May-June 2025

Machinery Lubrication

INDIA

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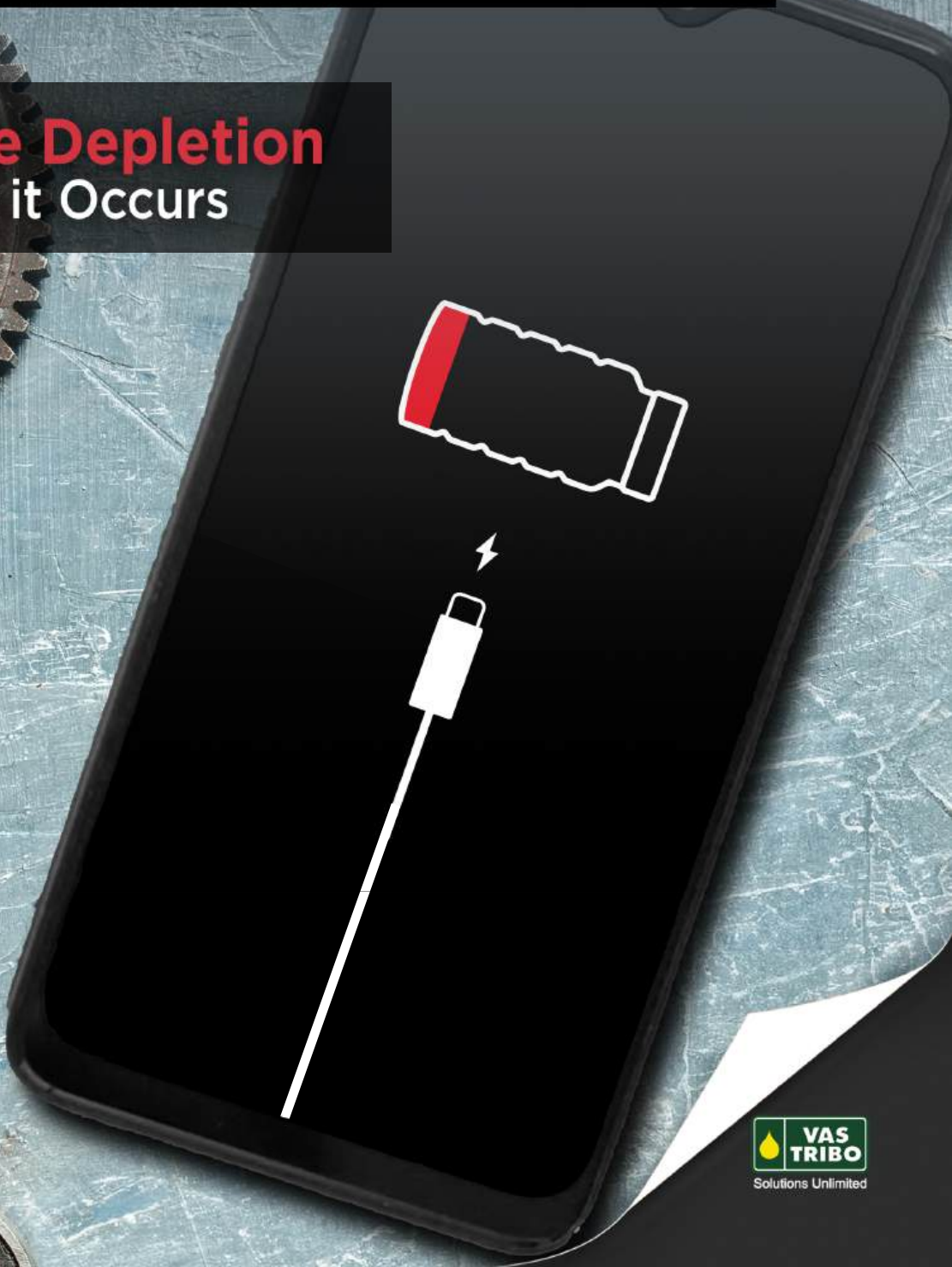
Additive Depletion and How it Occurs



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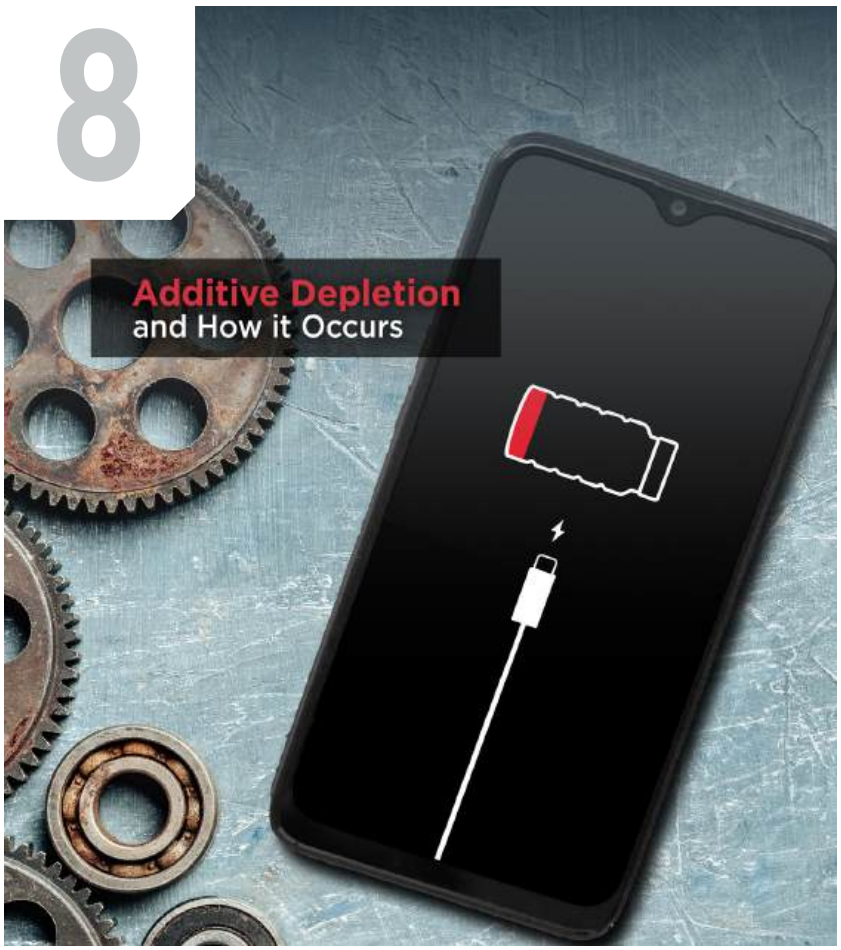
AS I SEE IT

Combating Dirty Fuel

COVER STORY

Additive Depletion And How It Occurs



From the Asian Desk

EDITORIAL FEATURES

Publisher's Note

As India strides forward into a new era of global trade and industrial growth—reflected in deepening partnerships with economies like the United States—our industries are gaining not just visibility, but also new layers of responsibility. With fast-paced advancements in manufacturing, energy, and infrastructure, the challenge now lies in sustaining this momentum through innovation and operational discipline.

Amidst this progress, recent events such as the tragic attack in Pahalgam remind us that our growth is accompanied by trials that test the strength of our values and our unity. In times of adversity, India's resilience shines through—not just in its people, but in its systems. It is in these moments that our collective belief in peace, progress, and purposeful action becomes even more vital. **Just as our nation stands firm through challenges, so too must our industries—resilient, forward-looking, and built on a foundation of reliability.**

For professionals in reliability, maintenance, and plant operations, this spirit translates into a key question: how do we make our systems—both large and small—robust enough to consistently deliver performance that meets global standards? The answer lies in proactive thinking, smart monitoring, and a deep understanding of every moving part.

This month's cover story, "How Additive Depletion Occurs in Lubricants Used in Motor Bearings," addresses a subtle yet crucial aspect of reliability. Lubricants, often viewed as routine consumables, are far more complex. While base oils provide fluidity, it's the additives that carry the heavy responsibility—protecting components from wear, oxidation, and contamination. Yet over time, even these protective agents quietly degrade.

In one case I witnessed, oil samples appeared to meet standard parameters, but unnoticed additive depletion led to a costly bearing failure. It was a reminder that **true reliability isn't about what we see—it's about what we know to look for.**

Today, with machinery pushed to run longer and leaner, condition-based lubrication decisions are no longer optional—they're essential. The tools are available to move beyond guesswork: advanced diagnostics now offer insights into oil health, well beyond appearance or viscosity. Mastering these tools is key to staying competitive.

In that spirit, we are proud to launch a new section: From the Asian Desk—dedicated to perspectives, stories, and innovations from across the region. This initiative reflects our belief that regional voices bring global value, and that learning is strongest when it is shared.

As we move forward, let's hold on to what makes us strong—not just cutting-edge technology, but shared wisdom, compassion, and the belief that peace and progress go hand in hand. Let's build industries that not only perform but inspire.

We deeply value the role of our readers, contributors, and advertisers. Your trust and engagement help us create a platform that educates, elevates, and connects. Together, we can shape an industrial ecosystem that's not only efficient—but also enduring, inclusive, and visionary.

Warm regards,
Udey Dhir

COMBATING DIRTY FUEL

Introduction

The fuel system is one of the most crucial and expensive systems in mobile equipment. Essentially, it is the lifeblood of all construction and mining machines. Fuel costs today are about 80% of operating costs, as against 35% in the 1970s. This cost is the largest expense over the lifecycle of any engine.

Fuel injection system pressure in the 1970s and 1980s was 8700 psi. Today, fuel systems operate at 29000 psi. Even a single foreign particle inside such a high-pressure system can have a devastating effect on various parts and components. That's precisely why present fuel systems demand consistently clean, dry fuel.

The performance and durability of an engine are highly dependent on the fuel's cleanliness. In this article, I highlight a few salient points on how to consistently provide clean and dry fuel.

Clean, Dry Fuel

There are multiple potential sources of contaminants in any fuel system. Following is the extensive list:

- Supply
- Storage
- Handling
- Transfer or dispensing
- Service
- Operation
- Maintenance

Now, it's relatively easy to understand the necessity of providing clean, dry fuel.

Before proceeding further, let's clearly define what it means. The fuel that complies with particle & size distribution according to ISO 4406 is ISO 18/16/13 or less at storage and is considered clean & dry. The cleanliness level is more stringent at the high-pressure pump inlet, ISO 15/13/10. This also includes water contamination because water is detected as a contaminant by a particle counter. However, the Karl-Fischer method may be used separately to quantify water content in fuel. The maximum water content recommended is 500 ppm.

Unfortunately, every facility in India cannot afford to procure such expensive instruments. Moreover, skilled technical personnel are required to operate, maintain and upkeep these assets. Here, we will discuss a cheaper and easier process for regularly monitoring fuel cleanliness.

Study and Observations

Two types of processes of fuel storage, handling and dispensing are usually followed in India:

- The fuel-filled bowser (tanker) reaches the sites and fills the vehicles' tanks.
- The bowser from the near by fuel station fills its tank and dispenses the fuel to the tank in the workshop adjacent to the site. The vehicles are refueled from this storage tank. This process is also followed in component repair shops.

The most common fuel contaminants experts have noticed over the years are:

- Water
- Fine abrasives
- Sediments
- Fibres & sludge
- Micro organisms

The genesis of all these contaminants is ignorance, poor work practices, or both. The entire chain of activities is performed in an open atmosphere, allowing free access to contaminants. We had been to a few of these mine operators' sites to check some random fuel samples. Another portion of the same samples was collected to do the particle count test. At the site, we were dependent solely on the patch test in the absence of any particle counter.

Patches were studied using a 50X manual microscope. Photographs were taken with a simpledigital camera using the optical zoom. Pictures of the patches are shown in Fig 1 A, B, C, D & E.Expensive microscopes are not required for this purpose. These fuel samples were pulled from the final filter before proceeding for combustion.

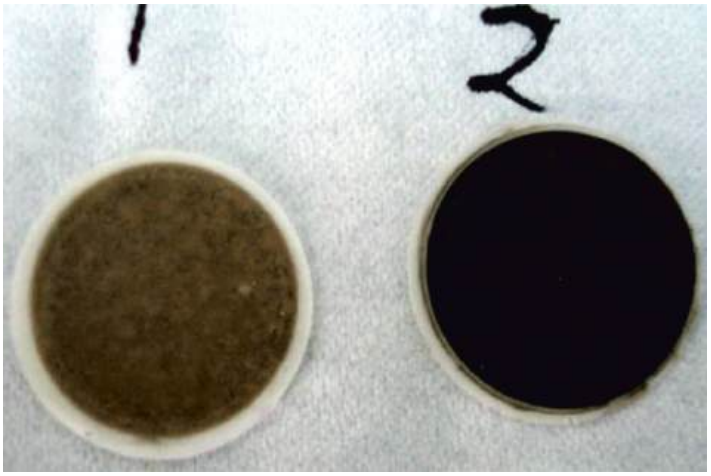


Figure 1A

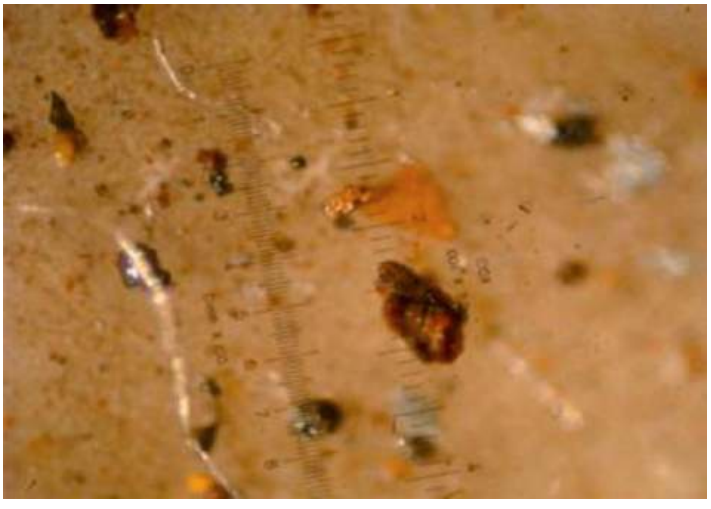


Figure 1B - Dirty fuel patch

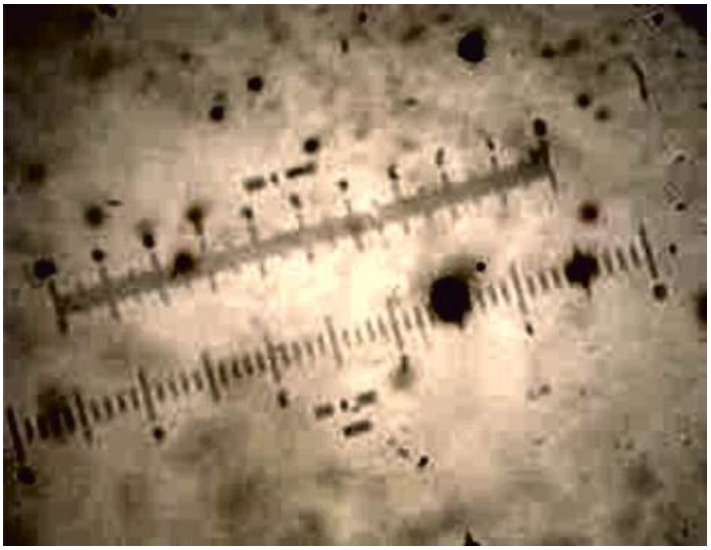


Figure 1C - Clean fuel patch with few particles

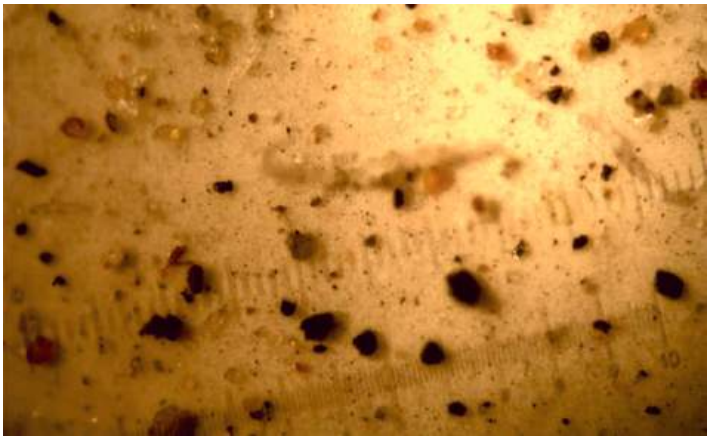


Figure 1D - Dirty fuel patch

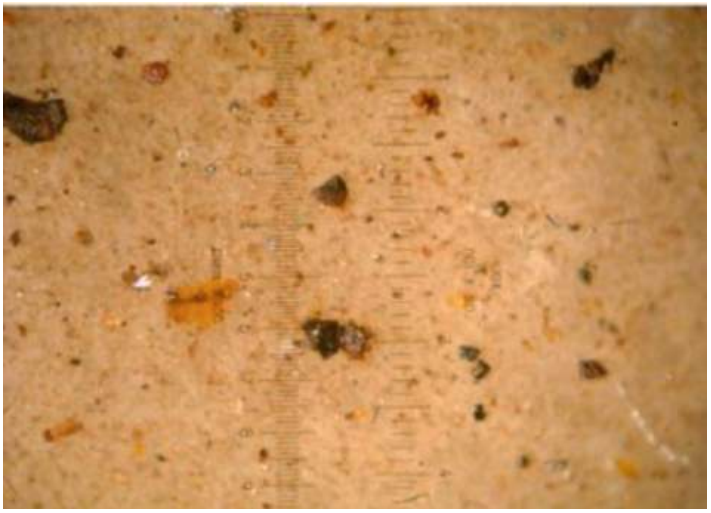


Figure 1E - Dirty fuel patch

The lighter the patch, the cleaner the fuel and the darker the patch, the dirtier the fuel. This is the thumb rule, with no exception. Contaminant particles in the patches are predominantly road dust. Please note that particles with red color in the patches may be noticed. The

soil in this region is red with abundant laterite deposits where red iron oxide is dominant. Occasionally, a few white particles are also observed in these patches. These are aluminum oxide from the soil. Laterite deposit contains both aluminum and iron oxide. These contaminants are abrasive. They are also ranked higher in the "mho" hardness scale. A long fiber-like particle is also present in Fig 1B. These are cloth fibers probably originating from repair activities. Instead of lint-free cloth, these facilities use torn clothes, which are cheap and widely available in local markets.

The particle count data of all these fuel samples were found to be ISO 23/22/20, compared to the recommended cleanliness level of ISO 18/16/13 or less. The particle counter was thoroughly flushed with clean solvent before each measurement until ISO 11/9/7 was achieved.

So, essentially, it boils down to the fact that these hard, finely abrasive particles act like sandpaper and freely invade sophisticated, crucial fuel injection components at such high pressure. Frequent two-body and three-body abrasions quickly damage the components. The reliability of the fuel system will be drastically reduced, and even mid-injector life would be impossible to achieve.

Deep Dive and Delve

Every step in the entire operation chain during storage, handling and dispensing of fuel must be conducted in a closed system.

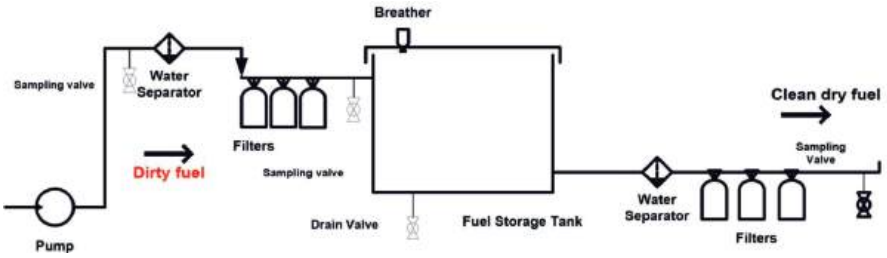


Figure 2A – Consistent supply of clean dry fuel

It's an overhead storage tank. All the best practices are incorporated – sampling points at various locations, drain valve at the tank's lowest point, proper size and type of breathers, filters and water separators. The last two items are installed both at the incoming and outgoing fuel. A pump must be used to fill the storage tank. Filter clogging indicators are not shown in Fig 2A. Also, sampling from any storage tank zone (particularly the bottom & middle region) may be pulled, as shown in Fig 2B. This applies to mobile bowser systems also.

Figure 2B – Fuel sampling from a storage tank

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Initially, three NOS fuel filters may be used if the fuel is too dirty. One no filter may be removed later when the particle count data consistently reads ISO 18/16/13 or less or the patch shows fewer particles when compared with the control patch. Next comes maintenance activities, which appear more challenging. The following actions are strongly recommended. These are repeatedly tested and established in one of our facilities:

1. All lines are closed using the proper size of caps & plugs when not in use.
2. Water draining from fuel storage tank - frequency daily
3. Checking of breathers, filters & water separators for proper functioning & replacement
4. Oil sampling from all locations initially thrice a week
5. Oil sampling from final delivery once a week when the process is standardized
6. Fuel storage tank cleaning – frequency once a year.
7. Fuel sampling from the fuel tank is shown in the picture below (Fig 2B)
8. Quarterly frequency
9. All consumable items must be in stock.
10. All maintenance records, documents, and data must be kept neatly in separate files. We must remember talking without data is meaningless.

Figs. 3A and 3 B show a water separator, followed by a series of water separators, high-efficiency fuel filters and the overhead fuel storage tank.

Figure 3A

Figure 3B

The author did not get any scope to implement the same system in fuel bowsers primarily because the clients showed no interest.

The processes and procedures described above are quite simple and commercially cheap. Many are consumables, and CAPEX components are low-value items. Maintenance activities, too, are relatively simple.

Lately, OEMs have developed their own fuel filtration systems that can handle high-volume flows— 50 gpm to 200 gpm. However, these units are quite expensive and a dedicated maintenance team is required to operate and maintain them. That's not a hopeful picture in a country like India.

Eliminate Innocence and Elevate Excellence

From the above discussion, we have primarily emphasized two basic work practices.

Patch test– its importance, technique and correct interpretation. It is qualitative yet cheap, and no formal, extensive training is required. Moreover, the process is beneficial when regularly, properly implemented and compared with a control sample. Patch test is applicable for all fluids involved in the activity.

Another one is the change in work practice. Any fluid under use must be handled in a closed system. This will prevent contaminants from invading the critical components. That's a revelation.

Here in India, the road to excellence is rocky and slippery. That's implacable, brutal ground reality. We are still not aware of the consequences of dirty fuel. A high concentration of hard, abrasive solid contaminant particles at such high pressure has a terrific destructive effect. Not only is the fuel system seriously damaged, but engine components like piston, ring, and liner are also likely to be adversely affected in case of profuse fuel dilution.

When this happens, the end-user typically blames the OEMs, trying to justify the failures as manufacturing defects and claims warranty replacement. OEMs, too, are becoming cleverer with experience. They ask for data, evidence etc. This on-going struggle, more popularly known as the arms race, persists today. However, this terrible, nasty war between the end-user and the OEM should not be confused with an elegant evolutionary arms race between cheetah and antelope (say).

In most cases, machines do not fail independently; they fail due to human error. That's precisely why some eminent personality has made the sensational statement, "Machines Don't Just Die . . .They're Murdered."

Acknowledgment

Caterpillar Inc & Gainwell Commosales India Pvt Ltd are wonderfully supportive of collecting data and evidence for this subject.

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Additive Depletion and How it Occurs

Lubricants are essential for the efficient operation of all machinery, to reduce friction, wear, and corrosion while ensuring smooth performance. These lubricants are made up of base oil and a package of additives. The base oil provides the most fundamental role of a lubricant via the viscosity to form a lubricant film that separates relative moving surfaces. Depending on the application, different additives are carefully selected to enhance lubricant performance. Each additive will either:

- Enhance a desirable property of the base oil
- Suppress an undesirable property of the base oil or
- Add a new property of which that base oil does not provide

These additives include oxidants inhibitors, corrosion inhibitors, viscosity index improvers, foam inhibitors, anti-wear additives, detergents, and more. Each serves a core function, typically indicated by its name. However, while each additive implies an ability to "inhibit" oxidation or"improve" the viscosity index, this ability is not unlimited and does not exist without a need for caution. Over time, additives are exposed to conditions which cause them to diminish their ability, or more simply, to deplete. Often, it's the core purpose of the additive that can become its demise.

The Role of Additives in Lubricants

Additives are crucial in extending the life and performance of lubricants. Their functions are broadly categorized into three groups:

- **Enhancing Properties:** For instance, viscosity index improvers enhance the viscosity stability of the lubricant across a range of temperatures.
- **Suppressing Undesirable Properties:** Each oil has a pour point, which is the temperature at which the lubricant begins to solidify. This undesirable property is suppressed by pour point-depressants helping maintain the oil's fluidity down to a lower temperature.
- **Adding New Properties:** Anti-wear additives provide additional protection against surface wear, a property not inherent to the base oil at low relative surface velocity or too much load.

Despite their effectiveness, additives have limitations. They are subjected to various stressors within the machinery, which leads to their eventual depletion. Understanding the mechanisms behind this depletion is crucial for effective lubricant management.

Let's Take for Example… Oxidation Inhibitors

Oxidation inhibitors, also known as antioxidants, are designed to delay the onset of oxidation and the resulting negative consequences including acid formation, varnish and the buildup of sludge. Oxidation occurs when the lubricant chemically reacts to oxygen, like when exposed to water and air seen in Figure 1. This decomposes the oil and turns it into a highly reactive molecule, such as a hydroperoxide.

The reason the oxidation inhibitor delays oxidation instead of prevents oxidation, is because it is sacrificial and loses its functionality as it performs its job. The oxidation inhibitor stops the hydroperoxide from reacting further with other oil molecules (Figure 2.), halting the oxidative chemical chain reaction. But in the process, the oxidation inhibitor is sacrificed, and the bulk additive has become gradually depleted.

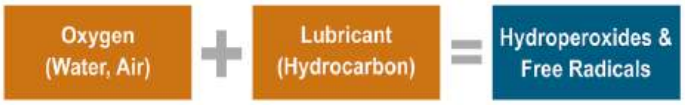


Figure 1 : Onset of Oxidation

Figure 2 : Oxidation Inhibitor in Action

Similar to oxidation, most additives can become depleted over time due to their exposure to various conditions. This is both a good thing and a bad thing. A good thing, because in the short term it's performing its function by delaying the oxidation of the lubricant. It's bad because overtime, it has lost a percentage of its additive concentration. In the case of the antioxidant, it has lost "oxidative life" resulting in the build-up of sludge, tar, varnish and generate acids.

Mechanisms of Additive Depletion

Let's cover the three primary mechanisms: decomposition, physical removal, and adsorption.

#1 - Decomposition:

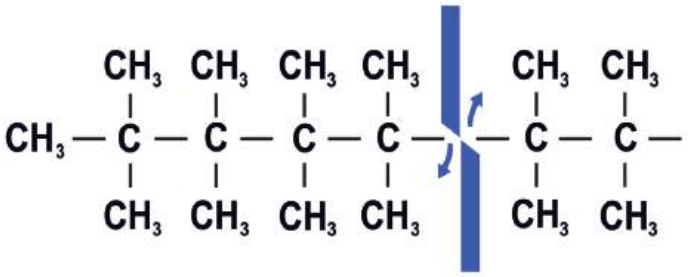
Oxidation: Oxidation inhibitors, such as zinc dialkyldithiophosphate (ZDDP) and hindered phenols, are designed to delay the onset of oxidation (see oxidation inhibitor example above).

Hydrolysis: Water and heat cause the chemical breakdown of certain additives. For example, ZDDP can hydrolyze, leading to the formation of sulfuric acid and hydrogen sulfide, which can further degrade the lubricant.

Thermal Degradation: As operating temperatures increase, thermal degradation of additives can occur. This is particularly true for additives that are sensitive to heat, such as certain antioxidants and viscosity index improvers.

Neutralization: Certain additives, like over-based detergents, are designed to neutralize acids that come into the oil as contaminants. They sacrifice themselves in this process, depleting over time due to this exposure. If not monitored correctly, the oil can become corrosive to the machine if it continues in service after most of the over-based detergents are depleted.

Shear-Down: The larger the molecule, the more likely they will be susceptible to breaking of the molecular chains under shear effects. This is particularly true for viscosity index improvers.



#2 - Physical Removal (Mass Transfer):

Condensation Settling: If additives become insoluble due to contamination, temperature, or other operating conditions, they will become more prone to settling out by gravity to the bottom of a sump.

Filtration: Solid or condensed additives can be physically removed from the lubricant through filtration. Solid additives that may experience this include silicone Defoamants or Borate EP additives. In other cases, additives that are adsorptive to contaminants may also become trapped by the filter when the particles they are attached to are filtered out.

Centrifugation: High centrifugal forces can cause organometallic additives to separate from the lubricant. Centrifugal filtration used in some applications to remove contaminants may have this added consequence.

Evaporation: While uncommon, certain additives can evaporate, particularly when vacuum dehydrators are used to remove water from the lubricant.

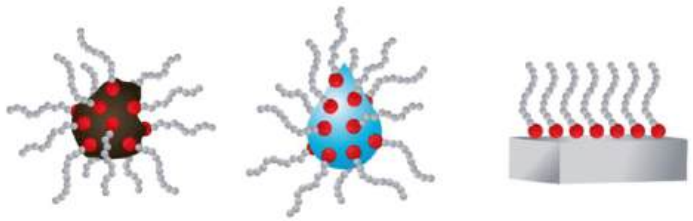
#3 - Adsorption:

Surface Adsorption: Polar additives, like EP (extreme pressure) and AW (anti-wear) additives, can adhere to machine surfaces, forming soap-like boundary films to protect against friction and wear. While this provides immediate protection, it depletes the additive concentration in the lubricant as they make themselves ready to perform their job.

Particle Scrubbing: Additives can be attracted to particles due to additive polarity*, thus trapped and dragged to sump floors or filters. This process, known as particle scrubbing, removes additives from circulation within the lubricant.

**What is Additive Polarity? This is the natural directional attraction of additive molecules to other polar materials in contact with the oil and enables the additive to perform its primary role or attaching to surfaces, particles or other contaminants.*

Water Washing: As water is a polar material, it can wash away additives, dragging them to the sump floor, especially in environments where water contamination is high.



Monitoring and Managing Additive Levels

To ensure the lubricant continues to provide the longevity and effectiveness over its intended service interval, it is essential to regularly monitor additive levels through oil analysis and take proactive measures if they are nearing depletion.

Best Practices to monitor or maintain additive levels:

Regular Lubricant Analysis: Testing instruments such as Fourier Transform Infrared Spectroscopy (FTIR), elemental analysis, and Linear Sweep Voltammetry (LSV) can monitor the conditions of certain additives depending on the elemental or molecular structure. FTIR, for example, can monitor multiple oil parameters, including additive molecules (like antioxidants and dispersants) and the consequences of depleted additives (such as oxidized oil molecules).

Using High-Quality Lubricants: Opting for lubricants with more robust additive packages can enhance resistance to depletion and extend the life of the oil to match an intended service interval.

Proper Storage and Handling: Maintaining optimal storage conditions and handling procedures minimizes the risk of contamination and unfavorable conditions that could lead to additive depletion or degradation.

Monitoring additive performance can also be measured through tests designed to calculate the lubricant's overall robustness. For example, Rotating Pressure Vessel Oxidation Test (RPVOT) can measure the remaining oxidative life of the lubricant by evaluating its resistance to oxidation under controlled scenarios. This often correlates very closely with the depletion of all types of antioxidants in the oil.

Proactive Measures

Perhaps the most effective way to mitigate the negative effects of additive depletion is to minimize what is first known as the root cause leading to additive depletion. You'll notice this often relates to the

contaminant influences during storage, transfer, and the machinery's operating environment. Maintaining recommended parameters reduces stress on the lubricant and its additives.

Reducing the ingression of water and particulate contamination helps preserve additive presence and effectiveness when they are most needed. Temperature also has a dramatic effect on additive depletion, particularly those that relate to decomposition. This is because decomposition is a chemical reaction and it is known through the Arrhenius Rate Rule that these reactions will occur twice as fast for every 10° Celsius increase.

Case Studies and Data

Case Study 1: Trending an Oil's RPVOT Life

Scenario: Monitoring the RPVOT life of a slow-speed high-horse power oil-lubricated motor bearing oil.

Findings: The new oil had an RPVOT value of 600 minutes. While the used oil showed a gradual decline, the measurement after a few months was down to 330 minutes. This trend indicated progressive depletion of antioxidants and indicating about a 55% Remaining Useful Life (RUL) of the oil, necessitating timely intervention to replenish or replace the lubricant.

Case Study 2: Risks of Mixing Lubricants

Scenario: Mixing lubricants from different brands and formulations.

Findings: The mixture of two oils in a gearbox was initially viewed as inconsequential as the two were intended for the same application. Although, when they are mixed, the additives became antagonistic to each other. This led to a steady additive precipitation, loss of anti-wear performance, and reduced oxidation stability. The gradual nature of this depletion resulted in the life of the oil to be reduced by 75%. But given the effects were not immediate, the failure mode was not recognized, and the scenario was unfortunately repeated on other similar machines at the plant. This was not recognized until oil analysis trends were scrutinized, realizing the effects of mixing oils. To avoid such issues, it is crucial to test planned mixtures for compatibility and retest frequently.

What to Take Away

Understanding how additive depletion occurs in lubricants is vital for maintaining machinery reliability and performance. By recognizing the mechanisms behind additive depletion and implementing best practices for monitoring and managing additive levels, industries can extend the life of their lubricants and ensure optimal machinery operation. Learn the skills and benefits of properly performing regular oil analysis and implement proactive measures that address the root cause. Preventing the adverse effects of additive depletion ultimately leads to improved efficiency and reduced maintenance costs.

EXPLORING THE FOUNDATIONS OF MACHINERY LUBRICATION: INNOVATIONS, KEY PRACTICES, AND INDUSTRY INSIGHTS

Machinery lubrication is the cornerstone of effective equipment maintenance and reliability. By reducing friction, preventing wear and tear, dissipating heat, and sealing out contaminants, proper lubrication is like healthy circulation in the body — it's what makes a long life and optimum operational efficiency possible.

In this exploration of the foundations of machinery lubrication, we delve into key practices, innovations, and industry insights shaping this critical aspect of maintenance engineering and reliability.

Importance of Machinery Lubrication

Effective lubrication practices are essential for maximizing equipment uptime, minimizing downtime, and optimizing long-term machine reliability. Neglecting lubrication can result in costly repairs, reduced productivity, and the ultimate disaster: premature equipment failure.

In other words, there are no shortcuts when it comes to proper lubrication. Cutting corners on lubrication points, using outdated equipment, or not monitoring conditions consistently can be truly catastrophic.

Innovations in Key Lubrication Practices

1. Lubricant Selection:

- **Choosing the right lubricant** is crucial for achieving optimal machinery performance. Factors such as viscosity, base oil type, additive chemistry, and compatibility with operating conditions must be considered.
- Some innovations include advanced lubricant formulations tailored to specific applications, including synthetic lubricants, high-performance greases, and environmentally friendly alternatives.

2. Lubricant Application:

- Proper lubricant application ensures even distribution and adequate coverage of moving parts. It involves selecting the right lubrication method, such as manual greasing, centralized lubrication sys-

tems, or automatic lubricators.

- Automated lubrication systems equipped with sensors and controllers for precise delivery of lubricants continue to lead innovations in lubricant application while helping reduce human error and improve consistency in operation under a variety of conditions.

3. Contamination Control:

- Contaminants such as dirt, moisture, and particles can compromise lubricant integrity and accelerate wear. Implementing measures to prevent contamination, such as sealed systems, fi ltration, and regular equipment inspections, is essential.

- A central contamination-control strategy is setting lubricant target cleanliness levels that exceed past levels by signifi cant margin. This improved lubricant machine services life longevity. Once the cleanliness targets are set, there should be a practice of routine monitoring using online or laboratory particle counters. If it is important, it must be measured and controlled.

4. Condition Monitoring:

- Monitoring lubricant condition and machine health through oil analysis, vibration analysis, thermography, and other predictive maintenance techniques allows early detection of potential issues and facilitates proactive maintenance interventions.

- Some modern innovations in lubricant and machine condition monitoring include online condition-monitoring systems, wireless sensors, portable and onsite oil analysis instruments, and predictive analytics software for real-time monitoring and data analysis. Inspection should always be a core condition-monitoring strategy. The human senses and brain can significantly out perform many advanced condition-monitoring technologies. The keys to this are inspectors who are trained and equipped with the tools they need to make daily inspection rounds. Inspection doesn't just mean looking at a machine. Instead, the inspector must carefully "examine" the machine to catch and troubleshoot problems early.

Industry Insights and Statistics

1. Market Growth:

- The global machinery lubrication market is witnessing steady growth, driven by increasing industrialization, infrastructure development, and the growing adoption of predictive maintenance practices.

- According to a report by Grand View Research, the global lubricants market size was valued at USD 127.6 billion in 2020 and is projected to reach USD 161.6 billion by 2027, with a CAGR of 3.2% during the forecast period.

2. Adoption of Synthetic Lubricants:

- Synthetic lubricants are gaining popularity due to their superior performance characteristics, including higher viscosity index, thermal stability, oxidation resistance, and extended drain intervals. Correctly selecting lubricants for optimized (not maximized) performance to the target application is key. It is an engineering process.

- The synthetic lubricants market is expected to witness significant growth, driven by in-

creasing demand from industries such as automotive, aerospace, manufacturing, and marine.

3. Focus on Sustainability:

- There is a growing emphasis on environmentally-friendly lubricants and sustainable lubrication practices to reduce environmental impact and meet regulatory requirements.

- Bio-based lubricants, renewable lubricant additives, and biodegradable lubricants are increasingly being adopted as alternatives to conventional petroleum-based products.

4. IoT and the Integration of Digital Technologies:

- Digitalization and automation continue to transform machine-lubrication practices, enabling remote monitoring, predictive maintenance, and data-driven decision-making.
- The adoption of IoT-enabled sensors , cloud-based platforms, and machine-learning algorithms is expected to continue accelerating at a rapid pace, driving major gains in operating effi ciency and reliability in lubrication and asset management.

Following the Foundations into the Future

Machinery lubrication is a fundamental aspect of equipment maintenance and reliability, with significant implications for operational performance and longevity. By embracing best practices, leveraging innovative solutions and advancements in digital technologies, and staying abreast of industry trends, organizations can optimize their lubrication programs and unlock tangible benefits in terms of uptime, efficiency, and cost-effectiveness.

As the machinery lubrication landscape continues to evolve, proactive adaptation to new technologies and market dynamics will be essential for staying ahead in this critical aspect of maintenance and machine reliability.

DEVELOPING TALENT TO SUPPORT GLOBAL OPERATIONS

Getting Started

Getting started is the biggest challenge to developing lubrication expertise in a global company. This is always a daunting step, but one that can be overcome. If you're reading this, you've taken the first step—you are interested in lubrication and its impact on your operations. The goal is to take your curiosity and knowledge and expand it to your entire global talent pool.

This interest can exist from the very basic situation of you being the person on the lubrication route, and you wonder what impact your actions have on the plant. You could be the head of the department and determine that a cultural change is necessary to improve your lubrication practices and plant performance. More than likely, you're probably somewhere in between.

This desire to improve your lubrication knowledge and program stems from necessity, machinery performance, changing requirements, operational demands, warranty considerations, and other factors. The best way to start your lubrication knowledge journey is to begin with what you know. Are you involved in any of the following?

- Performing lubrication tasks

- Oil analysis
- Lubrication program management
- Lubrication specification for machinery

This list is not comprehensive, but it is a general guideline, and many other activities would benefit from increased lubrication knowledge. Once you have identified your strengths and weaknesses and how those match up with your company's needs, you can begin to build the case for additional knowledge.

The Next Steps

Knowledge is good, and pursuing knowledge for its gain is noble. However, it would help if you also justified the related expenditures. This is where you begin to build the business case for expanding your knowledge via training, certification, and a reference library. All of these can become tools in your journey to improve your program and begin the process of developing talent in your company.

It will incumbent you to take what you've learned and spread that knowledge. Find a chance to utilize some training to improve a lubrication route, help develop a storage strategy for your oils and greases, take the analysis knowledge to trend oil sample data, or identify issues before they cause downtime. These tasks and activities will show the value of your increased knowledge and help build your business case. As you build your knowledge base and experience, you'll become sought after to assist in plant issues. This gives you the opportunity to showcase the advantages of a well-trained lubrication team.

Expanding Talent

This is the point where you will be able to bring in other personnel from outside departments for additional training. There are several potential suppliers that can provide training, but don't be afraid to approach your selected partner and request modifications to the training regimen. Your chosen company should be willing to work with you to tailor a training program for your needs.You may opt for a certification program for your people or take a couple of different classes and combine them to meet your specific requirements. At this point, with the goal being to expand your talent base and introduce a broader audience to lubrication fundamentals and the impact they can have on your availability and plant health, you might consider passing on a certification course unless you have an employee with the identified desire and aptitude.

Once you have chosen your instruction supplier, it is time to bring in your audience. I would recommend the "shotgun" approach. In addition to maintenance and lubrication technicians, there are a number of other personnel who could benefit from training like this. There are the operators of the equipment, the engineers who design the equipment, the supply and purchasing team who purchase the equipment and lubricants, and the quality team who monitors the incoming supplies and outgoing parts. All of these people interact with lubricants in one way or another on a daily basis, often without thinking about the fact they do.

The operators are the first line of defense against poor lubrication practices. They touch and watch the machinery daily. They will know when something doesn't sound right, or an operation may be tending abnormal while still in the "acceptable" range. Putting your technicians through such training can help them understand what they see and hear daily, its implications, and how or who to contact to correct a minor problem before the failure becomes catastrophic.

Perhaps more obviously, the engineers who specify and design plant machinery, end products, and the processes to create products should be involved in lubrication training. Hopefully, most of the information in the class will be familiar to them, but there are always some new nuggets of knowledge that can be gleaned and applied to your respective situation. It could improve your lubrication formulations, application technology, filtration and storage, or other factors that could improve your plant's performance.

These next two might not be as apparent participants as previous choices for attending your training, but remember you're attempting to build lubrication excellence and talent throughout your organization. The supply and purchasing teams are responsible for ensuring that the materials meet the specifi cations required for your organization. This means they need to know the basics of the different oil and grease types, the best storage and handling practices, and minimum specification compliance.

The quality department would likewise benefit from training for the reasons listed for the supply/purchasing department and would additionally be the optimal group for validating that the incoming supplies are as ordered and meet any imposed cleanliness requirements. These personnel and technicians validate that the materials meet supply requirements and may be able to identify plant issues based on the materials presented in the lubrication training.

Follow Up Activities

Once you have assembled your diverse team and had your initial training, it is time to take the following steps. First and foremost, continue to encourage your people to utilize the training they just went through. You should identify motivated personnel to further their learning and direct them to various certification paths. Additionally, you should capture the increased knowledge base and expand it to the rest of your facilities. This can be initiated via a knowledge exchange,- such as a working group meeting shared task force, or individual encouragement resulting from discussions between counterparts at different facilities.

As you continue to expand your knowledge base and network, you will discover that you are improving your reputation in the company, expanding your influence, and increasing the performance of your facilities. Talent development is a continuous improvement exercise; there's always something new to learn or share. The more you train and the more you teach, the more people will look to you as the expert and knowledge source. This should be the beginning of a cultural change in your corporate environment. Lubrication expertise should translate into more ownership of production in your facility, increase awareness of maintenance practices, and a general positive shift towards a culture of excellence.

REVOLUTIONIZING LUBRICATION: AN INSIDE LOOK AT CHEVRON'S ISOCLEAN® PROGRAM

Chevron's ISOCLEAN® Certified Lubricants program is designed to ensure the lubricants used in your machinery meet the highest standards of cleanliness right from the start. Unlike standard lubricants, which can often contain contaminants even when new, ISOCLEAN® Certified, Lubricants are filtered and tested to achieve specific cleanliness levels that align with equipment manufacturers' specifications. This meticulous process helps prevent premature wear, reduce downtime, and extend the life of your equipment, ultimately leading to more reliable and efficient operations.

Why Do Machines Require Clean Lubricants?

To dive deeper into the transformative impact of Chevron's ISOCLEAN® Certified Lubricants program, we spoke with a Chevron representative and a trusted distributor. They shared insights into how the program consistently delivers on its promises. While the notion of starting with perfectly clean oil might seem too good to be true, their first-hand accounts reveal the rigorous processes and real-world benefits that set ISOCLEAN® apart from conventional lubricants.

Exclusive Insights with Chad Bertrand, Americas' ISOCLEAN® Certified Lubricants Program Manager

Chad Bertrand, Americas' ISOCLEAN® Certified Lubricants Program Manager, Chevron

First, we sat down with Chad Bertrand to get the inside scoop on how the ISOCLEAN® program guarantees ultra-clean lubricants and significant improvements in machine reliability.

Q: Could you start by describing the cleanliness levels achieved by ISOCLEAN® Certified Lubricants?

A: The ISOCLEAN® program was created because of OEMs ISO cleanliness specifi cations for lubricants. Chevron saw a need and created a solution to meet that need. We refer to standard lubricants delivered to customers as typical lubricants. Regardless of the supplier, these lubricants will likely be at a cleanliness level that does not meet most

OEMs cleanliness specifications. These typical lubricants could be a couple ISO cleanliness codes higher than what the OEM recommends. Chevron and its ISOCLEAN® marketers collaborate with customers to understand the ISO cleanliness specifications for their equipment and then deliver lubricants to the customer that meets the OEM's ISO cleanliness specifications.

Q: How do ISOCLEAN® Certified Lubricants compare to typical lubricants in terms of performance and longevity?

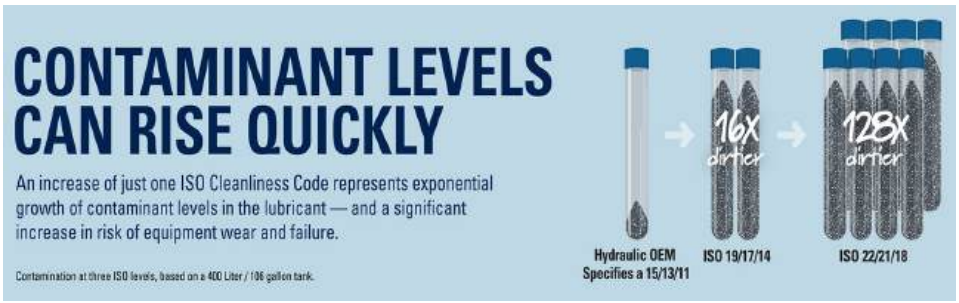
A: ISOCLEAN® Certified Lubricants help our customers maximize the life of their equipment. Eighty-two percent of mechanical wear is attributed to particle contamination in the lubricant. By removing these harmful contaminants, our customers can extend the life of their equipment and maximize their investment in the equipment. Using ISOCLEAN® Certified Lubricants instead of typical, new lubricants enables our customers to keep their equipment running longer.

Q: What specific filtration and contamination control methods are used in the ISOCLEAN® process?

A: Chevron has tested its portfolio of ISOCLEAN® Certified Lubricants to ensure additives will not be removed during the filtration process and change the makeup of the lubricant. Chevron has guidelines on what size filter, temperature of the lubricant, and how many cycles the lubricant should pass through the filter to ensure no harm is done to the lubricant. Chevron also has handling procedures to ensure the lubricant is not contaminated.

Q: If you are already filtering oil when it arrives onsite, why do you need ISOCLEAN®?

A: Filters on equipment will remove some but not all contaminants. Before the contaminants are removed in the filtration process, they have already caused damaging wear. Many systems are not properly balanced or sized to exclude and remove the most critical clearance-sized particles. For example, the customer has a target ISO code of 17/15/12 and is using a typical new hydraulic oil with an ISO code of 22/21/19. It would take running the filtration system continuously for 44 hours to lower the ISO code to 17/15/12. During this time, the harmful contaminants are doing damage to the equipment. Also, on-board filters typically have a bypass to ensure lubrication is not cut off once the filter's capacity is met. If the operator is unaware, the filtration system will continue to run and not filter the lubricant.



Q: In your opinion, what is the greatest benefit of ISOCLEAN®?

A: I feel the greatest benefit of ISOCLEAN® is peace of mind knowing you are doing right by your equipment so the equipment can do right by you. The customer knows they are using a lubricant that meets the OEM's ISO cleanliness specification and doing so, reduces the risk of the equipment failing due to wear caused by contamination. If the equipment continues to run, it is positively impacting the bottom line of the customer. The customer purchased the equipment as an investment, and they want a return on the investment. If it is not working, the return-on-investment decreases or does not happen. ISOCLEAN® helps the customer ensure that he or she will get the full return on the investment and more.

In-Depth with Nick Bilius: Certified Distributor Discusses Chevron's ISOCLEAN® Advantage

Nick Bilius, Vice President of Shrader Tire & Oil (Certified ISOCLEAN Distributor)

Having explored the rigorous standards and benefits of the ISOCLEAN® Certified Lubricants program with a Chevron representative, we now turn to a distributor's perspective. Distributors play a crucial role

in delivering these high-quality lubricants to customers and ensuring they receive the support needed to maximize the program's benefits. Nick Bilius with Shrader Tire & Oil offers valuable insights into how the ISOCLEAN® program is implemented, the challenges they help customers overcome, and the tangible results they've observed in various industries.

Q: What led your organization to become an ISOCLEAN® distributor?
A: Becoming an ISOCLEAN® certified marketer was an easy decision for Shrader Tire & Oil. Offering ISOCLEAN® Certified Lubricants differentiates us from the competition by providing a unique value to our customers. There is a strong demand for increased reliability and uptime, as these factors signifi cantly impact productivity, efficiency, and profitability for organizations.

Q: Is there an increased lead time for ordering and receiving ISOCLEAN® products due to the filtering and testing process?
A: Not at all. Throughout the sales process, we identify our prospective customers' needs to ensure we have sufficient inventory when the product is sold.

Q: How would you describe the support and service you've received from Chevron regarding the ISOCLEAN® program?
A: Chevron has been an integral part of the ISOCLEAN® program from the beginning. Operation and Sales Training were crucial to its implementation. As the program developed, we were able to collect data through oil analysis, which allowed us to quantify the savings for each customer. Chevron's team has supported us every step of the way!

Q: How can you guarantee the oil is clean upon delivery?
A: To ensure oil cleanliness upon delivery, a strict process must be followed. This process includes proper filtration, third-party lab testing, storage, tracking, and certification prior to an ISOCLEAN® delivery. Adhering to these steps guarantees that ISOCLEAN® lubricants are handled and delivered properly to our customers.

Q: In your opinion, what is the greatest benefit of ISOCLEAN®?
A: ISOCLEAN® lubricants help minimize downtime, reduce maintenance costs, and improve over all equipment performance. However, if we had to highlight one key advantage, it would be the increased reliability that comes from extended equipment life.

The Chevron ISOCLEAN® Certified Lubricants program stands out as a transformative solution for industries seeking to enhance equipment reliability and performance through cleaner lubricants.The insights shared by Chad Bertrand and Nick Bilius highlight the program's rigorous standards, innovative processes, and tangible benefits . From reducing contamination and wear to extending machine life and lowering maintenance costs, ISOCLEAN® Certified Lubricants provide a compelling case for upgrading to cleaner, more efficient lubrication solutions.

To learn more about Chevron's ISOCLEAN® Certified Lubricants program, visit *www.chevronlubricants.com/isoclean.*

DESIGNING AN EFFECTIVE LUBRICATION PROGRAM

We all know lubrication is the lifeblood of machinery. But how do we know our lubricants are doing their job? Well, that's where an effective lubrication program steps in. Think of it as your doctor prescribing medications and monitoring vital signs to make sure you're in top shape. An effective lubrication program is what keeps our machinery healthy, which ultimately leads to operational reliability and equipment longevity. However, numerous challenges and pitfalls plague organizations, preventing them from establishing a successful program – ranging from incorrect lubricants to poor lubrication practices, lack of personnel training, and resistance to culture change. These factors contribute to decreased performance, increased downtime, decreased morale…the list goes on.

This article sheds light on those lubrication challenges, advocating for best practices, raising awareness of potential pitfalls, promoting cultural change, and demonstrating the benefits of embracing a comprehensive lubrication program.

Lubrication Challenges

First, let's look at the most common challenges associated with machinery lubrication, standing in the way of an effective lubrication program.

- **Contamination control–** Particles and debris, water ingress, and chemicals lead to problems like abrasion, wear, rust and corrosion, degradation of lubricant quality, and even hazardous chemical reactions.
- **Lubricant degradation–** Exposure to oxygen and high temperatures causes sludge and varnish to form, and lubricant breakdown, reducing its effectiveness and requiring more frequent changes. Mechanical stress also degrades lubricants, especially greases, thus reducing their ability to protect moving parts.
- **Improper lubricant selection–** Too often lubricants are chosen based on costs without considering compatibility issues. Mixing incompatible lubricants can lead to chemical reactions, which in turn leads to downtime. It's also important to consider machinery compatibility since different components can react differently and have different failure-modes as a result.
- **Operational factors–** Frequent equipment starts and stops, as well as varying loads and speeds, can cause fluctuations in lubrication distribution and lead to

increased wear.

- **Economics–** High-performance lubricants can be expensive, and implementing an effective lubrication program can be resource-intensive. However, inadequate lubrication leads to machinery failure and unplanned downtime with mounting repair costs and lost productivity.
- **Lack of understanding–** When operating conditions, lubrication intervals, and maintenance techniques (such as oil analysis) are not fully understood, over-lubrication or under-lubrication can easily occur leading to component failure.

By addressing these challenges through strategic planning, regular monitoring, and adopting best practices, machinery performance and lifespan can be significantly enhanced.

Six Lubrication Best Practices

So, what are the best practices to incorporate into a lubrication program? Indirect response to the above challenges, I recommend these practical solutions:

1. **Mitigate contamination-** Use filters with the proper beta ratio to prevent contaminants from entering the lubrication system; create a labeling standard for lubricant naming and identification to prevent cross-contamination; use quick connects instead of pour spouts to top up equipment; and regularly check and replace filters.
2. **Prevent lubricant degradation-** Monitor operating conditions; perform oil analysis; check on additive/contamination levels; and most importantly, store your oil in a designated place under conditions that will keep it CLEAN, COOL, and DRY for the longest shelf life.
3. **Ensure proper lubricant selection-** Select lubricants designed for specific temperature ranges; use multi-viscosity oils for variable operating conditions; implement pre-lubrication systems for start-up operations; consult machinery manuals and lubrication experts; and-consider the application of synthetic lubricants for extreme conditions.
4. **Optimize lubrication process-** Train personnel in proper lubrication techniques, use automated lubrication systems where feasible, and establish a comprehensive lubrication schedule tailored to specific equipment needs.
5. **Adopt cost-effective economic strategies-** Conduct a cost-benefit analysis for purchasing high-quality lubricants, implement predictive maintenance to reduce downtime, and invest in a reliable lubrication system to minimize long-term costs.
6. **Assign knowledgeable SMEs-** Give lubrication duties to only carefully vetted professionals (internal or external) well versed in lubrication practices to maintain the accuracy and integrity of the entire lubrication cycle.

Potential Pitfalls

Whether a lubrication program is already in place, or in the planning stage, be aware of some pitfalls that could potentially compromise an effective program.

Over-lubrication increases fluid friction, generating excessive heat that can cause seal damage, leaks, and contamination ingress, resulting in higher costs and waste of resources. Under-lubrication, on the other hand, increases machinery wear and tear due to overheating and makes equipment components more susceptible to rust and corrosion.

Selecting the incorrect lubricant for temperature or load conditions can impact performance by not providing adequate protection and shortening the life of the lubricant, thus requiring more frequent changes and increasing costs.

Cross-contamination from mixing different lubricants can cause chemical reactions that reduce effectiveness and increase wear. The metal particles from wear and tear then circulate in the lubricant, causing further damage.

Poor lubrication practices stemming from in adequate application techniques, ignoring-manufacturer recommendations, or a lack of training can potentially introduce errors into the lubrication process.

Neglecting regular maintenance, such as a failure to regularly monitor lubricant condition, replace filters when necessary, or the prolonged use of degraded lubricants can lead to significant machinery damage.

Environmental factors can cause harm, including temperature variations that alter lubricant viscosity, humidity and moisture that cause lubricant emulsification and corrosion, and dust and particulates in harsh environments that contaminate the lubricant.

Then, there are economic constraints that can lead to setbacks and poor outcomes. For example, cost-cutting may dictate the use of lower-quality lubricants or longer lubrication intervals, as well as postponing the purchase/use of advanced monitoring tools (such as ultrasound equipment, thermography, vibration, or oil analysis kits).

Finally, lubrication programs can face technological limitations, e.g. outdated systems that do not provide consistent or adequate lubrication, and legacy monitoring methods that do not provide real-time data on lubricant condition and machinery performance.

Culture Change: Overcoming Resistance

For a lubrication program to succeed, organizations need to create a culture that values and prioritizes proper lubrication practices at all levels. A shift in mindset based on the following principles will help overcome the usual resistance to such a widespread culture change:

- **Leadership commitment–** management leading by example, committed to the lubrication program by actively participating and promoting best practices, along with a clear visionand goals.
- **Effective communication–** awareness campaigns to highlight the value of lubrication and feedback channels for employees to make suggestions in a collaborative environment.
- **Education & training–** programs for all relevant personnel, e.g. maintenance staff, operators, and engineers, focusing on lubrication best practices, the importance of proper lubrication, and the consequences of neglect.
- **Standardization & documentation–** lubrication procedures and schedules tailored to each piece of equipment, supported by checklists and detailed record keeping to track compliance and identify areas of improvement.
- **Monitoring & metrics–** defined KPIs (for equipment uptime, maintenance costs, and lubricant consumption), as well as regular audits and inspections to ensure Lubrication Program effectiveness.
- **Advanced technologies & tools–** software solutions to manage and track lubrication activities, as well as condition monitoring tools (e.g. oil and vibration analysis) to assess the health of lubricants and machinery in real time.
- **Incentives & accountability–** assignment of roles and responsibilities for lubrication tasks, as well as recognition and reward of employees who follow best practices and contribute to the success of the program.
- **Continuous improvement–** periodic reviews and updates of lubrication procedures to reflect feedback, audit results, and technological advancements, as well as root cause analysis to investigate lubrication failures or issues so they do not recur.
- **Benchmarking & consulting with experts–** stay competitive and innovative by comparing lubrication practices with industry standards and best practices, as well as leveraging the knowledge and perspectives of external lubrication expertise.

Incorporating these cultural changes into the company's core values and operational philosophy will bring machinery lubrication to the same level of concern as safety and quality standards.

Lubrication Program Benefits

A well-designed, well-organized lubrication program formalizes processes and procedures, bringing consistency and accuracy for more efficient, reliable, and cost-effective operations. When the above best practices and culture changes are adopted, and the pitfalls are taken into account, businesses achieve substantial benefits, including:

- Extended equipment life
- Improved equipment reliability
- Enhanced performance and efficiency
- Cost savings
- Improved safety
- Reduced waste / lower hazardous emissions
- Streamlined maintenance processes
- Regulatory compliance
- Quality assurance
- Boost in plant morale

Conclusion

The importance of an effective lubrication program cannot be denied. It is the key driver for optimal performance and longevity of industrial equipment. Proper lubrication reduces friction, wear and heat, which can significantly extend the life of mechanical components and improve overall efficiency. Therefore, the health of your machinery is reflected in your bottom line.

NORIA Skill Training

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Empowering People to Succeed

GEAR TALK : Episode 7

In this episode of Gear Talk, Wes sits down with Charli K. Matthews, CEO and founder of Empowering Brands, and a passionate advocate for empowering teams. Charli believes in the power of psychological safety — a place where speaking up, taking responsibility, and proactive action are not just encouraged but celebrated. Join Wes and Charli as they delve into the art of creating an environment where team members don't just exist, but excel.

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Machinery Lubrication INDIA

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Got a perspective that matters? Share it with us at sangeeta.iyer@machinerylubricationindia.com

Recent Advancements In The Development Of Industrial Gear Oil For Steel Plant Gear Drives

Understanding Gear Failures and Limitations of Standard Lubricants

Standard industrial gear lubricants with Sulfur and Phosphorus as EP additives do not actively combat wear. Under challenging operating conditions, issues like microcracks, micropitting, sharp edges, or pitting (material breakouts) can occur—leading to gear failure and production downtime.

Prolonging Gear Life with Anti-Micropitting Gear Oils

Anti-micropitting gear oils allow previously damaged gears to continue functioning—sometimes for several years—until a replacement is available. These oils have been developed through collaboration with gearbox manufacturers and research institutes, offering benefits like increased lifespan, improved safety, and cost savings.

Technology Behind High-Performance Gear Oils

New formulations, such as the Eutectic Formula, ensure optimal performance even under extreme loads and temperatures. These oils provide maximum wear protection, even under the toughest conditions like wind power generation.

What Causes Micropitting?

Factors such as oil film thickness, temperature, and slide-to-roll ratio contribute to micropitting. This wear appears as a dull, gray

finish, caused by surface fatigue. It alters the gear tooth profile, creating noise, vibration, and misalignment.

Combating Oil Aging in Industrial Gearboxes

Oil aging accelerates with temperature—doubling with every 10°C rise. Anti-micropitting gear oils help reduce oil temperature and aging by using advanced additives with low friction coefficients.

Role of Advanced Additives in Wear Protection

These additives help adapt to changing loads, increasing the load-carrying capacity and smoothing out pre-damaged surfaces. Lower friction improves efficiency and reduces energy consumption.

Advantages of Anti-Micropitting Gear Oils

- Active wear protection
- Lower maintenance costs and extended oil change intervals
- Increased energy efficiency
- Smoothing of pre-damaged surfaces
- Longer gear and component life

Applications of High-Performance Industrial Gear Oils

These oils are suitable for nearly all enclosed industrial gears—especially in conditions of:

- High loads

- Variable speeds
- Thermal stress

They are also recommended for:
- Bearings
- Gear couplings
- Slideways
- Circulating systems
- Flender gears (approved use)

Technical Specifications
- Viscosity Grades: ISO VG 100 to ISO VG 680
- Base Oils: Mineral / Synthetic (PAO)
- Standards: ISO 12925-1, DIN 51517-3 (CLP), DIN ISO 3448, ANSI/AGMA 9005 – F16

Performance Highlights
- Prevents micropitting and pitting
- Superior wear and corrosion protection
- Reduces noise, oil sump temperature, and energy consumption
- Resmooths damaged surfaces

Typical Parameters (ISO VG 680)
- Viscosity @ 40°C: 655 mm²/s
- Viscosity @ 100°C: 40 mm²/s
- Density: 0.912 kg/m³
- Flash Point: 230°C
- Pour Point: 0°C
- FVA No. 54 P: >10
- FZG Test: >12

Managing Water Contamination and Foam
Wet oil promotes micropitting—possibly due to hydrogen embrittlement. These oils resist water contamination and foam formation using special inhibitors and selected base components, minimizing corrosion risks.

Debris-Related Wear and Required Cleanliness Standards
Debris in the oil can dent gear teeth, causing micropitting. Dent shape and depth vary with debris type. Proper cleanliness must be ensured during gear assembly and service to prevent damage.

Oil Sample Source	Required Cleanliness (ISO 4406)
New oils before filling	16/14/11
Gearbox after factory testing	17/15/12
Gearbox during service	18/16/13

Product Description and Characteristics
Anti-Micropitting Gear Oil is a high-performance product based on mineral/synthetic (PAO) oils with advanced Eutectic additive technology. Suitable for a wide range of industrial applications from -10°C to +100°C.

Key Characteristics:
- Excellent wear and corrosion protection
- Reduces friction and oil temperature
- Silicone- and solid-free

Advantages and Benefits
- Prevents micropitting and pitting
- Smoothens damaged surfaces
- Extends service life
- Handles low-speed, high-load conditions
- Enables longer oil change intervals
- Suitable for all bearing and filter systems

About the author:

Mr. C.M. Sharma has over 30 years of experience in the field of lubrication, having served as a senior manager at Tata Steel, from where he superannuated a few years ago. He has been involved in every aspect of lubrication—from the project stage to operations—and has managed lubrication for major equipment across the Steel, Power, Mining, and Cement sectors. He continues to contribute actively through training and consulting assignments across India.

LASSI FOR US, LUBE FOR THEM: SURVIVING SUMMER, HUMAN & MACHINE EDITION

What Indian Summers Can Teach Us About Keeping Equipment Cool

It's that time of year again—when fans whirl at full speed, ACs groan under pressure, and the only thing hotter than the sun is the debate over whether buttermilk or coconut water is the better coolant. As India heads into peak summer, we're all trying to cope.

I'm not an engineer, but working closely with reliability professionals through training sessions, interviews, and magazine stories, I've picked up a thing or two about how heat doesn't just test people—it tests machines too.

And unlike us, machines can't reach for a cool drink or complain. They just keep running… until they don't.

Heat Hurts Machines More Than We Think

In almost every training session I've coordinated, someone inevitably mentions this: "Our breakdowns go up in summer."

It makes perfect sense. Higher ambient temperatures cause:

- Lubricants to break down faster
- Bearings to overheat
- Seals to fail
- Oil viscosity to drop
- Cooling systems to underperform

I once spoke with a maintenance planner from Gujarat who said their gearboxes regularly overheated in May and June—especially those near furnace areas or under tin sheds. "It's like working out in the sun with no water," he said. "You can't blame the machine if it gives up."

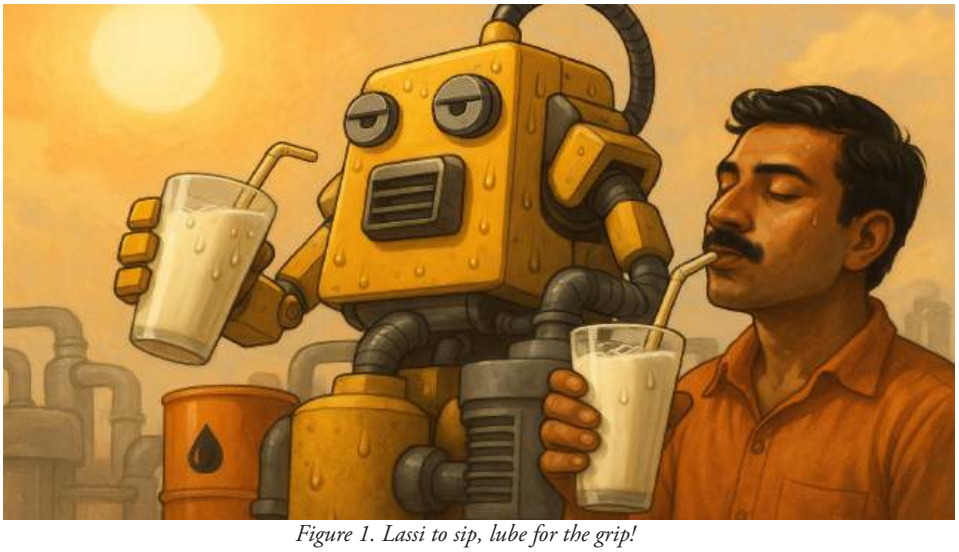

Figure 1. Lassi to sip, lube for the grip!

How We Survive vs. How Machines Should

Let's compare:

What We Do in Summer	What Machines Need
Drink water all day	Proper lubricant levels and top-ups
Wear cotton and linen	Heat-resistant seals and synthetic oils
Avoid going out at noon	Load reduction and downtime during peak heat
Use fans and ACs	Ventilation and cooling systems
Take electrolyte drinks	Condition monitoring and oil analysis

At one plant visit I tagged along for, the team was tracking oil temperature in a compressor

that kept tripping in the afternoons. Turns out the lube had oxidized and thinned out due to extreme heat. Their fix? A higher viscosity synthetic oil and a dedicated cooler. Since then, no more shutdowns.

Lubrication = Hydration (For Machines)

If machines could talk, they'd ask for:

- Clean, thermally stable lubricants
- Timely oil changes and filter replacements
- Grease reapplication (but not overdoing it!)
- Proper storage of lubricants—no barrels baking under the sun

At one training, a participant joked, "Our oils get more sun than we do." And honestly, it's true in many plants. Just moving oil drums indoors or under a shaded area makes a surprising difference in quality.

Cooling Isn't Luxury—It's Necessity

Some practical tips shared by maintenance professionals I've met:

- Fit exhaust fans or blowers near high-temperature machines
- Don't ignore clogged vents—dust kills cooling
- Add temperature gauges and alarms—it's better than guessing
- Use reflective sheets or insulation over outdoor machines

One team in Telangana retrofitted heat shields around a hydraulic unit exposed to the western wall of their building. The oil temp dropped by 12°C almost instantly—and they haven't faced a shutdown since.

Final Thought: Respect the Heat (For You and Your Machines)

Machines don't ask for much. Just clean oil, good air, and a little monitoring. And in return, they work relentlessly. But summer is brutal—even on steel.

As someone who's seen the passion reliability engineers have for protecting their equipment, I've learned this: a little empathy and preparation go a long way.

So next time you reach for your third coconut water of the day, pause and ask—has the machine had what it needs to stay cool too?

Stay cool. Stay consistent. And don't let your machines suffer a summer meltdown.

About the author:

Sangeeta Iyer, as Publications Manager, she combines 18+ years of expertise in technical writing and editing. She oversees the editorial direction of Machinery Lubrication India, translating complex lubrication and reliability concepts into relatable stories. Her passion lies in making technical knowledge accessible and actionable for industries.

UNDERSTANDING LOW VISCOSITY ENGINE OIL IN HEAVY-DUTY SEGMENT AND ITS FORMULATION CHALLENGES

In recent years, the use of low-viscosity engine oils in the heavy-duty segment has been on the rise, driven by the need for better fuel efficiency, lower emissions, and enhanced engine performance. Low viscosity oils, typically found in grades such as 5W-30 or 0W-20, offer significant advantages, particularly in reducing internal engine friction during cold starts and under high-load conditions. By minimizing friction, these oils help improve fuel economy and reduce greenhouse gas emissions, which is essential in meeting increasingly stringent environmental regulations, such as Euro VI and EPA 2027 standards.

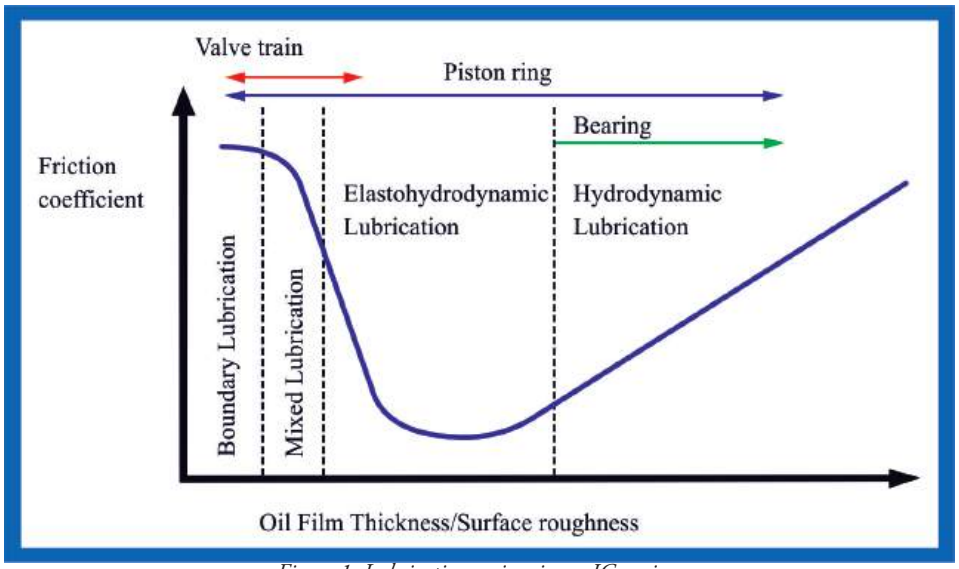

Figure 1. Lubrication regime in an IC engine

Emissions from the Transport Sector in India

The transport sector contributes 25% of global carbon dioxide (CO2) emissions from fuel combustion. In India, it ranks as the third highest CO2 emitting sector, with road transport responsible for over 90% of emissions within this category. Heavy-duty vehicles, particularly those over 12 tons, account for approximately 60% of fuel consumption and greenhouse gas (GHG) emissions in the heavy-duty vehicle fleet. Consequently, regulations are in place to lower fuel consumption and emissions from diesel-powered trucks and buses. To comply with Indian CAFÉ regulations, energy-efficient lubricants are the most cost-effective solution, as they typically do not necessitate modifications to vehicle designs.

Energy Losses in the Engine

Energy loss in engines primarily occurs due to friction in four key areas: the piston and cylinder, the valvetrain, and the crankshaft. The cam and tappet contacts contribute significantly to friction within the valvetrain, operating under boundary and elastohydrodynamic conditions. In the piston assembly, friction is influenced by mixed, elastohydrodynamic, and hydrodynamic regimes, while the engine bearings predominantly function in hydrodynamic conditions. Lubricating oil is crucial for maintaining the oil film thickness and managing viscous drag, especially in the full hydrodynamic regime. Additionally, the lubrication properties of the oil can affect friction in boundary or mixed lubrication regimes.

Reducing Viscosity of the Lubricants- A Promising Option

Using a low-viscosity lubricant is the most efficient and cost-effective way to lower engine friction out of all the solutions available. By decreasing viscous drag, lower viscosity engine oils lower friction and produce mod-

est but noticeable increases in fuel efficiency.

Therefore, the viscosity grades of the lubricants shifted from 15W-40 and above to lower viscosity grades like 10W-40, 10W-30 and 5W-30. Because it lowers the frictional forces, lower viscosity and the inclusion of friction modifiers are common in gasoline engines. On the other hand, excessive viscosity decrease puts engine component durability at risk. Consequently, there may be a limit to viscosity reduction, which is typically higher for diesel engines than for gasoline engines.

Challenges of Low Viscosity Engine Oil

One of the primary challenges in transitioning to lower-viscosity lubricants is achieving a balance between improving fuel economy and ensuring the durability of engine components. Low-viscosity lubricants tend to create thinner oil films, making it more difficult for the oil to maintain adequate separation between loaded contact surfaces within the engine. This can result in increased wear rates. Figure 2 shows Schematic representation of film forming potential of high and viscosity oil in cam shaft and journal bearing cross section.

Therefore, it is essential to develop lubricant formulations with the right combination of base oils and additives that promote fuel efficiency while still protecting the longevity and performance of the engine.

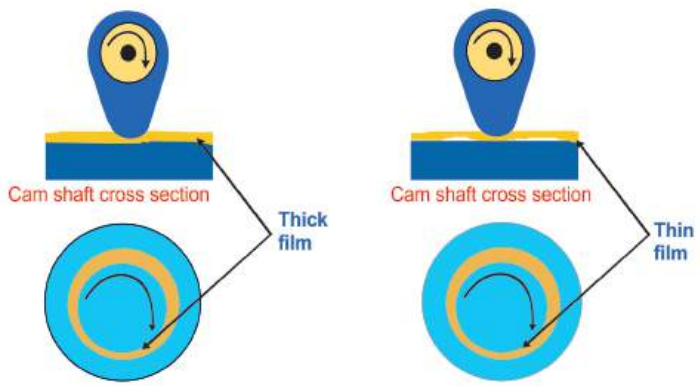

Figure 2. Schematic representation of film forming potential of high and viscosity engine oil in cam haft and journal bearing cross section

Low Viscosity Grades in Heavy-duty Diesel Engine Oil Specification

The government, original equipment manufacturers (OEMs), and consumers have been the primary forces behind recent modifications to engine oil formulation and specifications. API (American Petroleum Institute) creates oil categories based on various product attributes for American Auto industry. In response to the automotive industry's push to lower fuel consumption and CO2 emissions, API introduced two new engine oil categories in 2016: CK-4 and FA-4. While API FA-4 concentrates on improving fuel efficiency through reduced viscosities, the API CK-4 specification preserves backward compatibility.

Formulation Challenges Stringent High Temperature High Shear Viscosity (HTHS)in Low Viscosity Engine Oil

High-temperature high-shear viscosity (HTHS) assesses the viscosity, or flow resistance, of engine lubricants at elevated temperatures while maintaining constant shear conditions. This illustrates the tight tolerances and high-speed interactions that occur between hot engine parts. Greater potential for increased fuel efficiency is indicated by a lower HTHS viscosity. Along with the more popular 15W-40, API CK-4 does permit low-viscosity engine oils like 10W-30 and 5W-30.

To attain a minimum HTHS of 3.5 cSt, API CK4 SAE 10W-30 oil must be formulated toward the higher end of the SAE viscosity limits. As a result, most API CK-4 10W-30 engine oils typically have viscosities above 11.5 cSt, which is significantly higher than the minimum requirement of 9.3 cSt.

API FA-4 engine oils are designed with a lower HTHS viscosity than their API CK-4 counterparts. This implies that these oils move through the engine more quickly at working temperatures, giving the internal hardware the essential lubrication it needs. The ease of flow also reduces friction, fuel consumption, and lowers exhaust emissions to improve the overall efficiency of the vehicle.

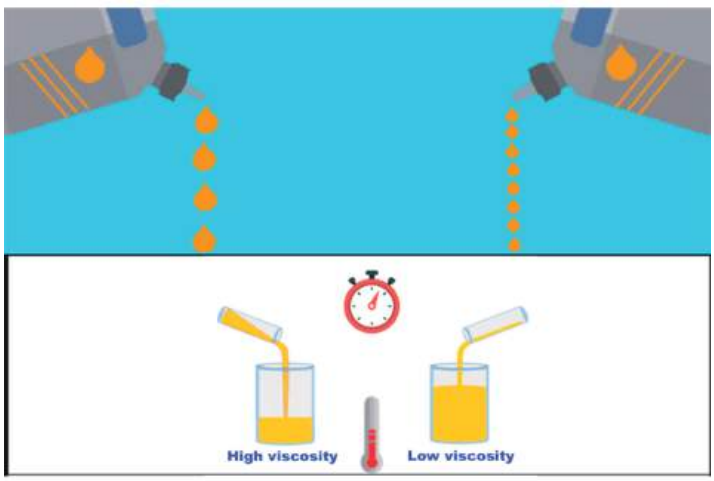

Figure 3. Schematic representation of flow properties of high and low viscosity engine oil

In contrast, API FA-4 oils typically have HTHS values between 2.9 and 3.2 cSt and viscosities of about 10 cSt at 100°C. To satisfy both viscosity and HTHS requirements, careful selection of base oil combinations and viscosity modifiers (VM) is crucial. Even oils formulated to meet FA-4 specifications need to incorporate high-quality low-viscosity base oils. Figure 4 shows viscosity and HTHS difference of CK-4 15W-40, CK-4 10W-30 and FA-4 5W-30 viscosity grades.

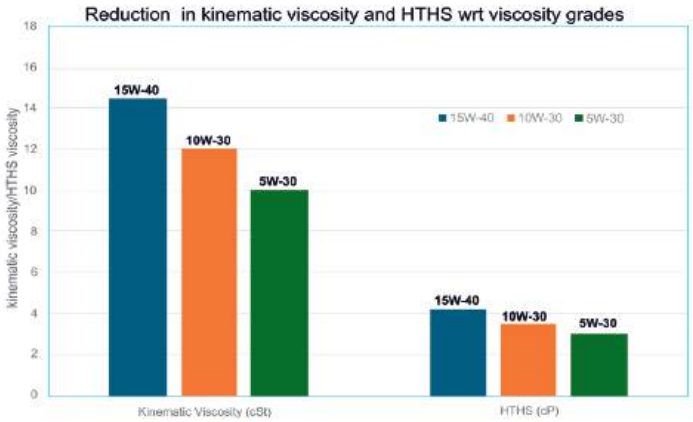

Figure 4. Reduction in kinematic viscosity and HTHS w.r.t. viscosity grades

Stringent Volatility Limit

Evaporation loss plays a critical role in engine lubrication, particularly at high temperatures. When oil is subjected to these elevated temperatures, some of its components can evaporate, leading to increased oil consumption and potential changes in oil characteristics. To address this issue, engine manufacturers and API specifications set limits on the maximum evaporation loss permitted.

In low-viscosity engine oil, volatility is important because it directly impacts oil consumption, drain intervals, and overall engine performance. Lower volatility is crucial for maintaining oil's lubricating properties, preventing excessive oil burning, and maximizing fuel efficiency. Evaporation loss plays a critical role in engine lubrication, particularly at high temperatures. Some of the components in oil may evaporate when exposed to extremely high temperatures, which could result in changes to the oil's properties and greater consumption.To address this issue, engine manufacturers and API specifications set limits on the maximum evaporation loss permitted. Low viscosity oils must have lower volatility to ensure they retain their lubricating properties, reduce the likelihood of oil burning, and enhance fuel efficiency. Consequently, base stocks with lower viscosity, greater viscosity index (VI), and lower volatility are needed for low-viscosity engine oil formulations. The price and accessibility of premium base stocks have a significant impact on ultra-low viscosity lubricants. Therefore, choosing base stocks carefully is crucial.According to API guidelines, the Noack volatility limit is higher in the CK4 and FA4 categories (13%), as opposed to the 15% limit in the earlier categories. SAE 15W-40 is the prevalent grade require Gp II base oil whereas FA4 is the fuel economy category where 10W-30 and 5W-30 is the prevalent low viscosity grades and to meet the volatility requirement Gp III base oils are required.

Shear Stability The ability of an oil to resist mechanical breakdown under extreme stress is known as shear stability. When the polymers in multigrade oils are sheared into smaller fragments, it can lead to a decrease in viscosity, potentially compromising the oil's ability to protect essential engine components. When assessing shear stability, the effectiveness of viscosity modifiers (VMs) is essential. These modifiers are susceptible to permanent shearing, especially when they pass through engine gears or oil pumps. To guarantee long-lasting performance, it is crucial to select the appropriate kind of VMs that complies with the shear stability requirements established by OEM and industry standards.

Shear stability is vital for low-viscosity oils, which are formulated to enhance fuel efficiency. These oils maintain a thinner film thickness to safeguard moving engine parts. The protective film's strength is reduced if shearing causes the viscosity to drop, which could lead to increased wear on engine parts. Consequently, a new test for high-temperature high-shear (HTHS) viscosity after shearing has been introduced for the first time in the latest heavy-duty engine oil specifications, API CK4 and FA4.

Viscosity Trend in Indian Market

SAE 15W-40 is the most often used grade in the heavy-duty diesel industry globally. However, this grade is at its highest point and is predicted to fall by 2030. Moreover, the on-highway industry is anticipated to rapidly transition to SAE 10W-30. Additionally, FA-4 10W-30/ SAE 5W-30 will continue to be slow until entire fleets turn over, such that OEMs specifically endorse API FA-4 fluids.

A decade ago in India, the SAE 10W-30 grade was practically non-existent in the heavy-duty segment. However, with the introduction of BS VI emission standards, the adoption of CK4 10W-30 grade has significantly increased. This grade is now commonly used by original equipment manufacturers (OEMs) for both plant filling and service filling, following extensive testing on BS VI vehicles. In contrast, the adoption of the lower viscosity oil, FA4 5W-30, has seen slower progress, which may be attributed to its compatibility with existing hardware.

About the author:

Dr Snigdha Praharaj is a Senior Research Manager in IndianOil R & D centre with 15 years of experience in the field of Automotive engine oil and Defence lubricants. Her expertise includes development, validation, used oil analysis, conducting field trials, and approval process for OEMs. She has played instrumental role in introduction of low viscosity oil in heavy duty segment and indigenization of Defence lubricants. You can contact Dr. Snigdha at praharajsn@indianoil.in.

Mind Maintenance

How to Manage Stress Under Pressure!

Ever felt like your brain is running a marathon while your body is still at work?

This happens when we face constant dealines, high expectations, and unpredictable problems. Whether you're working in a factory, at a desk, or leading a team, stress is the common thread. When pressure builds, our body produces cortisol, a hormone that can be helpful in emergencies, but harmful when it stays elevated for too long. It fogs your thinking, disturbs sleep, and slowly affects your health.

5 Habits That Actually Work

1. Pause & Breathe

Before reacting to stress, take a moment.

Pro Tip - Inhale for 4 seconds, hold for 4, exhale slowly for 6 seconds. Do this 3 times—it takes less than a minute, and your brain resets.

2. Take Tiny Breaks

You don't need a vacation to relax.

Pro Tip - 2-minute micro-breaks during the day, like stretching or simply stepping away from your screen, can help you return with sharper focus and less tension.

3. Simplify the Chaos

Under stress, we often feel overwhelmed.

Pro Tip - Create a quick mental plan:

- Breathe
- Break the task into parts
- Do one thing at a time
- Ask for help if needed

This reduces anxiety and improves clarity.

4. End-of-Day Cool Down

We often carry the stress of work into our evenings. Make it a habit to decompress. Remember, a calm evening means a better tomorrow.

Pro Tip - Listen to music, go for a walk, play with your pet, do what you enjoy doing the most, or just sit quietly.

5. Don't Bottle It Up

You're not weak if you are feeling stressed. Sometimes, just saying it out loud brings unexpected relief and fresh perspectives.

Pro Tip - Talk to someone—a colleague or friend.

Why This Matters?

Stress will always be part of work life. But how you handle it makes all the difference.

Think of your mind like a battery—it needs recharging. When you take care of your mental health, you show up stronger, sharper, and more resilient—not just for work, but for life.

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.

Want to bring a health session to your workplace?

Let's connect!

LinkedIn - https://www.linkedin.com/in/jhumpa-mukherjee-a0383a150/

Instagram - @thefitlifetales

ISFL 2025 CHAMPIONS INNOVATION FOR SUSTAINABLE ENERGY TRANSITION

The **14th International Symposium on Fuels & Lubricants (ISFL 2025),** organized by **IndianOil R&D** under the aegis of the **ISFL Society,** was successfully held from **March 20–22, 2025**, at **Vivanta by Taj, Surajkund, Delhi NCR.** The event brought together global experts, researchers, OEMs, and policy makers to exchange ideas and innovations shaping the future of sustainable energy through advancements in fuels and lubricants.

The event was inaugurated in the presence of notable industry leaders including S**hri N. Senthil Kumar,** Director (Pipelines), IndianOil; **Shri Debasish Nanda,** Director (Business Development), Coal India; **Dr. Alok Sharma,** Director (R&D), IndianOil and Chairman, NSC, ISFL; **Dr. Chris Locke,** Executive VP - Commercial, Infineum; and **Dr. Mark Davies,** VP, Lubrizol Additives Technology.

In his keynote address, Shri Senthil Kumar emphasized the growing importance of resilience and sustainability in the energy sector, underlining IndianOil's commitment to achieving **net-zero emissions** through a structured, multi-pronged approach. Shri Debasish Nanda highlighted India's environmental initiatives, including evolving vehicular emission norms and the introduction of cleaner fuels. He also shared insights into **Coal India's pilot LNG project** with GAIL, aimed at integrating LNG into mining operations to improve efficiency and reduce emissions.

Glimpses of technical, plenary and panel sessions during ISFL 2025

Dr. Alok Sharma, Director (R&D) and Chairman, NSC, emphasized the pivotal role of **technological innovation** and **collaborative efforts** in accelerating the transition to a low-carbon economy. He called for a complete transformation across refinery, marketing, and R&D operations, urging stakeholders to rethink how energy is produced and consumed. He reaffirmed ISFL's mission to facilitate actionable outcomes that drive sustainable development in the fuels and lubricants industry.

This year's symposium, themed **"Fuels & Lubricants towards Sustainable Energy Transition,"** showcased more than **150 technical papers** by leading scientists, industry experts, academicians, and OEMs. Key discussion areas included energy-efficient lubricants, cleaner fuels, advanced additives, and sustainable mobility technologies. The event saw participation from over **450 delegates representing 10 countries.**

ISFL 2025 also introduced new engagement formats such as an **Energy Quiz for students,** a **Business Talk session for OEMs,** and an interactive **KIOSK-based quiz for delegates,** all of which received enthusiastic responses.

ISFL 2025 reinforced its position as a premier platform for global dialogue, fostering meaningful partnerships and innovations for a greener, more sustainable energy future.

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*look out for our next *Lunch & Learn* announcement

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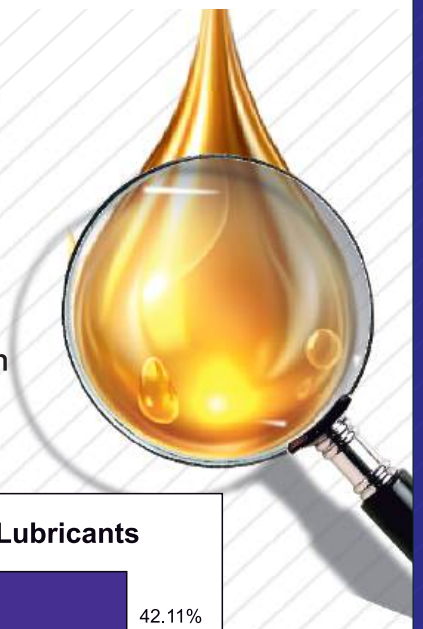
LUBRICATION LENS CHALLENGE #2

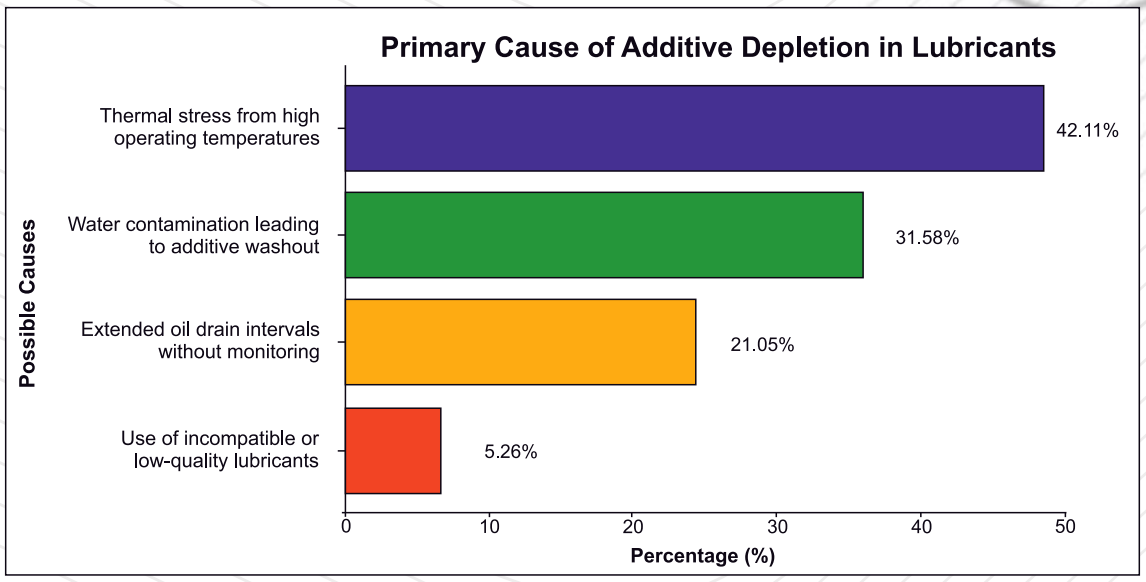
Machinery Lubrication INDIA



What's the buzz in lubrication this month?

We put the spotlight on a critical question:

- What do you believe is the leading cause of additive depletion in your plant's lubricants?
  Here's what professionals across the industry had to say!



Announcing the Winners!

1st

Mandar Joshi

"Monitoring matters!" Many plants follow fixed drain intervals without considering actual operating hours, leading to misjudged oil condition and additive depletion.

2nd

Satyadarsan Mohanty

"Water wins where we lose control!" Water contamination remains one of the leading causes of lubricant degradation, impacting performance, reliability, and component life.

Congratulations to our winners! Stay tuned for the next Lubrication Lens Challenge!

Sign Up For Your
FREE Subscription Today

HPCL RACES AHEAD WITH DELHIVERY: A NEW ERA IN LUBRICANT DISTRIBUTION

In a strategic move to strengthen its supply chain, Hindustan Petroleum Corporation Limited (HPCL) has partnered with Delhivery, one of India's leading logistics and supply chain companies. This collaboration aims to expand HPCL's lubricant distribution network to remote and underserved markets across India, ensuring faster and more efficient deliveries to customers and retailers..

The partnership leverages Delhivery's nationwide logistics infrastructure, warehouse capabilities, and last-mile delivery expertise. For HPCL, this step marks a shift toward embracing technology-driven logistics solutions, ultimately improving product availability and brand reach in highly competitive markets.

HPCL and Delhivery join hands to redefine lubricant distribution efficiency in India

This development is a win for both operational efficiency and customer satisfaction. As India's demand for industrial and automotive lubricants continues to grow, innovative distribution partnerships like this one will be vital in maintaining market leadership and fulfilling delivery expectations at scale.

DAEWOO DRIVES IN: KOREAN GIANT ENTERS INDIA'S BOOMING LUBRICANTS MARKET

South Korean conglomerate Daewoo has entered the Indian lubricant market through a strategic licensing agreement with Mangali Industries, aiming to capture a 2% market share by March 2026. The company has established a manufacturing facility in Wada, Maharashtra, with an annual production capacity of 40,000 metric tonnes, which can be expanded by 2.5 times to meet future demand.

Daewoo's phased rollout strategy focuses on key metropolitan cities and Tier-2 towns, supported by a robust dealership and distribution network. The company plans to offer a range of high-performance lubricants tailored for various vehicles, including two-wheelers, passenger cars, commercial vehicles, and agricultural machinery. This move signifies Daewoo's re-entry into the Indian market, leveraging its global expertise to meet the growing demand for quality lubricants in the country.

The collaboration with Mangali Industries combines Daewoo's technological prowess with Mangali's local market knowledge, aiming to deliver advanced lubrication solutions that enhance engine life,

Daewoo marks its return to India through a strategic tie-up with Mangali Industries to tap into the booming lubricants market.

improve fuel efficiency, and promote sustainable mobility. With this initiative, Daewoo seeks to establish a strong presence in India's dynamic automotive sector and contribute to the evolving landscape of the lubricant industry.

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