THE TWO COOLANT FAMILIES EVERY DATA CENTRE OPERATOR IS BETTING ON - AND WHAT IT MEANS FOR YOUR FLUID SKILLS

For decades, data centre operators treated cooling as a mechanical engineering problem. Today, as we frequently advise our partners at Reliability Engine, surviving the AI infrastructure boom requires a completely different discipline: chemical engineering.

Data centres are moving decisively from air conditioning to liquid cooling. The global data centre cooling market is projected to hit $40 to $45 billion by 2030, with liquid cooling alone accounting for $15 to $20 billion.

That growth rests on two main fluid families: water-glycol mixtures for direct-to-chip cooling, and dielectric fluids for immersion cooling. Both draw heavily on the same fluid-conditioning skills you already use, but the financial stakes for getting them right have never been higher.



1. Direct-to-Chip: Why Water Quality is Your Biggest Liability

Direct-to-chip is the most widely adopted liquid cooling method in modern data centres. A coolant loop circulates fluid through micro-channel cold plates mounted directly on processors, memory, and other high-wattage components. The fluid never contacts the electronics - it pulls heat through a metal plate and rejects it to a facility water loop or outdoor heat exchanger.

The standard coolant is PG25 - a 25% propylene glycol and 75% water blend. Anyone who has maintained a glycol loop in an HVAC system, a food plant, or a low-temperature chiller will recognise it. The glycol provides freeze protection down to around -10 degrees Celsius and a baseline of corrosion inhibition. Leading chemical companies now sell ready-made PG25 fluids designed to the Open Compute Project specification for material compatibility in cold plates.

The real action, though, is in the water.

The Chemical Mandate. Water quality is non-negotiable. Specifications call for deionised (DI) or reverse osmosis (RO) water with conductivity held below 5 to 10 µS/cm. This keeps stray current problems at bay in the event of a minor leak and, under normal operation, reduces the risk of scale formation to near zero.

Ignoring this **Chemical Mandate** - a foundational principle we champion at **Reliability Engine** - is what leads to catastrophic, multi-million dollar derating events. The most expensive mistake operators make is topping up with hard tap water. A single top-up can introduce calcium and magnesium that precipitate inside micro-channels barely wider than a human hair.

A blocked microchannel does not throw an error code - it silently throttles processors, costing thousands per hour in lost compute. *At one hyperscale facility, a single hard-water top-up event clogged cold plates across 40 racks, triggering a week-long derating that cost an estimated $2 million in lost compute capacity.*

Surviving the Chemical Mandate means watching your inhibitor package. As glycol ages, it breaks down into organic acids. Without proper buffering and a biocide programme, microbial growth and fouling appear - exactly the kind of slime and clogging found in an under-maintained cooling tower.

Industry best practice is to sample and test PG coolant every 50 to 100 days, or at least quarterly, checking pH, glycol concentration, conductivity, inhibitor levels, and bacterial counts. The power densities served by these loops are extraordinary: an air-cooled rack might handle 10 to 20 kW, while a direct-to-chip rack comfortably pushes 50 to 100 kW.

Routine coolant sampling on a live direct-to-chip loop.

2. Immersion Cooling: The Dielectric Chemical Puzzle

If direct-to-chip is a scalpel, immersion cooling is a full bath. Entire servers - motherboards, power supplies, everything - are submerged in a dielectric fluid that, in its uncontaminated state, does not conduct electricity.

Heat is removed either by circulating the fluid across the hardware (single-phase) or by letting it boil and condense (two-phase). Over time, moisture ingress or additive degradation can alter electrical properties, so periodic dielectric strength testing remains part of a mature programme.

The fluids fall into three main chemical families:

- Synthetic hydrocarbons: Highly refined mineral oils or synthetic base stocks. Lower cost, but higher viscosity can limit heat removal in very dense configurations.
- Fluorocarbon-based fluids: Products such as 3M's Novec series set the performance benchmark but sit squarely in the PFAS regulatory crosshairs.
- Silicone oils and esters: Emerging alternatives with lower toxicity and better biodegradability profiles, sometimes at a slight thermal penalty.

The maintenance headache. Servers in an immersion tank are not sealed away forever. A failed DIMM or a CPU upgrade means a technician must lift the server out of the fluid.

The dielectric liquid clings tenaciously - a single hardware pull can carry out several litres of fluid, which must be captured, topped up, and accounted for. After repeated maintenance cycles, one colocation operator saw dielectric breakdown voltage drift from 40 kV to 28 kV in 18 months due to moisture and particulate ingress, forcing an unplanned fluid swap and tank clean-out that cost hundreds of thousands in downtime and new fluid.

The PFAS time bomb and a lifecycle mismatch. Many high-performance fluorocarbon immersion fluids are PFAS compounds. 3M's decision to exit all PFAS-related manufacturing by the end of 2025 came from the regulatory mathematics reshaping the entire industry. In the EU, five regulatory authorities submitted a universal PFAS restriction proposal under REACH. In the US, the EPA is evaluating rules that could effectively ban PFAS from non-essential uses by the early 2030s.

Meanwhile, the typical infrastructure depreciation cycle in a data centre is 10 to 15 years. Fluorocarbon-based immersion fluids could face use restrictions within 3 to 5 years - a mismatch that could leave tanks filled with a stranded asset.

Hardware removal from an immersion tank demands full PPE and accounts for fluid carryout losses.

3. Quick Reference Comparison

Water-Glycol Direct-to-Chip

- **Typical fluid:** 25% PG / 75% RO water
- **Conductivity risk:** Low if maintained; upsets introduce contaminants
- **Main maintenance:** Routine water chemistry checks and inhibitor top-up
- **Regulatory outlook:** Widely accepted (local glycol disposal rules apply)
- **Service safety:** Wet electronics if seals fail
- **Typical rack power:** 50 to 100 kW

Dielectric Immersion Cooling

- Typical fluid: Synthetic hydrocarbon or fluorocarbon
- Conductivity risk: Very low in pure form; field contamination alters properties
- Main maintenance: Fluid recovery, filtration, and cleaning after hardware pulls
- Regulatory outlook: PFAS restrictions tightening fast; future uncertain
- Service safety: PPE mandatory; spent fluid handling is regulated
- Typical rack power: 100 kW and above

4. The Economics: Fluid Health as a Profit Lever

Beyond the chemistry, a hard financial force is pushing liquid cooling forward. Moving from air to direct-to-chip typically drops a data centre's Power Usage Effectiveness (PUE) from around 1.6 toward 1.1. Air-cooled data centres generally perform efficiently up to approximately 20 kW per rack.

By contrast, liquid-cooled configurations in comparable deployments report stable PUE values of around 1.15, even at densities of 80 to 100 kW. That shift can reduce cooling OPEX by 30 to 50% at scale.

But here is where operators fail: When you neglect fluid health - allowing scaling, viscosity drift, or friction to build - you are paying what we at Reliability Engine define as a Token Tax. Bad plumbing and degraded chemistry literally steal compute tokens per watt right out of your pocket by forcing the system to throttle processors or burn excess pump power.

Higher rack density - up to 3x more servers in the same footprint - defers or eliminates new building CAPEX. For an industrial fluids professional, this reframes the conversation: coolant is no longer a utility - it is a profit lever.

5. Why This Matters in Practice

Data centre cooling is, at its core, a thermo-fluids problem. Pumps, seal compatibility, heat exchangers, filtration skids, corrosion inhibitor depletion, fluid degradation curves - none of this is new. The critical difference is that here, fluid condition directly influences compute throughput.

In AI clusters, Reliability Engine has seen firsthand how well-maintained coolant loops help keep processors running at sustained boost clocks without throttling; neglected loops leave millions of dollars of compute capacity on the table.

Further Reading

The Reliability Engine insights library contains a field guide on direct-to-chip coolant maintenance, a side-by-side technical and regulatory comparison of immersion versus direct-to-chip cooling, and case studies on AI compute density gains from liquid cooling. Visit reliabilityengine.com/insights for additional articles.

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Jhumpa Mukherjee

DIGITAL FATIGUE:
Protecting Your Eyes & Brain in a Screen-Heavy World

From control rooms and monitoring systems to laptops and mobile screens, they have become an unavoidable part of modern work life. While technology has made work faster and more efficient, it has also introduced a new workplace challenge - digital fatigue.

If your eyes feel tired after work, your head feels heavy by evening, or your concentration drops after staring at screens for hours, your body is already signaling overload.

Digital fatigue is more than just "being tired." It affects eye health, focus, sleep quality, mental clarity, and even decision-making. And in industries where precision and attention matter, this can directly impact both productivity and safety.

The Problem with Prolonged Screen Exposure

When we continuously focus on screens, we blink less frequently. This leads to dry eyes, irritation, blurry vision, and headaches. Add artificial lighting, poor posture, and extended working hours, and the strain becomes even greater.

Another growing concern is blue light exposure. Screens emit blue light that can interfere with melatonin production, the hormone responsible for sleep regulation. Excessive screen use, especially during late hours, can disrupt sleep cycles and leave the brain feeling unrested the next day.

Common signs of digital fatigue include:

- Eye strain or burning sensation
- Frequent headaches
- Difficulty focusing
- Mental exhaustion
- Neck and shoulder stiffness
- Poor sleep quality

The 20-20-20 Rule: A Simple Eye Rescue Technique

One of the easiest and most effective ways to reduce eye strain is the 20-20-20 rule:

Every 20 minutes,
Look at something 20 feet away,
For at least 20 seconds.

This simple habit relaxes eye muscles and reduces visual stress caused by continuous screen focus.

You can also:

- Blink consciously more often
- Adjust screen brightness to match room lighting
- Keep screens at arm's length and at eye level

Cognitive Overload: When the Brain Gets Tired

Digital fatigue isn't only about the eyes; it affects the brain too.

Constant notifications, multiple tabs, emails, dashboards, and endless scrolling overload the brain with information. This leads to cognitive fatigue, where the mind struggles to process efficiently.

As mental overload increases, decision-making becomes slower, concentration drops, mistakes increase, and stress levels rise.

This is often called decision fatigue, when the brain becomes exhausted from making too many small decisions throughout the day.

Digital Detox During Work Hours

A digital detox doesn't mean abandoning technology. It means creating intentional breaks from screens to reset the mind and body.

Try these practical habits during your workday:

- Take short screen-free breaks every hour
- Walk while taking calls when possible
- Avoid unnecessary multitasking
- Keep notifications limited
- Spend a few minutes looking at natural surroundings or greenery

Even 5 minutes away from screens can refresh mental clarity.

Technology Needs Balance

Technology is a powerful tool, but like any tool, it must be used wisely.

Digital fatigue doesn't happen overnight. It builds slowly through repeated habits. By taking conscious breaks, protecting your eyes, and reducing mental overload, professionals can improve both productivity and well-being.

About the Author

Jhumpa Mukherjee is a health educator and wellness speaker who believes that well-being and productivity go hand-in-hand. She conducts engaging health awareness sessions for corporates and professionals across industries, making fitness and mental wellness simple, science-backed, and achievable.

Would you like to bring a health session to your workplace?

Let's connect!

PROPER MAINTENANCE STRUCTURE WITH BRIAN BRZINSKI

Gear Talk: Episode 13

In this episode of Gear Talk, we dive deep into the world of maintenance and reliability with our special guest, Brian Brzinski, founder of AMSS Advanced Management Systems & Services, Inc. With over 25 years in maintenance and reliability and over 30 years in manufacturing, Brian brings a wealth of knowledge and experience. Brian has seen it all, from his beginnings as a steel mill laborer to his rise to executive leadership. Join Wes and Brian as they focus on the significance of aligning your maintenance structure with your plant's goals, how culture influences maintenance and reliability practices, and strategies for customizing maintenance programs to fit different environments. Don't miss this insightful episode, which offers practical advice and expert insights to help you optimize your plant's maintenance structure.

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INDIA PRODUCTION TECHNOLOGY WEEK BRINGS THE MANUFACTURING ECOSYSTEM UNDER ONE ROOF

Drives industry collaboration, innovation, and knowledge exchange across the production value chain

Pune, April 2026

India Production Technology Week (IPTW), organized by Future Market Events, concluded on a high note at the Pune International Exhibition and Convention Centre (PIECC), Moshi, Pune, from 9–11 April 2026. The three-day mega industrial platform brought together over 450 exhibitors and attracted more than 25,000 business visitors, reaffirming its position as one of India's most comprehensive gatherings for the manufacturing ecosystem.

Comprising six co-located shows from *Metal Forming Expo, Machine Tools & Cutting Fair, India Welding Technology Show, India Fastener Show, Lubricant Technology Show and AI Automation & Digital Expo* - IPTW showcased the full spectrum of production technologies under one roof.

The exhibition floor was marked by live machinery demonstrations, enabling visitors to experience advanced manufacturing technologies in action. From CNC machines, robotics and automation systems to sheet metal fabrication, welding, fastening solutions, metrology, and AI-driven digital manufacturing tools, the event offered hands-on exposure to next-generation industrial innovations.

The event witnessed strong participation from sectors including automotive, aerospace, defense, construction, heavy engineering, and MSMEs, highlighting the growing demand for advanced manufacturing solutions in India.

Speaking on the success of the event, Anuj Mathur, Managing Director, Future Market Events, said: *"India Production Technology Week has successfully brought together the entire manufacturing value chain under one platform. The strong exhibitor participation and high-quality visitor turnout reflect the industry's readiness to adopt advanced technologies and strengthen India's position as a global manufacturing hub."*

A major highlight of IPTW 2026 was its knowledge-rich conference program, where industry experts, policymakers, and technology leaders engaged in discussions on key themes such as Industry 4.0 adoption, automation in MSMEs, supply chain resilience, and digital transformation in manufacturing.

The Open House sessions and curated buyer–seller meetings further enhanced business engagement, enabling meaningful networking, partnerships, and deal-making opportunities across the three days.

We thank all our sponsors and Media Partners, the event received strong support from leading industry bodies including the Automotive Research Association of India (ARAI), Society of Automotive Engineers India, SME Chamber of India, Deccan Chamber of Commerce, Industries and Agriculture, and All India Association of Industries, Federation of Chakan Industries among others underscoring its significance as a collaborative platform for the manufacturing sector.

Following the resounding success of the 2026 edition, Future Market Events is set to further expand India Production Technology Week as a premier platform driving innovation, collaboration, and growth in India's manufacturing landscape. See you again on 16-18 April 2027 at PIECC, Moshi, Pune.

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LANXESS, HPCL JOIN FORCES TO GROW AVIATION, INDUSTRIAL LUBRICANTS BUSINESS IN INDIA, SAARC REGION

MUMBAI, May 14, 2026 — German specialty chemicals company LANXESS and Hindustan Petroleum Corporation Ltd (HPCL) have entered into a Memorandum of Understanding (MoU) to jointly advance the availability of aviation and industrial lubricants in India and SAARC countries.

“This partnership aims to deliver technologically advanced, high-performing lubricant solutions, advancing standards and availability in India’s booming aviation and industrial markets,” LANXESS said in a statement.

Under this partnership, LANXESS and HPCL will explore short, medium, and long-term marketing and business development opportunities for lubricants. The collaboration will enable broader local access to premium LANXESS-branded aviation and industrial lubricants, including in critical segments.

“This MoU marks a new chapter in our growth story. Together with HPCL, we will set new benchmarks for quality and performance while accelerating growth in India’s dynamic aviation and industrial markets,” said Neelanjan Banerjee, Senior Vice President and Global Head of the Business Unit Lubricant Additives, LANXESS.

“With LANXESS’ expertise and our strong market presence, this collaboration will drive growth across aviation and industrial sectors,” said Srinivas Ch, Executive Director - Lubes, HPCL.

LANXESS’ Lubricant Additives business offers a variety of premium range of synthetic basestocks, additives, and finished fluids for aviation, automotive, and industrial applications.

As regional governments continue to channel heavy investment into new aviation infrastructure—with India’s civil aviation market aggressively tracking to solidify its position as the world’s third-largest—the demand for next-generation, high-performance consumables is urgent.

Furthermore, as industrial operations face stricter environmental and regulatory mandates, the adoption of specialized synthetic fluids that facilitate lower emission profiles, minimize oil consumption, and maximize oil drain intervals is expected to gain strong traction. Moving forward, industry analysts anticipate that this collaboration will act as a major catalyst for regional product localization, potentially setting the stage for South Asia to evolve into a critical hub for high-end lubrication engineering.

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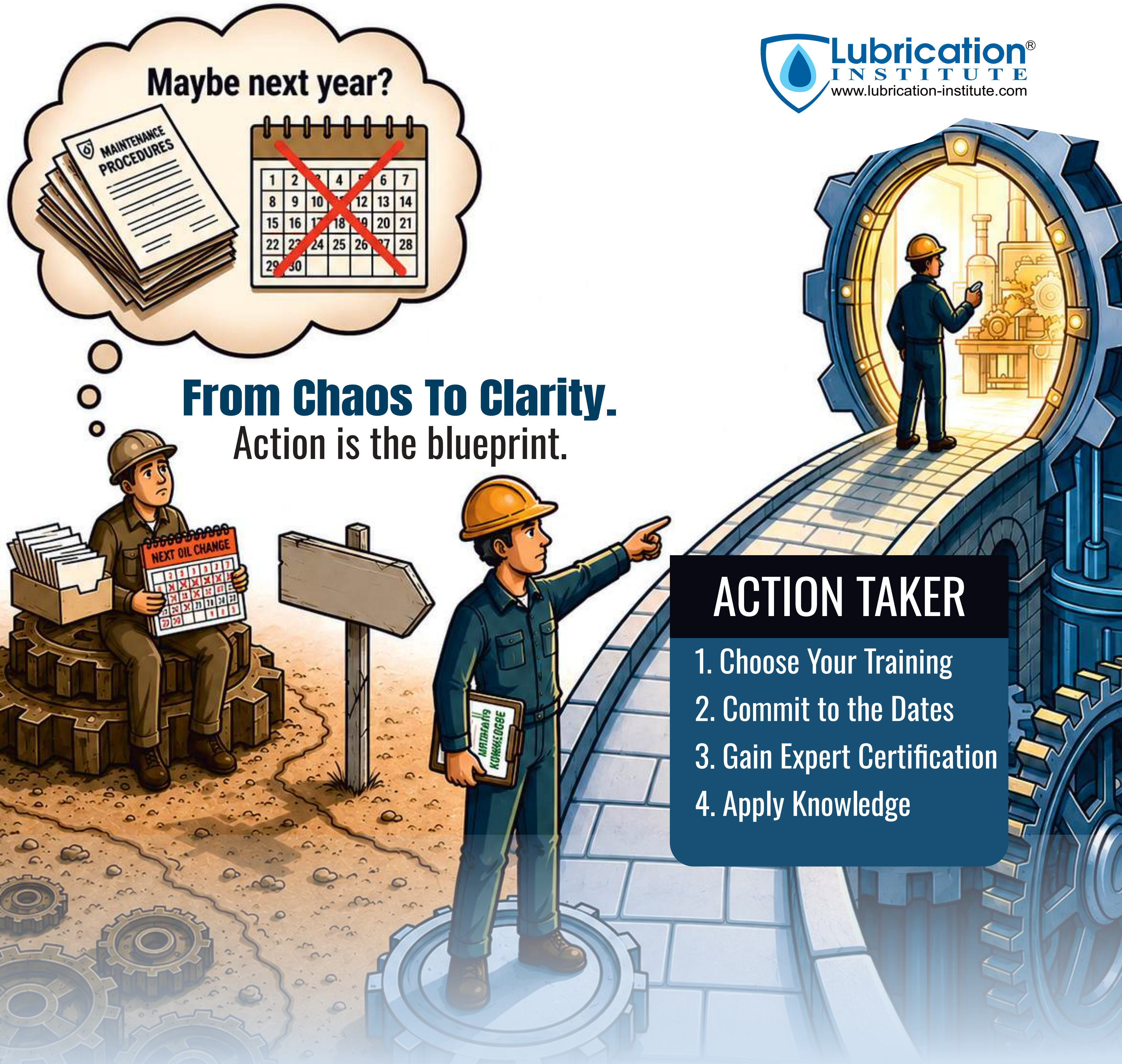

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