

NOVEMBER 2023

MAINTONIA

The only specialized and focused publication on *Tribology, Maintenance & Reliability*

SENSOR

REVOLUTION:

**A PARADIGM
SHIFT FROM
TRADITIONAL
OIL ANALYSIS**

What's Inside?

- ▶ Smart Solutions for Oil Analysis
- ▶ Key to Equipment Reliability
- ▶ ExxonMobil entering Lube Services
- ▶ 30 minutes with Mr. Phil Keep
- ▶ Green Talk with Mr. Samrat Sengupta
- ▶ Condition-based Oil Changes

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Publisher's Desk

Dear Readers,

Welcome to the latest issue of MAINTONIA, where we delve deep into the realm of oil analysis, oil condition monitoring, and sensor technology. In an era where precision and efficiency are paramount, these fields have emerged as the backbone of modern maintenance strategies, revolutionizing industries and ensuring the seamless functioning of machinery.

In this edition, we embark on a journey to explore the intricate science behind oil analysis. Our team of experts and contributors have meticulously crafted articles that unravel the mysteries of how oil's composition provides invaluable insights into the health of machinery. From deciphering wear patterns to detecting contaminants, oil analysis has transformed from a routine check to an indispensable diagnostic tool, helping maintenance professionals anticipate issues and prevent costly breakdowns.

Oil condition monitoring takes center stage as we examine how real-time data collection is shaping the landscape of industrial operations. Through continuous surveillance of oil quality and properties, organizations can optimize their maintenance schedules, reduce downtime, and extend the lifespan of the equipment. The synergy of human expertise and cutting-edge sensor technology is truly a game-changer, enabling us to predict problems before they manifest and elevating operational reliability to new heights.

Sensor technology, the unsung hero behind this revolution, merits its own spotlight in this issue. From advanced IoT-enabled sensors to AI-driven predictive algorithms, the marriage of technology and engineering has unlocked unprecedented levels of accuracy and efficiency. We explore the myriad applications of sensors, from heavy machinery in remote locations to intricate



processes in precision industries, showcasing how these devices are reshaping the very core of maintenance practices.

As we delve into the world of oil analysis, oil condition monitoring, and sensor technology, we are reminded that progress is not merely confined to scientific breakthroughs. It is the people – the brilliant minds in labs, the dedicated engineers on the field, and the astute maintenance professionals – who make this progress possible. Their relentless pursuit of excellence and commitment to enhancing operational reliability truly define the spirit of innovation we celebrate in this issue.

I extend my heartfelt gratitude to our talented contributors, whose insights and expertise have enriched this edition. Moreover, I extend an invitation to our readers to engage with the material presented here, to question, and to challenge the boundaries of current knowledge. Let us continue to explore, innovate, and pave the way for a future where machinery hums in perfect harmony and industries thrive with unwavering efficiency.

Thank you for choosing MAINTONIA as your source of information and inspiration. Here's to embracing the transformative power of oil analysis, oil condition monitoring, and sensor technology.

Sincerely,

Anshuman Agrawal



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MAINTONIA | NOV'23

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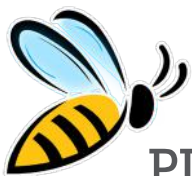
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Source: Internet

Condition-based oil changes: Save money and protect the environment



Inspections, maintenance work and oil changes take place at high altitudes, and components failing result in long interruptions to operations."



Protecting the climate and saving energy and resources are topics that are right on trend. Almost every company is working hard to reduce its carbon footprint. Meanwhile, returning a profit is becoming increasingly difficult, with manufacturing costs having only gone up in recent months. Savings are on everyone's agenda wherever possible, and all operational processes are being put in the spotlight. However, too little attention is often paid to lubricants. Even if higher-quality premium lubricants are used for the first time, they are often replaced far too early due to the fact that they have always been changed at fixed intervals or because it has been stipulated by the oil supplier.

When monitored using professional oil analysis, however, lubricants can be changed based on their actual condition. At the same time, the systems' operational safety is ensured as the analyses also detect contaminants and any wear

processes. This means the cost-effective analyses pay for themselves in a short time.

If oils are changed based on their condition instead of at fixed intervals, you'll be doing your bit for the environment. Fewer oil changes mean the following:

- Less need for fresh oil
- Less oil extraction and crude oil transport
- Fewer energy-intensive refinery processes
- Less transport of fresh and used oils
- Less reprocessing or disposal of used oils

The bottom line is that fewer oil changes reduce the formation of CO₂. The production and disposal of lubricants alone creates CO₂ emissions of approximately 1.5kg CO₂ per litre of oil*. However, fewer unnecessary oil changes also have an additional effect that should not be underestimated, particularly in today's climate - they

have a positive effect on the cost balance sheet. I illustrate the amounts involved using two practical examples.

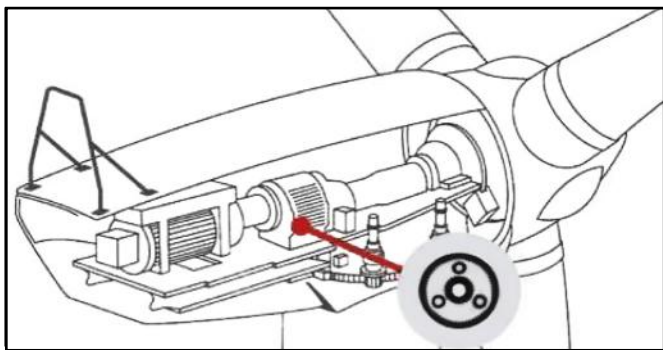
3MW wind turbine – Main gearbox: The components in a wind turbine are hard to access. Inspections, maintenance work and oil changes take place at high altitudes, and components failing result in long interruptions to operations. Changing the oil just once costs several thousand euros.



Source: Internet

Components in a wind turbine require a range of different lubrication oils, greases and coolants. To clarify the cost-benefit balance of condition-dependent oil changes, which are accompanied by oil analyses, only the 1,100 litres of synthetic gear oil that lubricate the planetary gear of a 3MW system have been taken into account in the example.

Analyses of the gear oil carried out every six months in the OELCHECK laboratory in Brannenburg, Germany have shown that the gear oil’s service life can be doubled from 30,000 operating hours (5-6 years) to 60,000 operating hours (10-12 years).



Initial Situation	
Component	Planetary gear of a 3MW wind turbine
Gear oil type	Synthetic CLP gear oil ISO VG 320
Oil volume	1,100L
Cost per litre of gear oil	Approx. €9.50

Costs for changing the gear oil after 30,000 operating hours Fixed interval; no oil analysis costs	
Gear oil	€10,500
+ Loss of production [3MW* €0.2* 6 hours]	€3,600
+ Service technician [external]*	€1,500
Total	€15,600

Costs for changing the gear oil after 60,000 operating hours based on 12 OELCHECK all-inclusive analyses	
Gear oil	€10,500
+ Loss of production [3MW* €0.2*6 hours]	€3,600
+ Service technician [external]*	€1,500
+12 × OELCHECK analysis kits [approx. €80/kit per year]	€960
+ 12 × 2- Service technicians €80/kit per hour for sampling	€1,920
Total	€18,480

Savings on an oil changes after 60,000 operating hours instead of 30,000 operating hours	
Total costs for two oil changes every 30,000 operating hours	€31,200
/Total costs including oil analyses after 60,000 operating hours + services technician [external]*	€18,480
Cost savings after 60,000 operating hours [10 years]	€12,720 Approx.
Annual cost reduction	€1,000

Goods vehicles – Euro 6D six-cylinder diesel engine: A well-known German freight forwarder is leading the way in reducing their CO₂ emissions. They have around 150 trucks on their books that run solely on biodiesel (B100), which reduces CO₂ emissions by around 80% compared to running on diesel (B7). With an average consumption of 33 liters per 100 kilometers and a mileage of around 120,000 kilometers per year, each heavy goods vehicle emits 70 tonnes less CO₂ each year.



Source: Internet

Unfortunately, there's a catch. Several years of findings relating to running engines on pure, non-esterified rapeseed oil indicate that engine manufacturers still stipulate that B100 engine oils should be changed at shorter intervals. This should eliminate the risk of increased fuel entry when running on B100 and of any resulting subsequent damage to the engine. To meet the engine manufacturer's warranty conditions as defined in the lease contracts, the freight forwarder had to shorten the oil change intervals from the usual 120,000 kilometers to 30,000 kilometers. Shortening the intervals led the cost accounts for oil changes and the CO₂ balance sheet to soar due to the following:

- The amount of used and fresh oil increased fourfold.
- The costs for changing the oil and the associated downtime quadrupled.
- Additional, avoidable CO₂ emissions generated during the production, transport, and disposal of engine oils.

Based on the initial situation, the freight forwarder and OELCHECK launched a trial in collaboration with the truck manufacturer.

Initial Situation	
Components:	
Four Euro 6D six-cylinder diesel engines in long-haul trucks	
Engine oil type:	
SAE 5W-30 based on polyalphaolefin and ester; meets the specifications ACEA E4, E6, E7, E9; API CJ-4; JASO DH-2	
Oil volume:	
41.5L per engine	
Costs for changing the engine oil	
Includes fresh oil, oil filter and labour	
According to the freight forwarder's specifications	€500

As part of the test, the engine oils in the four trucks with Euro 6D six-cylinder diesel engines were analysed in the OELCHECK lab every 5,000 kilometers. The limit values of the individual parameters were agreed with the vehicle manufacturer in advance. In this light, the following values came under particular scrutiny in the lab: any B100 fuel entry into the engine oils, a change in viscosity, oil oxidation and wear parameters. The short analysis intervals of 5,000 kilometers acted as a safeguard so we could intervene at short notice should serious deviations be detected and therefore avoid significant damage to the engines.

Saving per truck with an extended oil change interval after 90,000 kilometres	
Previous costs for two oil changes every 60,000 kilometres 2 × €500	€1,000
/ Current costs an extended oil change interval after 90,000 kilometres	€500
Annual cost savings per truck	€500

** Values are approximate and rounded*

In all four trucks, the engine oils reached the 30,000-kilometre milestone – the point at which an oil change would otherwise have been due, according to the manufacturer's instructions – without presenting any issues. The oil quality also returned good results at that point. The oil showed signs of ageing in the following 30,000 kilometers (up to 60,000 kilometers). However, this proved to be within scope. As expected, the fuel content in the oil increased throughout the test. The fuel entry was only proven to be moderate in all four vehicles observed, and the viscosity did not change as a result. The limit values agreed with the manufacturer were never reached, while wear metals could only be detected in low concentrations.

The analysis data showed that the vehicles' oil should be changed every 90,000 kilometers. To be on the safe side, however, the vehicle manufacturer involved in the test approved extended oil service intervals of up to 65,000 kilometers based on the data established for the haulage vehicles used in long-haul transport.

The freight forwarder, which runs over 150 vehicles on biodiesel (B100), would save over 75,000 € in engine oil costs per year due to tripling the oil change intervals as determined by the oil analyses. In addition to the cheaper biodiesel costs, the forwarder would secure a much more favourable cost structure in the much-discussed freight forwarding industry as well as a better CO₂ balance. ■

About the Author

Mr. Stefan Mitterer, Business Director at OELCHECK GmbH, is a leading tribologist known for promoting sustainable practices in industrial lubrication. With a wealth of expertise and a robust background in engineering, Stefan has steered technical service and sales divisions to new heights. With expertise in condition-based oil changes, he drives cost savings and minimizes the carbon footprint. Contact Mr. Stefan Mitterer at stm@oelcheck.de



Stefan Mitterer

Business Director, Technology | OELCHECK GmbH



MANGROVE PROTECTION AND CONSERVATION



Encroachment removal in sensitive mangrove areas in and around Mumbai

Mangrove demarcation and fencing at several sensitive mangrove sites



Installation of CCTV cameras is planned in sensitive mangrove areas



Maharashtra Security Force staff has been deployed at sensitive mangrove areas



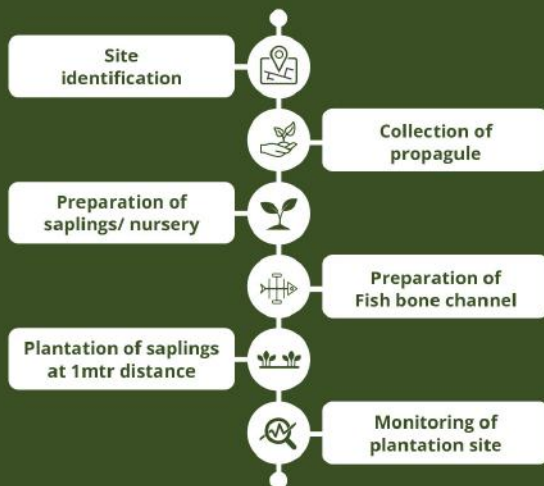
Legal action and seizure of vehicles dumping debris in mangrove areas

Regular cleanups are arranged to remove solid waste from mangrove areas



MANGROVE RESTORATION

MANGROVE PLANTATION PROCESS



≈ 1900 Ha. OF DEGRADED AND SPARSE MANGROVE AREAS HAS BEEN RESTORED

SCAN TO SEE VIDEO



MANGROVE AWARENESS PROGRAMMES

- SCHOOL AND COLLEGE EDUCATION PROGRAMME
- MARINE MATTERS LECTURE SERIES
- MANGROVE WALK AND BIRD TRAIL
- MARINE AWARENESS PROGRAMME
- WORKSHOP AND EXHIBITION
- CONSERVATION SAIL- BOARD GAME

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Source: Internet

Lubricant Condition Monitoring: Key to Equipment Reliability



The operational life of most industrial machinery is directly related to the contamination and chemistry of the lubricants."



The lubricating oil circulating around within an operating engine or machine is similar to the blood circulating within the living human body. Just as samples of the blood can be extracted and examined in a quest to identify the health state of the blood owner, samples of lubricating oil circulating around within a machine can also be indicative of the health of the machine. The advantage of monitoring lubricant is that the lubricant is highly likely to carry the evidence of faults from a variety of positions within the machine to some point where a monitor can be fitted or from where a sample can be drawn. Lubricant Analysis can be used for the following two purposes:

- Monitoring the condition of a Lubricant
- Monitoring the condition of the Equipment

Used Lubricant analysis is both proactive and predictive. The operational life of most industrial machinery is directly related to the

contamination and chemistry of the lubricants. By monitoring and reporting contamination issues, oil analysis is possibly the most valuable proactive condition monitoring technology available for improving equipment reliability. The following are the aims of Condition Monitoring of Lubricants -

- Determine Lubricant Condition / Quality
- Identify and quantify contaminants
- Optimize lubrication change interval
- Verify the equipment's abnormal condition
- Enhance the scheduling of repairs
- Enhance troubleshooting
- Monitor / Verify maintenance activities
- Develop complete profile history
- Aides in the equipment performance and replacement evaluation

Advanced Methods for Lubricant Condition Monitoring

Monitoring the condition of lubricants

is essential to ensure the smooth operation and longevity of machinery. For systems with less than 250 liters of lubricant, analytical testing may not be justified, and maintenance intervals are typically determined based on experience. However, in larger systems containing over 250 liters, regular testing becomes crucial to assess when the lubricant approaches the end of its useful service life. A combination of spot testing and laboratory analysis is recommended for comprehensive monitoring.

Spot Testing

Visual Test: Examine the lubricant's clarity and color. Both foaming (air and oil mixture) and emulsions (water and oil mixture) can render the oil opaque. Foaming is often caused by mechanical factors like excessive churning or high-pressure oil return impingement. It may be stabilized by certain contaminants. If excessive foam has no apparent mechanical cause, consider changing the oil.

Appearance when taken	Appearance after 1 hr.	Action to be taken
Clear	Clear	None
Opaque (1)	Clear	Cause of foaming to be sought (2)
	Clear with separated water layer	Check centrifuge function (4)
	Opaque	Check centrifuge function, Send for Lab test (5)
Dirty	Solids separated (6)	Check filter or Centrifuge, Send for Lab test (5)
Black (with smell)	No change	Send for Lab test (5)end

Fig 1: Visual test table

Odor Test: Oxidized or biodegraded oil tends to have an unpleasant smell, which can serve as an early indicator of lubricant degradation.

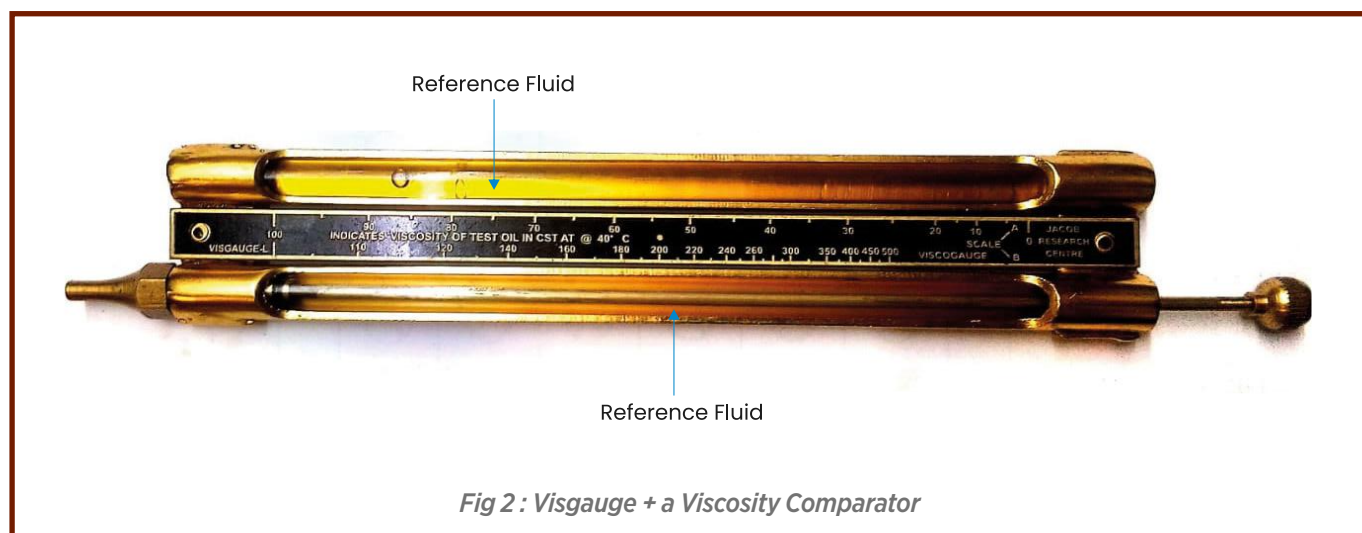


Fig 2: Viscogauge + a Viscosity Comparator



Early detection of issues through spot testing, including foaming, odor, viscosity, blotting, and crackle tests, can prevent costly breakdowns and extend equipment life."

Therefore, effective lubricant condition monitoring techniques are essential for maintaining machinery health. Early detection of issues through spot testing, including foaming, odor, viscosity, blotting, and crackle tests, can prevent costly breakdowns and extend equipment life. When dealing with larger systems, combining spot testing with laboratory analysis ensures a comprehensive approach to lubricant maintenance, helping industries achieve optimal performance and reliability.

Test	Type of oil	Action level
kinematic VISCOSITY at 40°C	Lube Oil	15% increase from new oil value (1)
Kinematic VISCOSITY at 100°C	Automotive Grade	15% increase from new oil value (1)
Water by distillation % volume	All	200 ppm
Flash Point	Auto/ Hyd	180° C min
TAN (Total Acid Number)	All	1 + TAN of new oil (2)4.0 Minimum
TBN (Total Base Number)	Automotive	4.0 Minimum
Sediment (% wt)	All	0.01 Maximum

Viscosity Comparison: Compare the lubricant's viscosity with that of new oil. A significant increase (around 15%) in viscosity may indicate degradation, warranting an oil change.

Blotting Test: Use this test to check for the presence of water and dirt in the lubricant, both of which can compromise its effectiveness.

Crackle Test: The hot-plate crackle test is a simple way to detect free and emulsified water, the most problematic forms of water in oil. It involves heating a drop of oil on a hot plate and observing the number and size of bubbles as water vaporizes.

Interpreting Results: If viscosity increases by 15% due to degradation, consider changing the oil. In cases where changes are caused by contamination or topping up with the wrong oil grade, different limits may apply. Acidity levels rise due to oxidation, which accelerates over time. While these acids aren't corrosive to equipment materials, measuring acidity provides valuable insights into lubricant conditions.

Techniques for In-Depth Equipment Health Evaluation

Monitoring equipment conditions is essential for optimizing machinery performance and preventing costly breakdowns. Three widely used techniques for this purpose are **Particle Counting**, **Spectroscopy**, and **Ferromgraphy**.

Particle Counting: Particle counting assesses wear particles and contaminants in lubricants, determining their concentration. ISO 4406 and NAS 1638 are two common standards for evaluating oil cleanliness levels. ISO 4406 uses cumulative counts, e.g., particles larger than 5 microns, while NAS 1638 employs differential counts, e.g., particles between 5 and 15 microns. An increase by one code level represents a doubling of particle counts. ISO 4406 distinguishes between silting (particles smaller than 5 microns) and wear catalysts (particles larger than 15 microns).

Spectrometric Elemental Analysis: Spectroscopy identifies elements (wear particles, contaminants, and additives) in lubricants and quantifies their concentrations in parts per million (ppm). Monitoring 22 elements associated with wear metals (e.g., iron, copper), lubricant contaminants (e.g., silicon, boron), and additive depletion (e.g., phosphorous, zinc) helps in assessing lubricant health. This technique is effective for small particles but may not accurately detect severe wear particles larger than 10 microns.

Range Number	Micron	Actual particle count range (per ml)
18	+2	1300-2500
16	+5	320-640
13	+15	40-80

Ferrography: Ferrography provides a comprehensive analysis of wear particles ranging in size from 1 to 250 microns, offering early indications of abnormal wear. It also identifies the wearing component and the cause and severity of wear. There are two components of ferrography: direct-reading ferrography and analytical ferrography. Direct-reading ferrography screens for wear issues quickly, while analytical ferrography offers in-depth analysis.

Integrating Vibration and Oil Analysis for Machine Condition Monitoring

Vibration analysis and oil analysis are pivotal techniques for assessing the health of machinery, often chosen by industries like power generation, petrochemicals, and steel. While each technique offers unique advantages, its true power is unleashed when integrated into a unified condition monitoring program.

Advantages of Oil Analysis: Oil analysis stands out for providing early and direct insights into wear modes and machinery conditions. It serves as a leading indicator of active machine wear, surpassing even vibration analysis in some cases. Additionally, it excels in monitoring low-speed machinery, where vibration analysis may be challenging. However, oil analysis alone may not unveil all failure mechanisms comprehensively.

Vibration Analysis Strengths: Vibration analysis is highly effective in detecting faults in high-speed journal-bearing systems and localizing the point of failure. It complements oil analysis by pinpointing specific issues in these systems. Nevertheless, it may not always provide insights into the wear mechanisms inducing failure.

The Synergy of Both Techniques: The combination of oil analysis and vibration analysis has proven to be a winning strategy for comprehensive machine condition monitoring. These techniques often serve as leading and confirming indicators of machine failure. Oil analysis excels in gearboxes, hydraulic systems, and reciprocating equipment, while vibration analysis shines in high-speed journal-bearing systems.

Effective Root Cause Analysis: Together, they offer an enhanced ability to determine the root causes of failure. Oil analysis excels at identifying wear mechanisms, while vibration analysis aids in localizing the failure point. This combined approach helps in diagnosing and addressing machine health issues more effectively.

Correlation and Conclusion: Overall, oil analysis and vibration analysis correlate well, providing a holistic view of the machine's condition. Although there are instances of contradictory results, the synergy of these techniques is indispensable in controlling the root causes of machine

failure and ensuring optimal machinery performance. In essence, integrating these two techniques is a game-changer in the realm of predictive maintenance, delivering significant benefits in terms of cost savings and enhanced reliability.

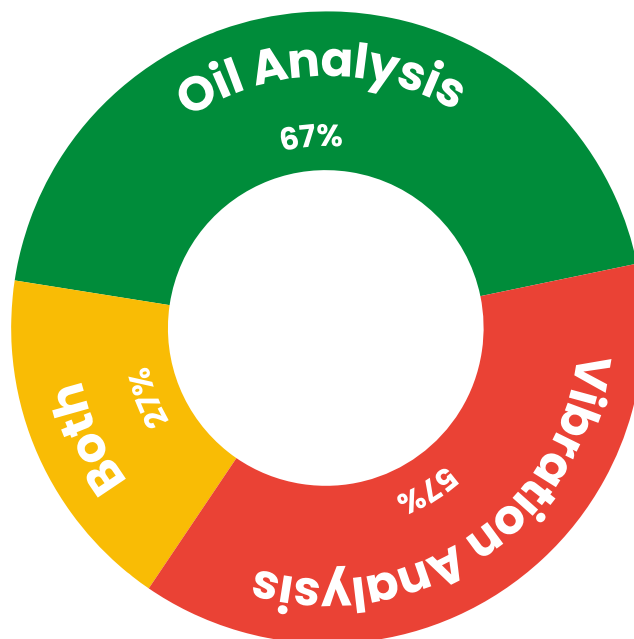


Fig 3: Bearing Fault Detection 750 Machines

One notable example is the Palo Verde Nuclear Generating Station, which successfully combined both techniques into a unified group, resulting in remarkable cost savings of approximately \$3.7 million in just one year. The fusion of oil analysis and vibration analysis is a best practice that continues to gain traction across various industries, leading to more proactive and effective machine condition monitoring.

Condition Monitoring of Bearing Lubrication

Whether the bearing has sufficient lubrication or not, can be found out by two techniques:

- Shock Pulse Measurement
- Acoustic Emission Monitoring

1. Shock Pulse Measurement: The difference between SPM and Vibration Measurement can be illustrated by showing what happens when a falling metal ball strikes a metal bar. At the moment of impact, the colliding molecules will cause a pressure wave to spread through both bodies. The magnitude of this wave is a function of the speed of the colliding bodies. It is independent of their masses and shapes. The SPM method analyses the first stage event, the “shock pulse” traveling through the material of the bar. The impact will then cause the bar to vibrate. This vibration is a function of the speed, mass, and shape of



Substantial life improvement in bearing life can be achieved by monitoring both particle and oil contamination and controlling it within the desired limit."

the bodies. Vibration measurement is used to measure the movement of the bar. When hit by a shock wave, a shock pulse transducer responds at its own resonance frequency of 32 kHz. It will magnify the high-frequency shock signal, while all machine vibration is filtered out. The output of the shock pulse transducer is a rapid sequence of electric pulses, proportional to the amplitudes of the shock waves. Shock pulses are measured on a decibel scale (dBsv= decibel shock value). The absolute shock pulse level of a bearing, measured in dBsv, is both a function of rolling velocity and of bearing condition. To neutralize the effect of moving velocity on the measured value, the instrument has to be programmed with:

- Shaft diameter (in millimeters or inch)
- Rotational speed (in rpm).

The instrument will then calculate the initial value dBi, the starting point of the condition scale for a particular bearing. The instrument takes a

sample count of the shock pulses occurring over a period of time and displays;

- The maximum value dBm for the relatively small number of strong shock pulses
- The carpet value dBc for the large number of weaker shock pulses.

The maximum value dBm defines the bearing's position on the condition scale. The difference between dBm and dBc is used for a finer analysis of the causes for reduced or bad conditions. An increase in dBc with dBm within the limit shows insufficient lubrication.

2. Acoustic Emission Monitoring: Acoustic monitoring has for many years been successfully utilized to monitor the condition of electrical systems and identify leaks in vacuum, compressed air, steam, and other fluid transfer operations. In recent years, more and more maintenance professionals have come to rely on this technology to monitor the condition of mechanical components and even monitor bearing lubrication conditions. The amount of noise produced by a lubricated bearing can be a useful indicator of the effectiveness of the lubricating film. Rolling element bearings typically employ an elastohydrodynamic lubricating film. In this type of lubrication, the loaded surfaces elastically deform and the load is carried by a film of oil sufficiently thick to prevent the interacting surfaces from contacting one another. At a microscopic level, the finished surfaces in the bearings present irregularities or bumps often referred to as asperities. When they collide, it generates noise which can be measured by the Acoustic Monitoring Device. In a properly lubricated bearing, these collisions should be few and, thus, generate a relatively low noise level, but as the grease in a bearing is "used up", the oil film begins to dissipate and the collisions become more frequent and create more noise. While it is certainly possible to hear this phenomenon with a stethoscope, the acoustic instruments allow it to be quantified and provide an objective interpretation of the sound levels. Based on the normal or baseline noise levels for a particular bearing, limits can be established that alert the technician to the precise time the bearing requires re-lubrication and even indicate when to stop applying grease to prevent over-lubrication. One such acoustic emission instrument is shown below. Distress readings are taken by the instrument. When bearings are found with a value >10, it is time to re-lubricate. The reduction in distress confirms the improvement. If there is no reduction in distress value after relubrication, it indicates bearing damage.

Benefits of Condition Monitoring of Lubricants

Lubricant analysis can be a first line of defense against catastrophic equipment failure. Condition Monitoring of lubricant can detect minor changes in the lubricant before they cause damage to the equipment, detect minor wear and corrosion problems before they cause major equipment damage, and identify contaminants so corrective action may be taken to eliminate these contaminants before they cause equipment damage. There are many examples where conditions monitoring of lubricants and corrective actions have given substantial benefits to the organization. At Chiba Mill of Kawasaki Steel Company Ltd., oil contamination control in the hydraulic system resulted in a 97% reduction in hydraulic system malfunctions over a period of 5 years. The piston pump's average life increased from 12 months - 24 months. Data given below shows, how bearing life is affected by both particle and water contamination. Substantial life improvement in bearing life can be achieved by monitoring both particle and oil contamination and controlling it within the desired limit.

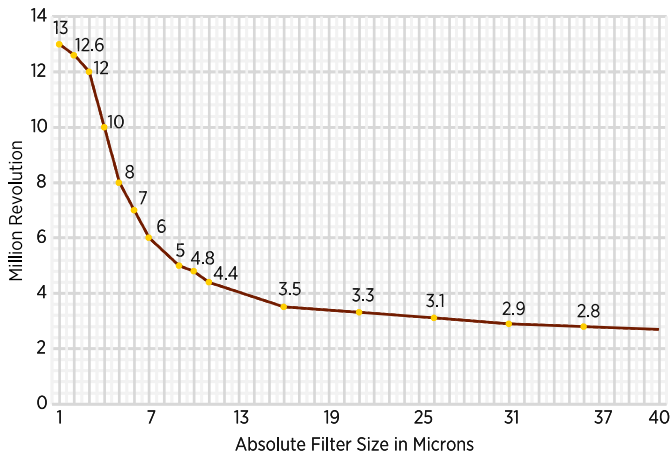


Fig 4: L50 Bearing Live vs Filtration Mesh Size

Lubricant SAE	
Water Concentration	Bearing Life
25	2.5
400	0.5
100	1.0

Fig 5 : Source: TIMKEN

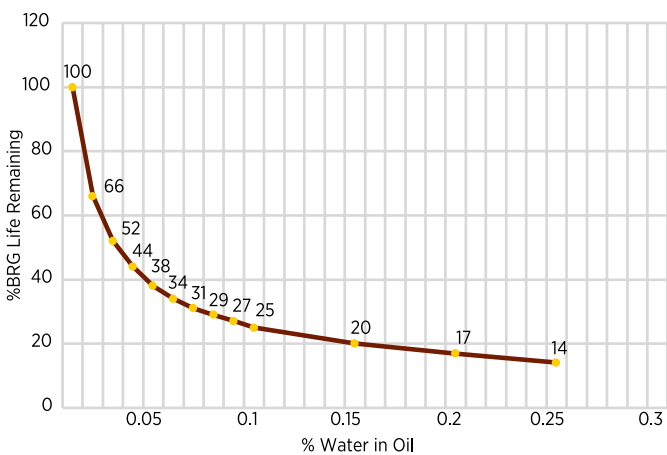
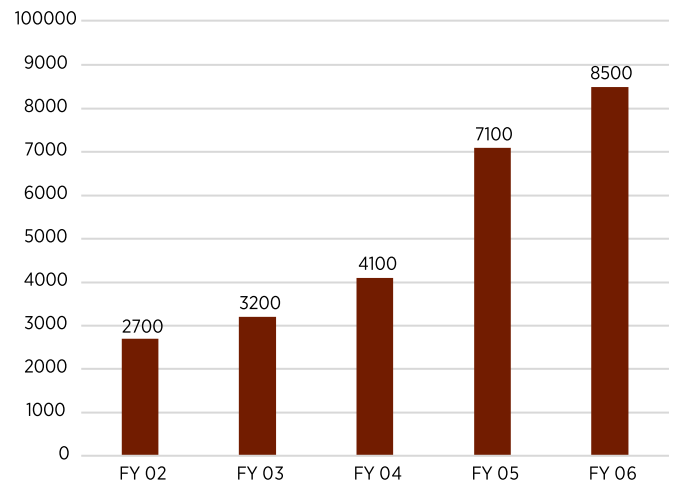


Fig 6 : Water Contamination vs Bearing Life

The oil analysis program at Tata Steel, West Bokaro, resulted in an improvement in engine life as given below.



One of the paper mills (Weyerhaeuser) reported an 80% reduction in bearing failures by improving oil cleanliness from 21/17 - 16/13 and moisture level from 400 - 500 ppm to 100 ppm.

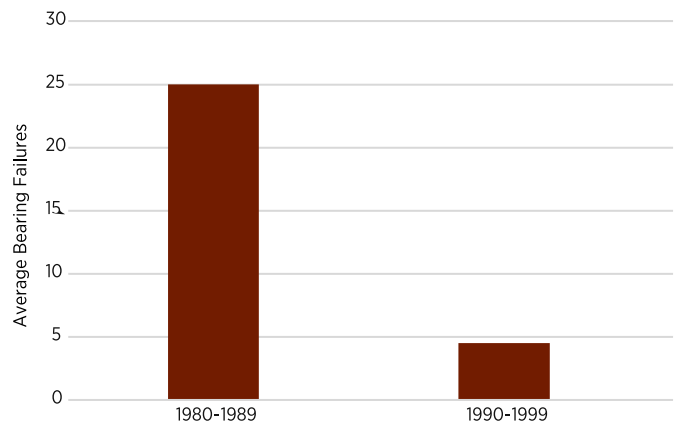


Fig 7 : Reduced Bearing Failures (Average Number Per Year)

About the Author

Mr. G.R.P. Singh with 34 years of steel plant maintenance expertise and a BE Mechanical Gold Medalist from BIT, Mesra, is deeply passionate about hydraulics, plant equipment condition monitoring, and root cause failure analysis. He actively contributes to his field by serving as the Secretary of the Condition Monitoring Society of India, Jamshedpur Chapter. He holds memberships in the Tribology Society of India and the Institution of Engineers. Currently, he plays a pivotal role at Tata Steel. Contact Mr. G.R.P. Singh at grpsin@tatasteel.com.



G.R.P. Singh
Head of the Quality Assurance Group | Tata Steel Ltd.

Companies have realized the importance of lubricant analysis as a means of reducing damage caused by wear or poor lubrication. Lubricant analysis helps to identify contamination, lubricant degradation, and abnormal machine wear. With the focus on enhanced asset reliability to avoid unscheduled machine downtime, condition monitoring of lubricants is growing to be an increasingly important aspect of every organization's predictive maintenance program. ■



Source: Internet

Cleaner Lubricant for Extended Equipment Performance: **Welcome to the future of Industrial Lubrication Management!**



MachineXT, a ground-breaking initiative by Mobil™, is set to redefine the way you perceive and manage lubricants in your industrial setting. Prepare to be amazed as we introduce you to cutting-edge filtration services that promise to elevate your machinery's performance to unprecedented levels. Say farewell to the hassles of traditional maintenance and embrace the arrival of MachineXT in your factory. Get ready for tailor-made

solutions that unlock unparalleled productivity and efficiency, furthering industrial excellence.

In the world of machinery and equipment, regular servicing and using high-quality lubricants are paramount for achieving peak performance. Quality Lubricants play a critical role in ensuring the efficient functioning of various mechanical systems.

India's machine tools segment is witnessing promising growth. Its market size is estimated at USD 100.63 billion in 2023, and it is expected to reach USD 116.19 billion by 2028, growing at a CAGR of 2.92 percent during the forecast period (2023-2028). With this promising growth, the machine tool segment in India encompasses a wide range of equipment, necessitating the use of superior lubrication solutions, timely servicing, and upkeep for unhindered operations.

THE CRUCIAL ROLE OF REGULAR SERVICING

Despite its potential, the machine tools segment encounters some challenges in the adoption of technology. The increasing complexity of equipment demands skilled operators who can effectively operate and maintain these advanced tools. Workshop operators encounter their own set of challenges, including inadequate maintenance practices, inefficient lubricant management, and suboptimal machine health. These factors contribute to reduced performance, increased downtime, and higher maintenance costs. Overcoming these challenges requires comprehensive solutions that address the specific needs of operators.

Maintaining machines through regular servicing and proper lubrication is vital for optimal performance. Quality lubricants play an imperative role in preserving machine health by reducing friction, dissipating heat, preventing wear and tear, and ensuring efficient functioning.

Based on a comprehensive understanding of the challenges faced by the machine tool segment, Mobil has developed MachineXT – a remarkable transformation in managing equipment performance with state-of-the-art mobile filtration services. MachineXT offers tailor-made solutions that will unlock unparalleled productivity and efficiency, furthering industrial excellence.

THE REVOLUTIONARY TECHNOLOGIES

1. Oil Filtration System: A high-end technology machine popularly used for superfine 3 stage solid filtration (fine solid particle removal) of lubricants. This machine is equipped with a sensor which can determine the cleanliness level of oil before and after the filtration. This machine can filter lubricants upto NAS 6 levels easily.

Types of lubricants which can be cleaned (32cst to 320cst Mineral & Synthetic lubricants)

Features:

- 20 LPM Pump
- NAS sensor
- Pleated inorganic filters with high beta ratio (> 200)



2. Low Vacuum Dehydration System: A high-end technology machine popularly used for dehydration of lubricants. This technique is used for removal of moisture content from the oil which is present in three forms:

- Dissolved
- Emulsified
- Free form

The technology evolves around the fact that water boiling point is 100°C, when the vapor pressure above the water surface is atmospheric pressure. But when we reduce the vapor pressure to a vacuum condition say 750 torr, it's evident that the boiling point of water reduces from 100°C to 60°C. Under this technique, there is a vacuumed chamber and a shower arrangement for the oil (mixed with moisture). There is a heater arrangement which heats up the oil under controlled temperature settings of maximum 60°C, when the heated oil is showered inside the vacuum chamber which is controlled at 750 torr vacuum, moisture particles would be evaporated or vaporised under the vacuumed conditions thereby separating the moisture from the oil. Clean oil is collected at the bottom of the chamber and delivered into the system using a delivery power.



Features:

- Moisture Removal Capacity of < 150 PPM.
- It does not involve any consumables because of rotating parts.
- Uses Mechanical Gear Pumps
- In-Built Temperature Control Device
- Fits externally to the Oil Reservoir.

3. Coolant Sump Cleaner: Its powerful two-stage vacuum blower creates a vacuum in the unit's tank that sucks in coolant, metal chips, swarfs, etc. from the coolant tank, passing it through a stainless steel mesh basket.

Features:

- No filter element
- No replacement cost
- Improved product finish
- Reduced coolant consumption
- Extended coolant change period
- Reduced machine downtime
- Reduced pollution & environmental impact
- Reduced storage and disposal cost of waste coolant

Applications:

- CNC/VMC Machines

- Soluble cutting oil
- Neat cutting oil
- Water emulsion
- Quenching oil
- Storage tanks

4. Tramp Oil Separator: Its built-in air-operated diaphragm pump sucks contaminated coolant from the CNC machine's sump. It flows through a stainless steel strainer. As the coolant flows further through a molded honeycomb device, it is separated by tramp oil by surface tension which is collected in a tray and clean coolant flows back to the CNC machine sump.

Features:

- No replacement cost
- Improved product finish
- Reduced machine downtime
- Reduced coolant consumption
- Extended coolant change period
- Disinfection & Deodorization of coolant
- Reduced pollution & environmental impact
- Reduced storage & disposal cost of waste oil

5. On-Site Testing Services: MachineXT also provides the MobilServSM Lubricant Analysis (MSLA) and MobilServSM Grease Analysis (MSGGA) suite of comprehensive services that assess lubricant conditions, contamination levels, and potential issues. MSLA can save as much as 66 percent of sampling time while providing the lubricant oil analysis needed to keep the equipment productive and minimize costly repairs. MSGGA can offer additional insights that will enhance equipment life. It can conduct six tests from one gram of grease sample. This convenient exercise enables problem identification before occurrence, minimizing unscheduled downtime to improve productivity throughout. The testing services include lubricant viscosity testing, pH testing, patch test, water crackle test, chloride test, and refractometers. These services provide essential insights into key parameters, ensuring equipment performance and durability. Through these on-site testing services, MachineXT empowers businesses to monitor and optimize their lubricants and coolants effectively.

CONCLUSION

In essence, MachineXT isn't just a lubrication management solution; it's a revolution in industrial excellence. Say goodbye to traditional maintenance hassles and welcome the future of industrial lubrication management. MachineXT is poised to elevate your machinery's performance, setting new standards in productivity, efficiency, and longevity. Embrace the future with MachineXT - where innovation meets industrial brilliance! ■

Applications:



Manufacturing Industry- Plastic & Machine Shop Industry



Steel Industry



Cement Industry



Mining & Construction Industry



Energy Industry-Coal based power plants, Wind turbines, hydroelectric turbines etc



Pulp & paper plants

Types of lubricants which can be cleaned (32cst to 320cst Mineral & Synthetic lubricants)

- Hydraulic Oil
- Gear Oil
- Engine Oil
- Turbine Oil
- Circulating Oil





with **Mr. Phil Keep**
 Managing Director - MP Filtri U.K. Ltd.

“ Mr. Phil Keep with an impressive 55-year career in the hydraulics industry, is a seasoned professional known for his invaluable contributions. His journey began as an apprentice at the Plessy company, where he honed his expertise in hydraulic pump and valve design and development. Phil's career took a dynamic turn when he transitioned into sales and marketing roles with prominent companies like Parker and UCC, focusing on promoting a comprehensive range of hydraulic components in both the UK and export markets. In a conversation with MAINTONIA Magazine, Mr. Phil Keep talks about MP Filtri and his inspiring journey in the industry.

33 years ago, Mr. Phil embarked on a remarkable chapter of MP Filtri with the goal of expanding the company's presence in the UK and Ireland. His dedication led to the development of a range of contamination monitoring products for the global fluid industries, a venture that has achieved remarkable success. Phil's influence extends beyond the corporate realm, as he served as a director of the BFPA (British Fluid Power Association) and currently holds the prestigious position of UK Chairman for the ISO 131/WG2 committee, shaping contamination control standards. His enduring commitment and wealth of experience continue to drive growth and excellence for MP Filtri and the broader hydraulics industry.”

During your over 30-year tenure as Managing Director of MP Filtri UK Ltd, what key strategies or initiatives did you implement to transform the company from a small distribution operation into an international market leader?

MP Filtri was born in the UK 32 years ago, just with two people: Myself and Sophie Fisher. We started with importing the standard range of MP Filtri hydraulic filtration products from our headquarters in Italy. At that time our colleagues at headquarters were making major investments in a foundry for aluminium castings; full machining facilities; a complete research and development laboratory; and manufacturing all our filter products and plastic products for accessories. A cornerstone ambition for MP Filtri in Italy was to become an ISO-classified manufacturing company, which actually encompasses all of the manufacturing and design activities you see with the complete range of products. So, we started initially just importing those core products. As time went on, we realised there were more opportunities available in the industry than just marketing and selling hydraulic filters; Bell housing, couplings, and Accessories. The Pasotto family who own and run the company allowed me to design and develop, with a small team, a range of contamination monitoring products so we could better explain to customers in the marketplace the importance of contamination control, which is exactly what Minimac is doing in the Indian end-user market.

What were the challenges and obstacles MP Filtri

faced during the journey of becoming the market leader, and how did the company overcome them?

The challenge was like any other company i.e., to put together the right team. We have a small team of top people, along with a top consultant who's been with us for 25 years. Sophie Fisher has been with the company since day one and is currently Operations Director. We have a dedicated engineering team and a marketing team and are fortunate to have key team members with extensive experience and knowledge of the market in UK Sales Director Chris Durkin and CMP Product Manager Geoff Grant. We thought that our first product, the LPA2, would be the only product for us, but as we've grown and we've responded to market demands. We are proud to have designed, manufactured, and delivered some extremely innovative technology products within the contamination monitoring sector.

Throw some light on the newly launched mobile filtration unit UFM015.

It is one of the new products to be offered to the market. It is what Minimac is doing in a different way - providing customers with solutions for contamination control of existing equipment so that you can clean and separate water from oil or whatever you want to do in terms of ensuring the reliability of systems. The UFM015 unit is a small fluid transfer unit designed for small to medium-sized applications where it's really important that we actually fill systems with a certain cleanliness of fluid. And also when we empty systems we can take the oil back out. When the oil is coming out from a barrel, we want to make sure that we're filtering the oil on the way into the system.

Could you provide more details about the expansion of MP Filtri UK Ltd. - including the move to a high-tech production facility? What are the goals and objectives associated with this expansion?

We started 32 years ago with two people in the UK and now we have 62 people. We have a sales turnover this year of 15M pounds and 65%-70% of the business is actually the filtration and accessories products for the UK market, mostly in the mobile construction and industrial offshore marketplace. Around 35% is in the design, manufacture, production, and calibration of CMP products. And there we have enjoyed substantial growth. We have a team of 12 people working at our new state-of-the-art facility in Worcestershire, UK. We have automated, semi-automated test benches, and automated calibration for these types of products.

Outline your vision for sustainability and corporate social responsibility in the Oil and Gas sector.

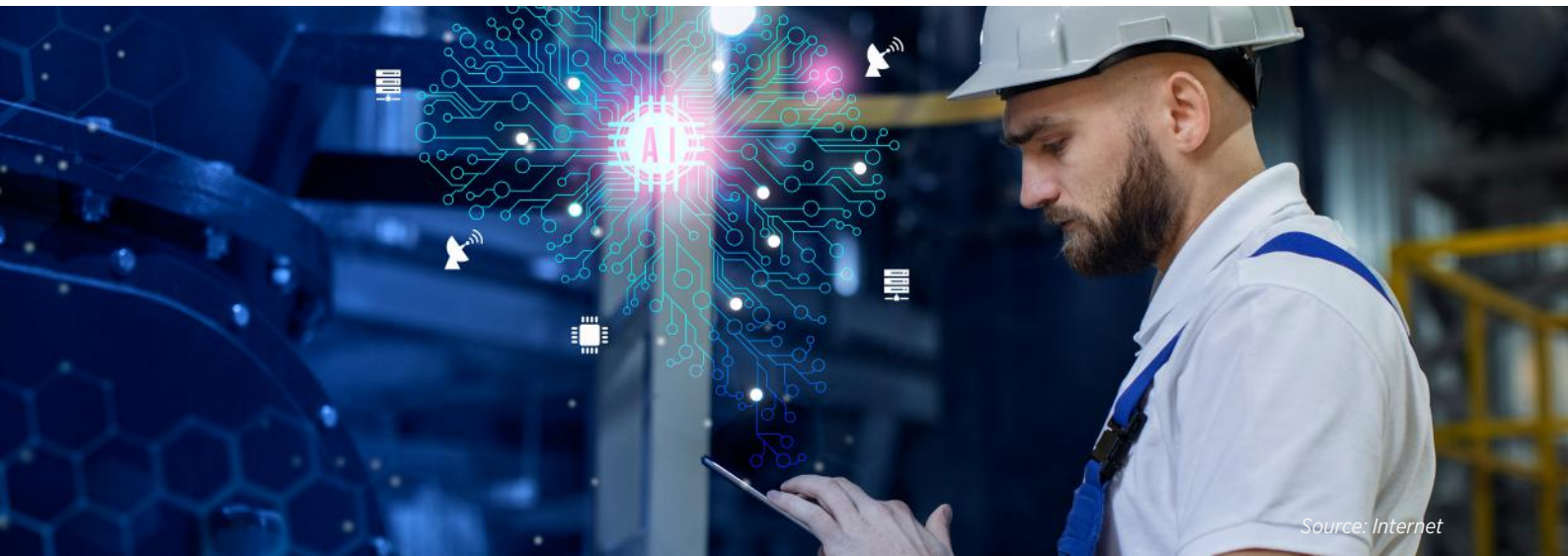
This is a difficult question because on the one hand, India is one of the biggest contributors along with China, and the USA is actually doing a lot more now in reducing emissions. India is still a large emitter because of its history and socio-economic situation, it is still burning fossil fuels. One of the things we try to do with the oil and gas industry is to try to install much better systems with more efficient filtration and contamination monitoring products. The actual equipment we have lasts longer, cost and reliability are much better - so there's a positive impact on the environment because there is much more efficient usage of fossil fuels.

You received the BFPA Lifetime Achievement Award in 2019. Can you provide more details about the specific contributions and achievements that made you receive that prestigious award?

Well, I've always been in the hydraulic industry. 55 years ago, I did my training with gear pump manufacturing and then I moved to a sales and marketing role with filtration products. And over the years I have worked for three or four companies (the main ones being UCC & Parker). I settled on MP Filtri so we could build our brand, our philosophy of sales and marketing products, and our philosophy of designing and manufacturing CMP products. Along the way, those milestones I guess have been recognized in building a company from nothing to something special. For 15 years I have served as a Director of the BFPA (British Fluid Power Association) and I am also the UK Chairman of the International Standards Organization, the ISO Committee for Contamination Control, which actually is a part-time role, setting and examining standards, including ISO 11171 calibration standard.

Is there anything you would like to add about the future plans/goals of MP Filtri?

MP Filtri is still and will always be a family company. The great thing that MP Filtri has always done is invested in new facilities, manufacturing, and up-to-date practices. The next goal for both the company and the Pasotto family is to grow our market share globally. One of the things that we've done is to make sure that we invest properly in India where we have the right people, and the right facilities to enable us to grow. We've just set up a small operation in Dubai for the Middle East area, which is a really big growth area. We've also set up an office and warehouse facility in Singapore. So we now have 12 branches globally and the rest of the world is served by MP Filtri's distribution network. The future plan is that we control our own destiny by having our own people, and our own branches, and sharing knowledge and expertise by promoting contamination control philosophy to all our staff and customers. ■



Source: Internet

Smart Solutions for Smoother Operations: Oil Analysis, Condition Monitoring, and Sensors



The flash point can't provide a percent of fuel contamination and the hot plate could only detect water from 1000 ppm - 5000 ppm."



OIL ANALYSIS

Tribology is the study of friction, wear, and lubrication. It is the science of interacting surfaces in relative motion. In the mid-1940s the Denver and Rio Grande Railroad began the start of oil condition monitoring of Diesel Engine Oil. It began with spectroscopy – elemental analysis to detect wear metal and monitor trends. Around 1955 U.S. and Naval Armed Forces established (the JOAP) Joint Oil Analysis Program which determined how useful the monitoring of wear trends helped with maintenance. Each had its own in-house oil analysis monitoring program. It was not until the 1960s that the first commercial lab was established in Oakland California by Edward Forgeron. This gave companies that have various assets an opportunity to launch their own program and partner up with these commercial labs to begin their journey to cost savings. This was a game changer for companies that were spending hundreds of thousands to millions a year on maintenance repair costs and loss in production.



Fig 1 : (Denver and Rio Grande Western Railroad)

The first tests established to monitor oil condition began with elemental analysis to check for wear, and blotter tests to check for soot, dispersancy, and glycol contamination. Hot plates were a quick way to detect water contamination. A flash point was used to check for fuel dilution or contamination with a more volatile fluid. However, each of these tests did come with its own limitations, while blotter test was a quick way to check fluid conditions, couldn't quantify how much soot or glycol contamination was present. The flash point can't provide a percent of fuel

contamination and the hot plate could only detect water from 1000 ppm - 5000 ppm. Viscosity analysis for both 40°C and 100°C were also common evaluated properties. To this day these tests are still utilized for quick checks and field testing. It is recommended that a sample be taken and sent to an accredited laboratory to verify.

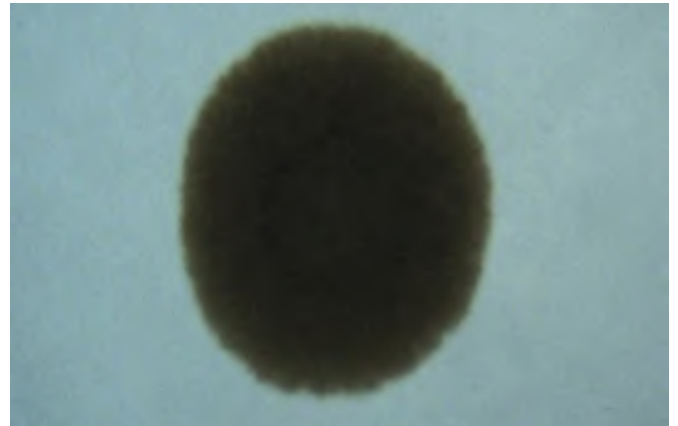
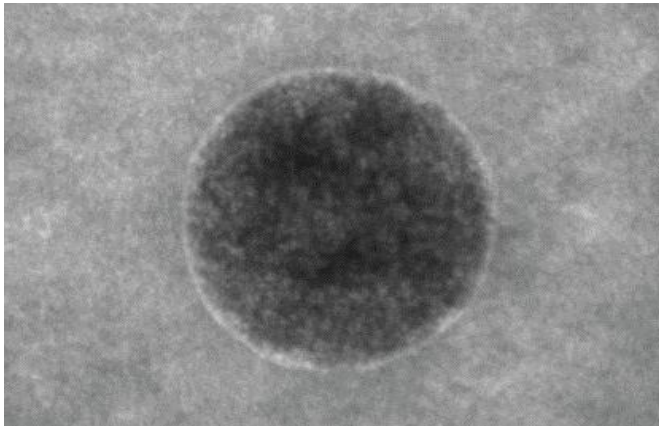


Fig 2 : (blotter test courtesy – POLARIS Laboratories)

Over time, more test methods were introduced such as Karl Fischer – which can accurately detect water contamination in ppm or percent, acid and base numbers can check for fluid degradation, and gas chromatography is utilized to detect fuel dilution in percentage. Furthermore, test methods began to expand to other fluid types; gear, hydraulic, compressor, and turbine to name a few. This required new test methods to be introduced such as particle count – to check for fluid cleanliness, particle quantifier for ferrous wear, water separability characteristics, foam, air release, and vibration analysis for misalignment or bearing failure, thermography analysis for hot spots, microscope analysis, as well as filter debris analysis, have been useful for root cause analysis (RCA). More advanced and specialty testing became necessary to further study the cause of wear. To date, there are useful tests, field tests, and data analytic tools to allow us to be more prescriptive and able to effectively monitor asset life.

Oil analysis has since expanded onto various fluid types, not just your standard oil. It's important to test and monitor all fluid types, for example, coolant analysis is crucial to ensure engine life longevity. It is said on average 40% - 60% of engine failures are related to poor coolant maintenance. Simply testing both your engine and coolant can extend the life of the engine and decrease maintenance costs. As the value in oil analysis continues to expand into different fluid types it's important to note that it's not just limited to oil. Oil is where it all began and since then it has expanded to coolant, diesel fuel, grease, metalworking, transformer, and fire-resistant glycols.

Each fluid type does require its own specific panel of testing. Like blood analysis, each fluid type has what you can call its own blood type. Each test must be specific to monitoring the fluids' properties and conditions. Ensuring the right panel of tests is being performed is extremely

important to managing your fluid analysis program.

CONDITION MONITORING

“It's not just data, it's what you do with it” POLARIS Laboratories®, now that testing is being conducted, what is next? The data in each sample report provides a story about the condition of the asset. It's important to have a basic understanding of what each test detects and its purpose. It is extremely important to provide as much information about the component type, manufacturer, and model as well as fluid manufacturer, product type, and grade. This information will help ensure the correct flagging criteria for both the component and fluid are being used for comparison on analysis. Missing information can lead to misinterpreted reports or missed opportunities to prevent failure.

So, let's take a look at some of the standard testing as well as advanced reliability analysis.

Elemental Analysis: Detects metals and reports them in ppm. There are 4 groups of metals that can be detected: **wear, contamination, multi-source, and additive metals.** **Wear metals** consisted of Iron, Chrome, Nickel, Aluminum, Copper, Lead, and Tin. **Contamination** consists of silicon, sodium, and potassium. Multi-source consists of manganese, molybdenum, antimony, lithium, and boron. **Additives consist** of calcium, magnesium, barium, phosphorus, and zinc.

Each element has its own source and purpose. Seeing an increase in wear metals can indicate specific areas of the asset that may be worn, for example – copper, lead, and tin can be bushing/thrust bearings. Silicon can be an abrasive material and can contribute to increased wear. Sodium and potassium can be coolant inhibitors, and multi-source metals can be alloys – steel alloy wear can be

a mix of chrome, nickel, manganese, molybdenum, and vanadium. In oil formulations phosphorus and zinc (ZDDP) are considered anti-wear properties to help protect against friction. It is important to note that elemental analysis methods do have size limitations. Different methods can vary in size and can detect up to an average of 8 - 10 microns.

Viscosity: A measure of fluids' resistance to flow. Viscosity is crucial in determining fluid film thickness. Ensuring the proper ISO or SAE grade is being used, the film thickness is what provides the proper boundary lubrication between two moving surfaces. A low viscosity can indicate more metal-to-metal contact with an increase in wear. Too high of viscosity can identify contamination or impact the fluidity of the oil and the capability of adequate boundary lubrication. Measuring the fluids' viscosity is key in ensuring a proper lubrication regime for the component. Viscosity can be measured at 40°C and 100°C.

Acid and Base Number: In most engine oils, magnesium and calcium function as detergents and dispersants - their role is to keep the engine clean, keep particles in suspension, and prevent them from agglomerating. They also have an alkalinity reserve which helps neutralize the acidic by-products of the oil. As the base number decreases the oil alkalinity reserve depletes and cannot neutralize the oil as effectively. The acid number is the opposite of the base number, it measures the formation of acids in the oil. An increase in acid number is an indication of oil degradation and oxidation.

Particle Count/ PQ Index: ISO 4406 - Particle Count measures how clean or dirty the oil is and can detect a range of particle sizes from 4 to 100. An overall ISO cleanliness code XX/XX/XX is reported at the following micron sizes - 4/6/14. ISO Cleanliness codes can range from 0 - 28, having a low ISO cleanliness code indicates the

fluid is clean. A high ISO cleanliness code can indicate severe particulate contamination in the form of filter media, wear particles, contamination such as abrasive, and on occasion rags or bugs. In systems that are high pressure and require fluid cleanliness it is recommended to do particle count. In non-filtered systems fluid cleanliness may be more difficult to obtain, therefore wear will be the main concern as well as contamination. PQ (Particle Quantifier) Index measures ferrous wear (iron) ; it has the capability to detect wear that is >5 microns in size. Both tests can be useful in detecting larger particles of wear or contamination. It is not recommended to use particle count on non-filtered systems.

These tests can be utilized to monitor asset conditions. Each of these tests can also be correlated to confirm a problem, then the necessary maintenance can be scheduled, and root cause analysis determined. For example, - high silicon, iron, and aluminum can indicate abrasive contamination which increases wear. Studies have found correlations between these 3 elements to determine wear due to abrasive contamination, action to check for the source of abrasive entry should be investigated as well as the severity of wear. Another example is between viscosity and base number, a decrease in base number can cause the viscosity to increase because as the oil oxidizes it thickens. The same logic can apply to acid numbers with viscosity as well, in this case, they will both increase. Viscosity can also decrease in the presence of fuel dilution, excessive fuel in the crankcase causes the viscosity to decrease. Diesel fuel has a viscosity range between 2 - 4 centi-Stokes (cSt), when mixed with oil it will cause the fluid film to thin causing metal-to-metal contact. Fuel dilution impacts other fluid properties such as base number and additives will also decrease.

Knowing the correlations and

limitations between other tests will help confirm an issue or lead to further advanced analysis. For example, a sample was taken and there was visible debris observed at the time, however, lab results came back normal for elemental analysis, and a high PQ was reported. Why is that? As stated earlier, elemental analysis has size limitations of 8 - 10 microns in size. Therefore, visible wear debris can range from 30 - 40 microns in size, since the wear particles were larger than the elemental analysis it was not able to detect those wear particles, however PQ did. Knowing this information may be useful in determining the type of testing needed to help with root cause analysis. Advanced reliability analysis has been proven to be extremely useful in having an in-depth understanding of failure or root cause. Below is a list of tests that focus on the study of particles, vibration, and thermography.

Analytical Ferrogram: Microscopic study of ferrous (iron) wear particles and contamination. Particles are separated from the oil and placed onto a slide. This test is recommended for components that are comprised of Iron, for example, gears, diesel, and unleaded gasoline engines, or sample analysis results with a high presence of iron wear. Ferrous debris analysis is meant to study the specific cut in wear - spalling, sliding, abrasive, or fatigue wear. Analytical Ferrography can detect contamination and rust that may not be detected via standard analysis. It is also useful to determine the root cause of wear and failure analysis and can even be used as a preventative measure to check for any early signs of wear.

Micropatch Analysis: Micropatch analysis is best used in looking for non-ferrous wear metals e.g., copper, lead, and tin. The oil is filtered through a 0.8-micron size filter. Wear particles are embedded between the filter patch and then analyzed. Micropatch analysis is recommended for turbines,

compressors, hydraulics, natural gas engines, or sample analysis results with a higher presence of non-ferrous wear. Micropatch analysis is capable of detecting wear, contamination, varnish, and micro-dieseling.

Filter Debris Analysis: In this test, particulate matter is removed from the filter media and studied in both micropatch and analytical Ferrogram Analysis. In-depth analysis of wear regime, failure analysis, root cause as

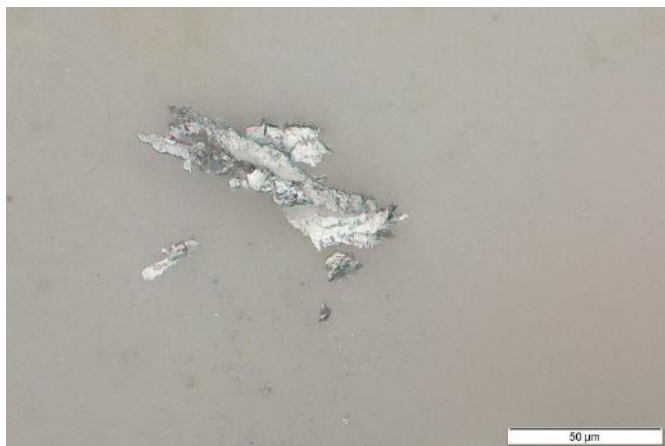


Fig 3 : (Ferrous Sliding Wear – Ferrogram analysis)

well as filter effectiveness. Filters are the kidneys in a component and hold a lot of useful data, so the next time you have a failure or need to check the health of an asset, test the filter and don't throw it away.

Below are some images (Fig 3, Fig 4) of microscope analysis and the types of wear and contamination that can be captured -

Varnish Analysis: The study of the potential of varnish within a Turbine, Hydraulic, or Compressor. Recommended on components that have a high operational temperature, are exposed to an electrical current, or tend to form varnish. Not detectable through standard testing.



Fig 4 : (Varnish and abrasive wear – micropatch analysis)

Vibration Analysis: Monitors change in vibration from a pre-established vibration signature. Each component will have a standard tolerance for vibration. Any increase in vibration can indicate an issue of misalignment or bearing failure.

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Sensors are a useful tool to assist with predictive and preventative maintenance."

Thermography Analysis: Checks for hot spots that can cause bearing failure or caused by varnish formation. Bearings will fail when exposed to higher temperatures. Varnish can also cause hot spots around bearings and heat exchangers. Varnish acts like an insulator, not allowing the heat to dissipate. Thermography analysis is important to monitor bearing life and help detect hot spots caused by varnish.

SENSOR TECHNOLOGY

Sensors are a useful tool to assist with predictive and preventative maintenance. They monitor particles, temperature, vibration, pressure, oil degradation, and power. Sensors are also useful in the early detection of failure, and changes in temperature and be used as early warning signs of a problem. If a sensor indicates an increase in temperature that can lead to further analysis such as thermography to detect hot spots and taking an oil sample to check for any wear as a result. Together they can be used to confirm a potential problem and catch it early to prevent failure. The data is typically monitored daily by maintenance personnel. There are different types of sensors out in the market meant to monitor specific areas to a period.

Vibration Sensors: Monitor the frequency, velocity, and acceleration

of vibration. These sensors can help monitor rotational equipment; each one has its own vibration signature. These sensors can help detect misalignments and help prevent failure. Useful in turbines, large circulation gearboxes, hydraulics, and compressors.

Power/Electrical Monitoring Sensors: Monitor changes or fluctuations in electrical current, voltage frequency, or energy consumption. Useful in power generation plants, transformers, and components exposed to electrical currents.

Particle Count Sensors: Monitor the overall cleanliness of the oil and can set target ISO code and set to alarm when ISO cleanliness code has been exceeded. Particle count sensors can help indicate an issue with wear or contamination and are useful in hydraulic, large circulation gearboxes, and turbines. Any component type where fluid cleanliness is essential to day-to-day operations would benefit from sensors.

Temperature Sensors: Monitor changes in operational temperatures that can lead to oxidation, hot spots, varnish, fires, and component failure. Temperature Sensors can even help detect leaks in HVAC systems or overheating problems and even

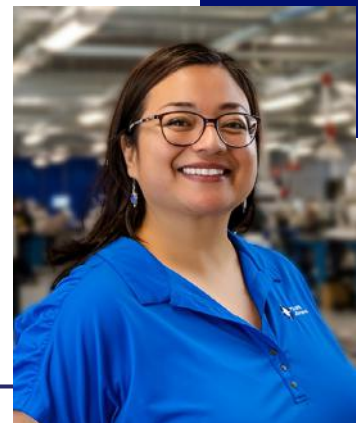
detect electrical issues as well. They are useful in various components where temperature control is essential to operations and fire prevention.

It is important to note that while sensors may be easy to install, not all are straightforward. It is suggested to consult with a sensor specialist to recommend a proper selection of sensors and assist with installation is key. There are other types of sensors that are battery-operated or wireless. Sensors are helpful to ensure the day-to-day operations are going smoothly, however, they are not meant to fully replace oil analysis. Sensors are an added tool used for condition monitoring but are not the end-all-be-all.

As the industry continues to change and shift into innovative technology, sustainability as well as data management. It's important to establish a fluid analysis management program that is diversified with condition monitoring, data management, and data connection. Closing the gap between sensor and telematics data is going to provide program managers with a 360-degree view of overall asset health and maintenance. Overall, the goal is to save on production loss, equipment downtime, maintenance, repair, and labor costs. ■

About the Author

Mrs. Elaine Hepley with 15 years of industry expertise, specializes in varnish analysis and leads a global team of 13 Data Analysts at POLARIS Laboratories®. As the in-house varnish subject matter expert, she has introduced advanced microscopic analysis to assess varnish formation and wear, offering valuable insights into system conditions. Active in the Society of Tribologists and Lubrication Engineers (STLE), Elaine currently chairs committees such as OMA, DEI, and Certification. She's also a board member and part of the LORV Chapter within STLE. Contact Mrs. Elaine Hepley at ehepley@polarislabs.com



Elaine Hepley
Data Analysis Manager | POLARIS Laboratories®

70-80% OF HYDRAULIC SYSTEM FAILURES ARE CAUSED BY PARTICLE CONTAMINATION

Protect your machines with effective Contamination control strategies

- **Fast, accurate, real-time hydraulic health-checks**
- **Reduces damage and downtime**
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- **Perfect protection for industry**
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LPA3



ICM 2.0



Comprehensive range of filters

PASSION TO PERFORM



with **Mr. Mika Perttula**
Co-Founder and CEO of Fluid Intelligence Oy.

“ Mr. Mika Perttula is a dynamic entrepreneur and visionary leader, serving as the Co-Founder and CEO of Fluid Intelligence Oy. With a remarkable career spanning over 25 years, he is dedicated to fostering innovation, new business solutions, and transformative growth. He possesses a unique blend of expertise in various fields, allowing him to drive digitalization benefits to heavy industries and the logistics sector through the groundbreaking industrial fluid performance optimization service, Fluid Eye®. Mika's passion for technology-driven solutions and his commitment to delivering measurable impact has positioned Fluid Intelligence Oy as a pioneering force in revolutionizing how industries manage and optimize industrial fluids. In a conversation with MAINTONIA magazine, Mr. Mika Perttula talks about condition monitoring and sustainable initiatives in the company.

Under his visionary leadership, Fluid Intelligence Oy has been instrumental in delivering the advantages of digitalization to heavy industries and the logistics sector through their groundbreaking service, Fluid Eye®. Mr. Mika Perttula's commitment to revolutionizing how industries manage and optimize industrial fluids reflects his unwavering passion for pioneering technology-driven sustainable solutions. ”

Can you provide us with an overview of Fluid Intelligence's core services in the field of oil analysis, condition monitoring, and sensor technology, and how these services contribute to the clean-tech industry?

Our core service is Fluid Eye®, an AI-based services platform to optimize fluid, machine, and process performance. This is complemented by our expert team services. Fluid Eye® services comprise of the following components - Carbon analysis with simulation and reporting, Health Scoring based on lab data, Real-time monitoring for fluid health and quality, and Fluid Reconditioning products and services. All the services are powered by our proprietary Oil Data Management solution. Fluid Eye® delivers a holistic enterprise and multi-fleet view of the assets' performance and carbon emissions with benchmarking. The platform also provides multi-organization services management, oil data management, and integration capabilities to our partners. Combining Real-time Monitoring with lab-data-based Health Scoring, Carbon Life Cycle Analysis, and Optimization Advice the service generates powerful insights into existing fluids & machines performance. These insights are used to optimize fluid performance, maximize its lifetime, and in this way minimize CO₂ emissions and costs.

What inspired you to enter the field of Heavy industry and industrial Fluid management?

Initially, our founding team met back in 2016.



Fluid Eye® delivers a holistic enterprise and multi-fleet view of the assets' performance and carbon emissions with benchmarking."

Our founders Mikko Oksanen and Viktor Laitinen had a long experience solving heavy industry customers' operational reliability problems and optimizing industrial fluids' performance. They witnessed many times unnecessary oil changes, maintenance work, and failures that could have been prevented with a proactive maintenance strategy. Their experiences of wasted resources and strong industrial domain expertise were combined with our other co-founders' (Eero Juustila CTO & CDO and myself) digitalization expertise and this way Fluid Intelligence's story got started and materialized as a Fluid Eye® service. We all share the same vision that industrial fluid performance management leads to notable sustainable and operational benefits and is an area where our actions directly contribute to heavy industry's Net Zero targets.

Fluid Intelligence aims to significantly reduce waste oil streams and enhance operational efficiency. Could you elaborate on this process which is supporting the sustainability goal while benefiting heavy industries and logistics?

That's a great and very important question. It may sound complicated but is fairly straightforward at the end of the day. As my colleague, Mikko says many times, minor steps lead to major changes and gains. Behind the process is open-mindedness and willingness to act early. Fluid Way is based on three main steps – Monitor, Analyze, and Optimize. First, it all starts with monitoring fluids and the machine's performance with real-time

and lab data. Some considerations here: Quality of the data is key for every later analysis. With poor or partial data you get poor analysis. We've paid a lot of attention and effort to this and developed an oil data management platform with my colleague Eero's lead to ensure high-quality analysis. Also, not all companies are digitally native and willing to take advantage of real-time monitoring. Still, we can extract a lot of information from existing lab data. Especially with larger assets we generate enterprise and fleet analysis that lets you see the forest for the trees and find the most problematic assets instantly. We can also benchmark a single component's Health Score to industry peers and gain insights into how you can perform better. And all this can be done without real-time data or sensors. So, there are options for how to start fluid performance optimization. Second, analysis is performed in our Analysis Engine. We base our analysis on existing customer data and our proprietary reference databases. Analysis can be a direct decision tree type rules model, multi-variate analysis, or algorithm-based analysis. Most of the analyses are automated but for example in Carbon Lifecycle Analysis, you can simulate future options. Third, our Advice Engine generates Optimization Advice automatically based on the analysis. It delivers written root-cause analysis with action recommendations and follow-up tasks for work orders. By repeating this process constantly and acting timely we find ourselves in a position where fluids and machines start performing better and we can start maximizing fluids' lifetimes. With

this we've been able to achieve -80% fluid-based CO₂ emission reductions with our customers lately.

The integration of AI and sensor technology is the key aspect of your Fluid Eye® industrial fluid asset management service. How does this combination enhance the accuracy and reliability of oil analysis and condition monitoring?

Compared to traditional oil analysis online monitoring delivers you a real-time heartbeat of the fluid and machine performance. It can be high-level indicative real-time measurement complementing lab analysis and a really good cost-effective option for many use cases. Alternatively, we can go as deep as real-time chemical parameters analysis. It's always case-dependent and relates to your business case. What is the asset criticality, fluid volume, downtime frequency, maintenance cost, etc. Context awareness is another point. There's a range of sensors measuring various parameters. Having knowledge and expertise of various industrial use cases, typical failure scenarios and so on it helps us to select the right sensor set for each case, and this way we increase the accuracy and reliability of our fluid asset analysis. Over time we have developed a strong oil data management model and reference databases. As AI analytics requires quality data this helps us to increase the accuracy and reliability of our analysis. We can identify anomalies very early in a cost-effective way.

Could you share a brief success story



Our fluid and reliability experts are constantly involved with our Oil Data Management, reference databases, Analysis, and Advice Engine development."

where Fluid Intelligence's solutions led to a significant improvement in the client's operational reliability or cost savings through effective oil analysis and condition monitoring?

I'd like to highlight our energy sector customer Vatajankosken Energia here. They have a gas engine in a remote location. Previously lab sampling interval was counted in weeks with a bi-monthly oil change interval. The process was costly due to frequent maintenance work and traveling to this remote location. Also, machine reliability was based on the lab-analysis information. In the beginning, we ran a detailed lab- and real-time data correlation analysis to set up a baseline for production performance monitoring. Since then, Fluid Eye® has been monitoring gas engine production 24/7 for several years. We've been able to triple the lifecycle of their oils, reduce costly lab sampling rounds, and improve operational reliability with real-time heartbeat of the engine's performance. This has led to over 60% CO₂ emission reduction and notable cost savings.

Predictive maintenance relies heavily on real-time condition monitoring and AI-powered analysis. How does Fluid Intelligence's methodology improve maintenance plans, resulting in less downtime and longer equipment lifespan?

We support our customers' and partners' journey to adopt proactive maintenance strategies. The foundation for this is being proactive and acting early. This approach is supported by timely monitoring, analysis, and actionable advice. All this leads to a situation where fluid-based problems are detected and overcome very early. It's much more cost-effective to prevent potential failure scenarios early before escalation. This lets our customers and partners move from time-based maintenance plans and overhauls towards a need-based

model and today we are witnessing less fluid-based maintenance downtimes. Machines also see longer lifetimes once we keep control of the fluid-based problems.

Fluid Intelligence also provides CO₂ simulation and reporting. What kind of impact have you witnessed in terms of carbon footprint reduction?

Indeed, we have introduced an automated CO₂ emission analysis and reporting model along with future emissions simulation capability. Looking back a few years and setting a placeholder to the date when we started to work with our customers and partners, we can see quite considerable impacts on carbon footprints. For example, our customer L&T, a leading Nordic circular economy company, has reduced their fluid-based emissions by over 80% since 2019 in their waste treatment facility's hydraulic crushers. Oil lifetimes have been extending considerably and no oil changes coming in the foreseeable future. Parallel to this reliability and cost-efficiency have been improving constantly.

Considering the complexity of AI-based analysis, how do you ensure that your expert advice database and professional services align with the specific needs and challenges of different industries that Fluid Intelligence serves?

The foundation for our analysis and reference database development came from the long-term experience our founders had accumulated by solving operational-level problems within many industries. This deep context-based understanding has helped us to steer our service development past years to keep our analysis value-adding and relevant. Our fluid and reliability experts are constantly involved with our Oil Data Management, reference databases, Analysis, and Advice Engine development. This way we are

constantly adding value to our customers and partners. My colleague Viktor puts it well, with Fluid Eye® fluid performance is analyzed by machines and overseen by experts.

What are your company's future goals in this rapidly advancing technological landscape?

Our customers have commented many times that they don't need any more data but solutions to their burning problems. This aligns well with our DNA and history of solving customers' and partners' problems on a daily basis. It also works as a guideline for our future goals and vision. We aim to strengthen the link between concrete operational reliability actions, digitalization, automation, and AI-based analytics, and this way deliver more relevant and value-adding advice. One day we may even see autonomous fluid performance optimization. By focusing on solving real-life customer problems, we keep our sight on the right issues rather than focusing on one specific technology development. Technologies and components develop so fast that mastering real-life customer needs to technical advances is where our team finds the most customer value. Parallel to this development we also push forward our Carbon Life Cycle Assessment models to better match future regulatory environments, automate

reporting, and help our customers and partners to adapt to this rapidly changing environment. More precise visibility of existing and future emissions accelerates carbon footprint reduction activities significantly.

What do you believe are the most critical qualities a leader should possess, and how do you embody these qualities as CEO?

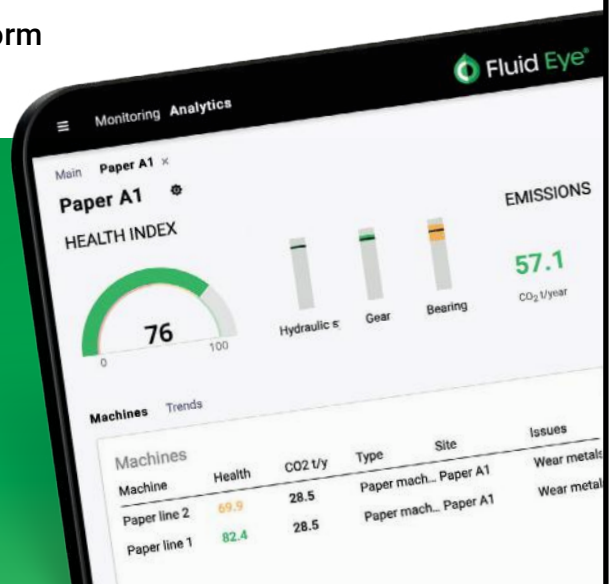
That's a broad question. Listening, vision, empowerment, and removing roadblocks are the first words to think of. Listening to your team, customers, partners, and market as a whole is a must-have quality for a leader. And understanding how things affect the direction where your organization is going. A clear vision and goals set together with your team is another important aspect that helps an organization to keep its focus and adapt to this constantly changing environment. Empowering your team and experts to do their work the best they can is yet another important theme. And removing roadblocks that may prevent them from achieving their targets. And back to listening, making sure you are bringing value to your customers and partners every day as otherwise, you'll become obsolete soon. In a small and dynamic growth organization, these are not always easy qualities and topics to foster, but I'm positive we are heading in the right direction every day. ■



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Source: Internet

Oil Quality Management: A Sustainable Approach to Machinery Maintenance



Any reduction in the viscosity during operation will result in a reduction in its load-bearing ability."



Lubricating oil plays an important role in the maintenance of machinery and equipment. Oil quality is critical to the reliability, operating cost, and lifespan of equipment. More than half of all machinery failures occur due to poor lubrication. This article seeks to emphasize the importance of oil and how it can be managed effectively.

Functions of Oil

Lubricating oil has the following main functions:

- Lubrication
- Remove heat to cool the system
- Carry contaminants to the filter
- In hydraulic systems, it also functions as a seal in control system components such as spool valves.

Lubricating oil must form a stable film between moving parts preventing metal-to-metal contact. Thus the oil needs to be viscous. Viscosity is related to its load-bearing capacity.

Any reduction in the viscosity during operation will result in a reduction in its load-bearing ability. Additives in oil ensure their usability for different applications. Anti-foaming, detergent, and extreme pressure are some common additives.

Importance of keeping oil clean

According to the US Bureau of Standards, oil does not mechanically wear out and thus, theoretically, can be used indefinitely. Yet, more than half of all machinery failures are attributed to bad oil or poor lubrication conditions. It is perhaps the most ignored commodity in any industry.

Oil contamination is primarily from four sources: generated in the system due to wear and tear, ingressed due to either leaking components in the system or bad maintenance practices, from fresh oil added to the system as top-up or contaminants that are left over (such as welding slag) after maintenance work.

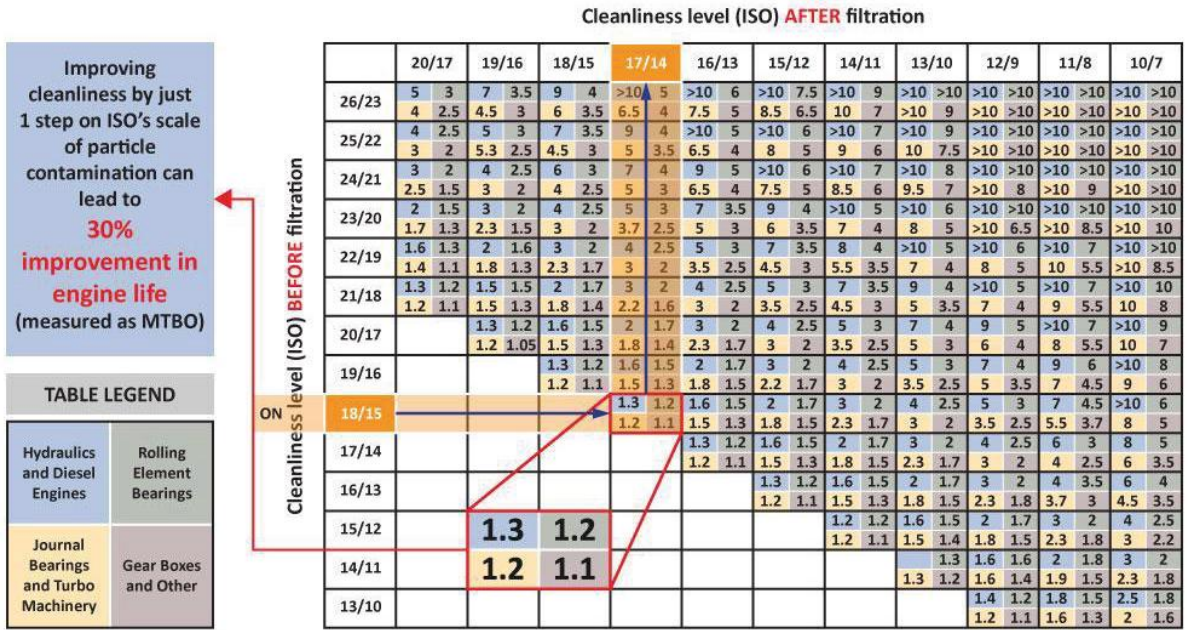


Fig 1 : shows how improving oil quality can have a direct bearing on the life of equipment components. As an example cleaning oil from 18/15/12 to 17/14/11 can increase the life of rolling bearing elements by a factor of 1.2, of Hydraulics and Diesel engines by a factor of 1.3, of Journal bearings by a factor of 1.2 and of Gear boxes by a factor of 1.1. (Source: Noria Corp.)

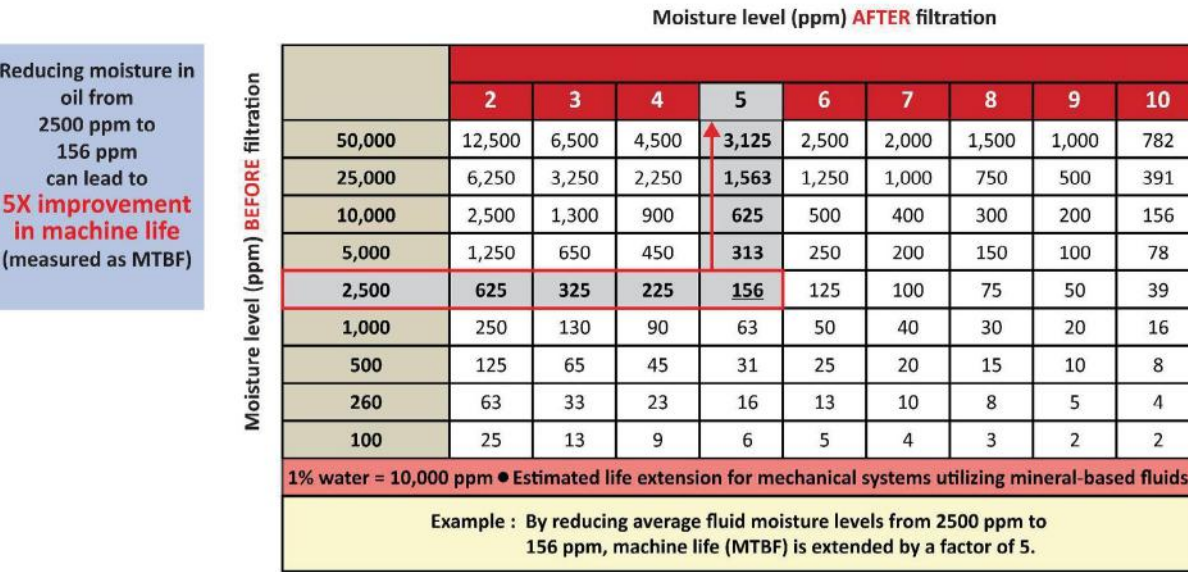


Fig 2 : shows the effect of moisture on oil life. As an example, keeping water contamination to less than 156 ppm as compared to 2500 ppm will enhance oil life by a factor of 5 times. (Source: Noria Corp.)

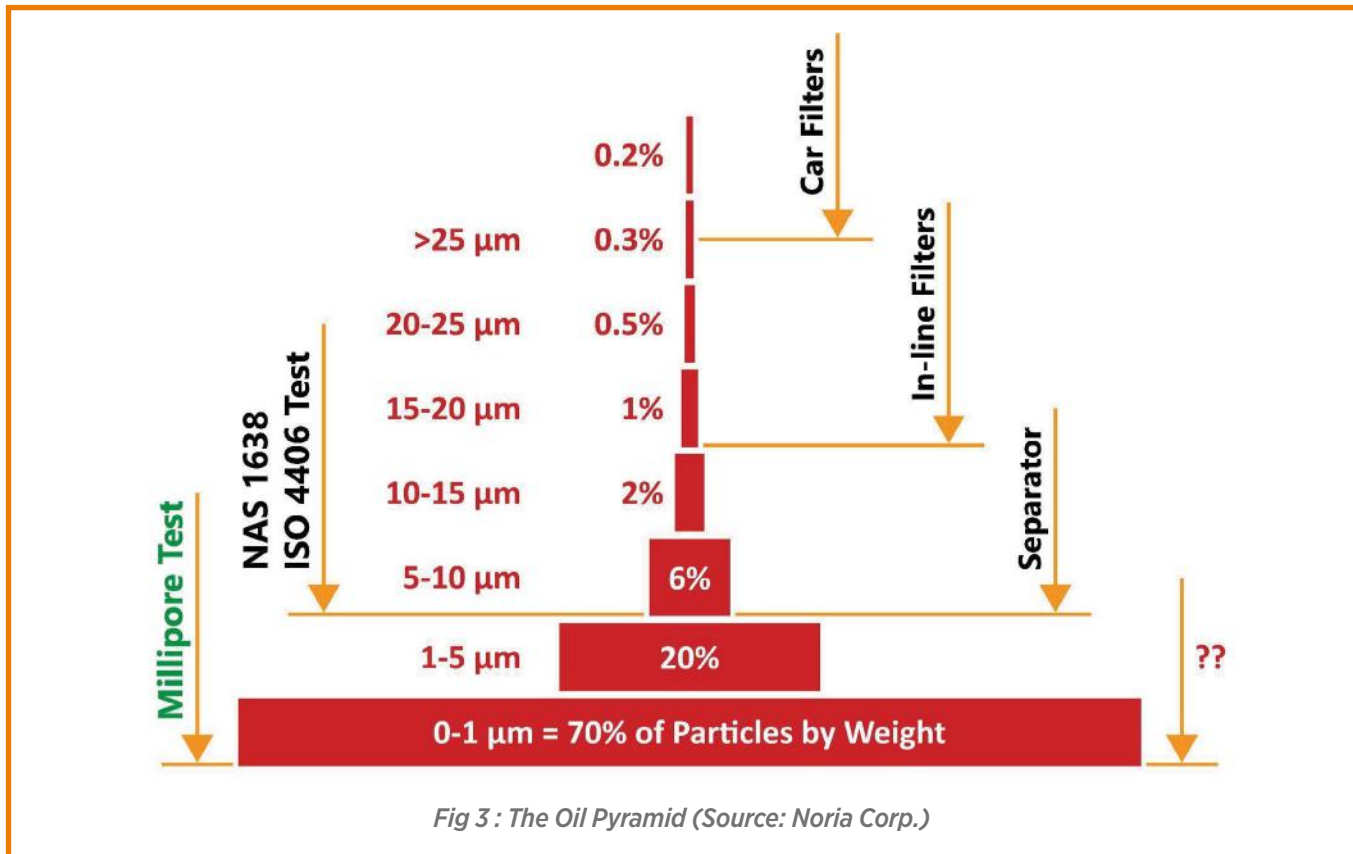
The Oil Pyramid

The old school of thought proposed that as long as the size of particulate matter in lubricating oil was considerably smaller than the clearances in moving parts, these particles were harmless and would simply pass through the system without causing much harm.

The Oil pyramid (Fig.3) shows, typically, the distribution of particles by size in lubricating oil. Over 90% of particulate

matter is < 5 microns and 70% of particulate matter is < 1 micron. Online and return line filters in engine and hydraulic circuits are typically 8 -12 microns. Centrifugal separators may remove particles up to 5-8 microns. Online filters thus do not trap almost 90% of the particulate matter in oil systems.

These small particles, < 5 microns in size, are the cause of concern to us. Small in size but with large surface areas; in the presence of heat, moisture, and pressure, they act as catalysts that promote oxidation. Oxidation is the nemesis of oil.



Stages of oxidation

(Fig. 4) explains the process of oil oxidation. Oxidation drastically deteriorates the oil quality, reduces its load-bearing capacity, and accelerates wear and tear. This in turn generates larger quantities of fine particulate matter, and the chain reaction continues.

The brown sludge that we observe in the bottom of hydraulic tanks is varnish and sludge, the products of oxidation. Diesel engine oils also oxidize, but in 4s engines the oil discolors quickly due to the soot from combustion products, and therefore varnish is not visible. Most control components in hydraulic systems 'fail' because of the hard brown colored varnish deposits on them which restrict free movement.

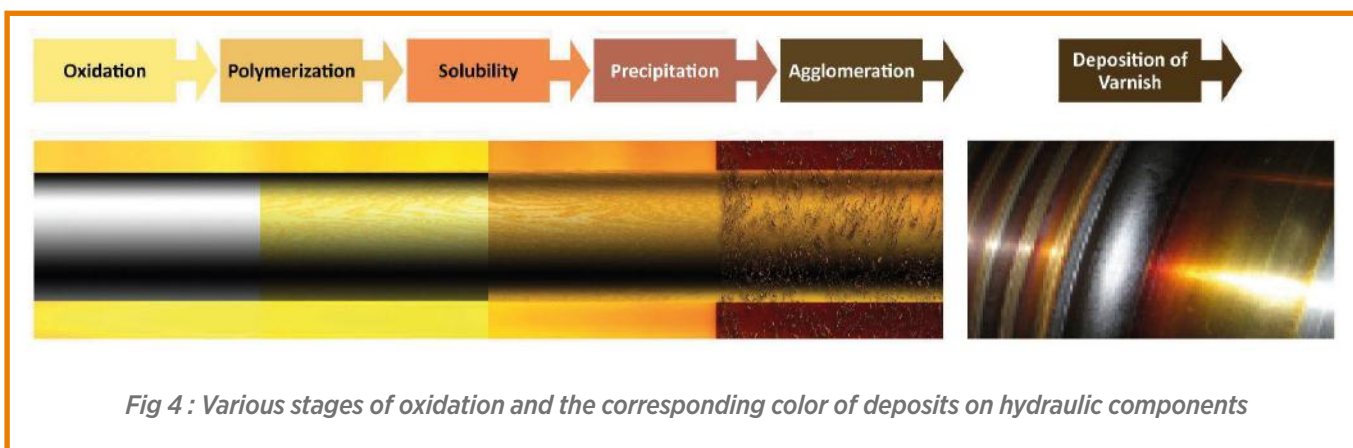




Fig 5 : Varnish deposits on spools (the primary reason for control equipment failures)

Standards of Oil Cleanliness - ISO 4406, NAS

The primary function of filters is to remove particulate matter from the system. Having filters in the system by itself is no guarantee that the oil will be clean. What needs

to be monitored must be measured. Therefore regular oil sampling (the better solution is online monitoring which will be discussed later in this article) and analysis is an important tool to monitor oil health. While most companies send out oil samples from their machinery at periodic intervals for routine analysis at laboratories, the 'particle count' is seldom requested.

ISO Cleanliness Code 4406		
ISO Code Number	Number of particles per ml of fluid	
	More than	Up to and including
24	80,000	160,000
23	40,000	80,000
22	20,000	40,000
21	10,000	20,000
20	5,000	10,000
19	2,500	5,000
18	1,300	2,500
17	640	1,300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.3	2.5
7	0.64	1.3
6	0.32	0.64

Fig 6 : ISO 4406 table

Cleanliness Code Comparison	
ISO CODE	NAS CLASS
23/21/18	12
22/20/18	-
22/20/17	11
22/20/16	-
21/19/16	10
20/18/15	9
19/17/14	8
18/16/13	7
17/15/12	6
16/14/12	-
16/14/11	5
15/13/10	4
14/12/09	3
13/11/08	2
12/10/08	-
12/10/07	1
12/10/06	-

Fig 7 : NAS is an outdated standard. The table shows a comparison with the ISO 4406 standard

Typically the Industry uses two 'codes of cleanliness'. NAS used to be the industry standard but is now outdated. The current standard in the Industry is ISO 4406. The standard specifies the particle sizes of 4, 6, and 14 microns in a 1 ml sample of oil. For eg ISO 4406 19/17/14 implies the oil has up to 500,000 particles of 4 microns or more, 130,000 particles of 6 microns or more, and 16,000 particles of 14 microns or more. The ISO 4406 table is shown in the previous page.

The minimum recommended cleanliness level for hydraulic oil is 19/17/14. Certain applications will require oil to be maintained to higher standards of cleanliness.

New Oil is not Clean!

It must be stressed that new oil from barrels is seldom clean enough to be used directly in your hydraulic systems. Bulk oil from refineries is 'packaged' at commercial facilities in barrels of different sizes. These barrels are not free of debris and contaminants. Often, the system oil is cleaner than the 'so-called' new oil. The use of a portable transfer pump to refill the system tank is another source of contamination. It is therefore strongly advised that oil from any storage facility - barrels or storage tanks, must be filtered before adding it to system oil.

Online filters, return line filters

Online filters in lubrication systems (engines, turbines, etc) and hydraulic systems are full-flow filters, generally located after the pump. There are practical limitations to the media pore size of these filters. The primary condition is that oil flow to the system cannot be restricted. Very fine pores are prone to getting clogged more often thus potentially restricting flow to critical components downstream. Also, in high-pressure hydraulic systems, a clogged filter will cause a great pressure differential and therefore the filter media will be prone to rupture. Full flow filters are therefore designed accordingly, their primary function being to ensure adequate oil flow to the system and to prevent 'larger than clearance' particles from damaging the components.

Another factor to note is that almost all full-flow filters have a bypass valve. If the pressure differential across the filter increases, the bypass valve opens allowing full flow of 'unfiltered oil' to the components. This is not desirable but necessary in case the filter gets clogged. Filter media pore sizes must necessarily be large enough to prevent frequent clogging.

Often high pressure hydraulic systems do not have full flow filters on the pressure side but are equipped with return line filters. Return lines are always larger in diameter than pressure lines and have a gradient towards the

return oil tank. This is to ensure that oil flow to the tank is unhindered. For this reason, the media pore size on the return line filters typically is 8-10 microns.

Beta Ratio of Filters

While all filters, including non-genuine ones, may look alike, the Beta ratio of the filter is one important factor that defines its cleaning efficiency. The filter size, say 5 microns, is a general reference to its filtering efficiency. It does not imply that every particle >5 microns will be trapped in the filter. Obviously, contaminant particles come in varying sizes and have different profiles. It is unrealistic to expect that any media can trap every particle beyond a certain size. The Beta Ratio becomes useful in judging the filter efficiency.

For example, $\beta_3=100$ means that for this filter, whose nominal rating is 3 microns, for every 100 particles of 3 microns or more, 1 particle will go through the filter downstream. Beta ratio can be used to calculate the efficiency of the filter.

Filtration efficiency = (Beta Ratio -1) /Beta ratio, expressed as a percentage. A Beta ratio of 100 yields a filtration efficiency of 99%. It also means the same filter of 3 microns nominal size will have several β ratios at say 5, 7, 10, and 100 microns.

When using replacement filters, always discuss the Beta Ratio with your supplier along with other filter parameters such as filter media, nominal filter rating, bursting pressure, internal bypass valve setting, etc.

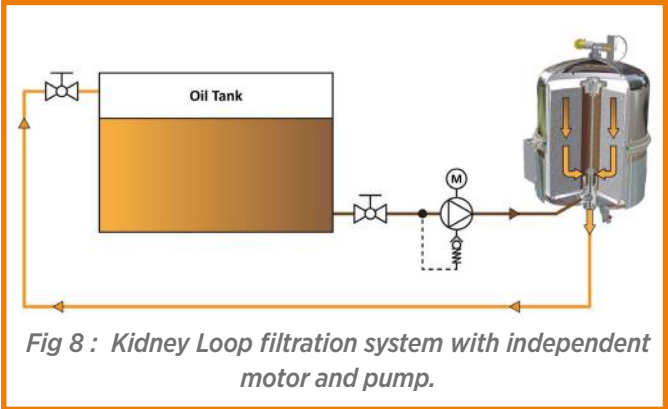
Bypass kidney loop filtration systems

The most efficient method to keep oil clean is to install kidney loop bypass filtration systems. These typically have very low flow rates and have depth filters (discussed later). Typical flow rates could be as low as 1LPM and the system is generally designed with its own pump and motor so that it is independent of the main system and can operate 24x7, even when the main equipment is stopped. The flow rates are designed to give between 1.5 and 2 passes of sump oil every 24 hours. As an example consider an oil sump of 6000 litres capacity. The desired flow rate for the kidney loop filter is between 9000 and 12000 liters per 24 hours. Considering that each filter housing can pass only 1LPM or 1440 litres/24 hours, the system will incorporate between 6 and 9 filter housings depending upon the running hours of the main equipment.

Media pore size in bypass filtration systems will vary depending on the application. In our experience for trunk-type diesel engines a 3-micron filter is fit for purpose. Smaller media sizes will choke the filter more often.

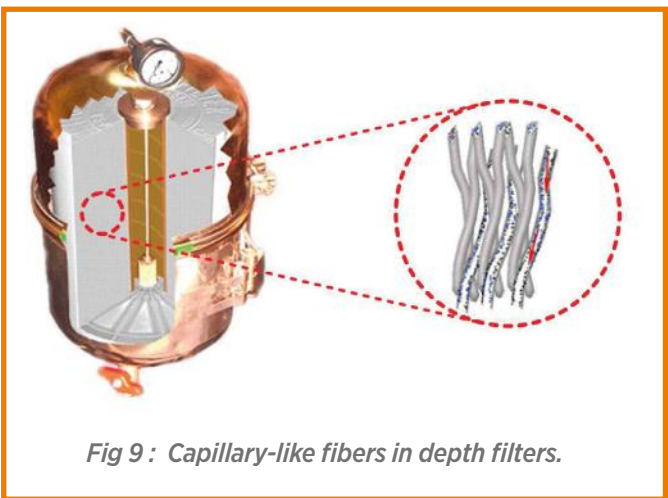
Keep in mind that in the trunk type 4-stroke engine, oil contamination by soot is very high. The soot discolors the oil, however, the color of the oil is no indication of its cleanliness.

For hydraulic systems, we would recommend bypass, kidney loop filters of 0.1 micron.



Depth filtration

Online full-flow filters are generally radial flow type, the oil passes through the filter media either inside out or outside in a radial direction. Consequently, retention time in the filter media is small. We recommend kidney loop filters with depth filtration. The filter cartridge consists of long strands or capillaries of chemically impregnated cellulose fiber material. Oil is forced through these capillaries under pressure and must traverse the entire length of the capillary. The cleaning process is therefore more thorough due to the longer retention time of the oil in the filter media.



Measure what you need to monitor

Oil sampling and lab analysis is a well-settled practice in almost every industry. While it is a good indicator of the oil health of the equipment, there are more modern

methods available to do this job. The traditional method of collecting oil samples and sending them to labs for analysis is an unreliable method of measuring oil health. Consider the following:

- The sampling point and collection container could be dirty
- The sampling point may be different every time a sample is withdrawn resulting in varying results
- Transit time to the lab could be long, causing oil to deteriorate and oxidize in transit
- Accuracy of testing in the lab is always a question mark

Additionally, considering transit time of the sample to the lab, the test results often come in too late for the equipment operator to make any sense or use of the results. The oil could have been drained and replaced or the machinery could have failed. In both cases the results are useless and defeat the purpose of oil analysis reports as a tool for better maintenance.

Online Oil Quality Monitoring Sensors

Several online sensors are available in the market today which relay real-time online data on Oil Quality. Some sensors measure only water or viscosity which might be adequate for some applications. The 'go - no go' type of sensors work on the principle of measuring the dielectric constant of the oil. Any change in any of the parameters of the oil - viscosity, particle contamination, dilution, additive depletion, flash point, etc will change the constant value and alert the user. Long-term trends can be established giving the operator an insight into the health of the equipment itself. We have seen that as the mean time to overhaul decreases, the oil deteriorates faster.

The approach is that if the oil, as indicated by the single sensor, is fit for use for the hours of operation as specified by the manufacturer, no action is required. It is only if oil deteriorates earlier than expected that samples should be drawn and sent to a lab for detailed analysis.





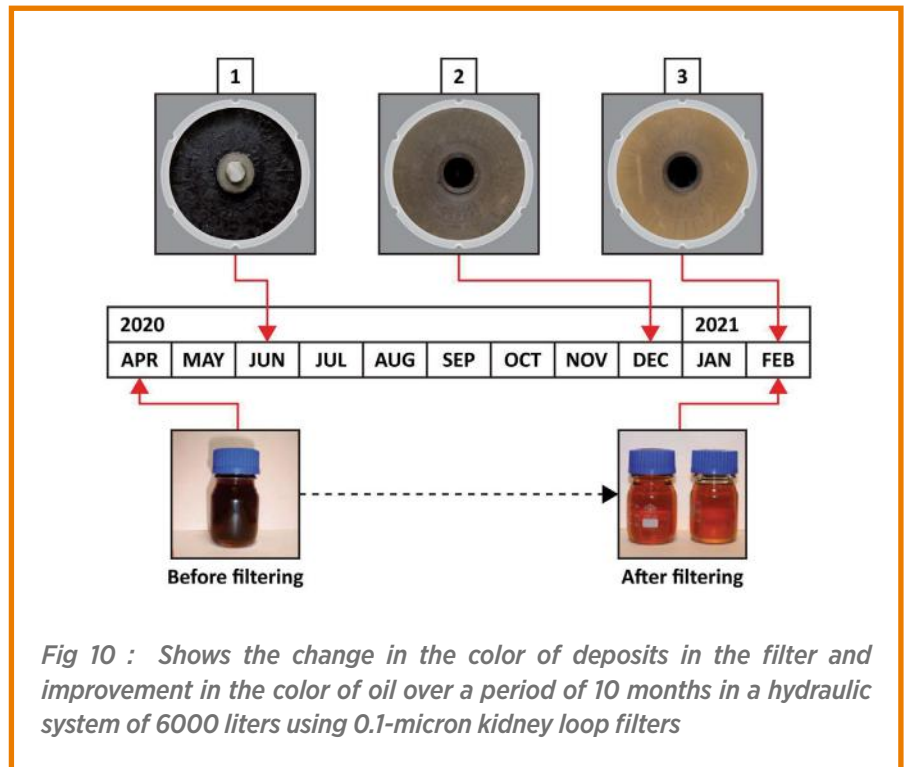
The 'go - no go' type of sensors work on the principle of measuring the dielectric constant of the oil."

- In a Gas Turbine-based power plant, the 0.1-micron filter was able to reduce varnish in the oil significantly.
- The 0.1-micron filter was able to reduce the varnish content in steam turbine oil significantly. A varnish is a form of lubricant degradation causing the formation of undesirable deposits. In turbine systems, few failure conditions can disrupt operations as quickly and completely as a varnished control valve. The MPC value is the only procedure worldwide that can be used to quantify an oil's potential to form varnish. The higher the MPC index is, the more undissolved particles are present in the oil. The 0.1-micron filter was able to significantly reduce the MPC value.
- Chief Engineers report that the Oil Quality Monitoring sensor is a powerful tool to maintain the condition of the oil. In one case diesel contamination was quickly detected and further complications were avoided. Several sites where these sensors are fitted have stopped sending samples to the lab for analysis.

Field Data

We have been installing bypass filtration systems for over six years now, on a variety of equipment, and field results are very encouraging.

- Using bypass kidney loop filtration systems (even of 0.1-micron size) did not affect the additives in the oil.
- On high-speed engines, we have been able to increase oil life by a factor of 3-4 times. In most cases, the oil was replaced even though it was fit for further use.
- In all cases, where the filtration system was installed on engines, the crankcase color (cleanliness) significantly improved after six months, and the hard soot deposits were washed away. The engine components were visibly clean.
- We observed much lesser carbon deposits in the cylinder and on the piston crown when the engine was opened for overhaul.
- In hydraulic oils, the 0.1-micron filter significantly improved the condition of oil in the system over a period of weeks.



Sustainability

Using bypass kidney filtration systems in conjunction with Online Oil Quality monitoring systems gives the following advantages:

- Significant benefit in improving MTBO of the equipment. Cleaner oil means longer life of equipment.
- Reduced operational costs.
- Oil life can be significantly enhanced.

Besides lower operating costs, the more compelling reason to use similar systems to increase oil and filter life is to move towards cleaner and greener maintenance practices. Both the disposal of used oil and discarded filter cartridges is a nightmare to handle and continuously increase the carbon footprint and thus the burden on our planet earth. It is simply common sense and 'earth sense' to use the oil for longer intervals.

Recommendations

Some recommendations I would like to leave with the readers:

- Oxidation is the nemesis of lube oil refer to Fig 3. Bypass kidney loop filtration systems can play an important role in managing oil quality. Depth filters give far better results than conventional ones.
- Understand the ISO 4406 standard of oil cleanliness.
- Get regular particle count done on hydraulic system oil.
- New Oil is not Clean oil. Refill oil only through a 5-micron filter.
- Remember the Beta Ratio and its importance in oil filtration.
- Measure what you must monitor - Online Oil Quality Monitor sensors are the solution.
- If you continue to send samples to the lab for analysis, take care to collect the sample properly.

Get it quickly to the lab. The more time the sample spends in your premises the greater the error in the result.

- It is time to look at prolonging oil life not just as a maintenance issue but as a responsibility to the environment. ■

About the Author

Mr. Uday Purohit brings over 15 years of seafaring experience to his role. His firm belief in harnessing advanced technology to revolutionize machinery maintenance and has made Neptunus a leader in the Marine and Oil and Gas sectors. He is a respected thought leader in machine health monitoring, frequently addressing industry associations and manufacturing giants, and delivering seminars to top executives, plant managers, and maintenance leaders on efficient maintenance practices. Contact Mr. Uday Purohit at uday@neptunus-power.com



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Green Talk

Mr. Samrat Sengupta

Vice President- Business Development, EKI Energy Services Ltd.

“ Climate & Renewable energy professional and policy campaigner, with two and half decades of experiences, with proficiency carbon market & renewable power business strategy & development. Policy research & advocacy at national and international - multi & bilateral platforms.

His expertise extends beyond the boardroom, encompassing policy research and advocacy at both the national and international levels. EKI have actively engaged in multi and bilateral platforms to drive the adoption of progressive climate policies and initiatives. Their relentless commitment to advocating for sustainable practices and policies has made them a formidable force in the global effort to combat climate change.

At present working as Vice President – Business Development [New Markets & Business Strategy], with EKI Energy Services Limited, one of the largest carbon originator, aggregator, and trader in the global market; responsible for new business-line development in climate change vertical.

EKI contributions have left an indelible mark on the industry, steering it towards a more sustainable and environmentally responsible future.”

Can you share some key highlights from your 25+ years of experience in renewable energy and low-carbon development? What inspired you to pursue a career in this field?

With over 25 years of experience in renewable energy and low-carbon development, my journey began as an energy manager, specializing in energy conservation. I was among the pioneering batch of students at Calcutta University who pursued a master's in Energy Conservation and Management. My early career led me to the Central Fuel Research Institute, where I delved into thermal energy conservation, particularly focusing on coal. It was during that time, around 2001, that I first encountered the concept of human-induced climate change, igniting my academic interest in the field. From that point forward, I embarked on a journey in renewable energy and climate mitigation. As the field was relatively niche at the time and had fewer technocrats involved, I found myself representing Indian Civil Society in various international forums, including the United Nations and G8. This experience not only enhanced my technical knowledge but also provided valuable insights into the political aspects of energy. Over the years, this multifaceted perspective has equipped me with a comprehensive skill set to navigate the intricate terrain of energy policies and business strategies.

As someone who has represented Indian and South Asian Civil Societies in various multilateral forums like UNFCCC and G8, what are the most



It's encouraging to see the Government of India taking subtle steps in this direction, particularly through initiatives like the "Life Movement."

pressing global challenges in climate change mitigation today, and how can associations like yours make a difference?

Having previously represented Indian and South Asian civil societies in significant international forums, I've gained valuable insights into the pressing global challenges of climate change mitigation. One of the most critical issues we face is the focus on what could be described as a "tailpipe solution." In essence, we're often addressing the symptoms rather than the root problem. The centralized development model that the world has predominantly followed for the past century and a half is fundamentally unsustainable. This is a perspective I hold independently, separate from my current business role. From a business standpoint, the primary challenge lies in transitioning from highly concentrated fossil fuel sources to more diffuse renewable energy. Electrification acts as the bridge between these two energy paradigms, but it's not without its challenges. Certain sectors, particularly those with high fuel-intensive processes such as metallurgy, cements, long-distance transportation, etc., don't have readily available electrification solutions. For instance, processes like metal production remain bottlenecks. Here, coal isn't merely a heat source; it also serves as a vital chemical component. The potential solution emerging is hydrogen, which could bridge the gap in these hard-to-abate sectors. However, it's important to note that we're likely a decade behind in truly kickstarting a hydrogen-based economy. Success in this endeavor is crucial to the broader energy transition. Ultimately, the transformation we need necessitates a shift toward a decentralized

development model. Currently, when individuals transition from rural to urban living, their environmental footprint significantly multiplies. To address this issue, we must explore solutions that might not be immediately politically correct, such as reevaluating our emphasis on GDP or consumption. It's encouraging to see the Government of India taking subtle steps in this direction, particularly through initiatives like the "Life Movement." This, I believe, is the path to a sustainable and successful energy transition.

EKI has a strong global presence with clients in over 40 countries. How does the company adapt its carbon offset solutions to different regions and industries?

EKI is not solely a technology specialist; our expertise lies in facilitating technologies that combat emissions, particularly the six major greenhouse gases. We specialize in helping these technologies navigate the complexities of registering in carbon market-based ecosystem, ensuring that your noble environmental endeavors also become viable business ventures. Geographical differences are not a significant hindrance; our approach hinges on establishing a baseline scenario that aligns with specific geographic nuances. While data for most energy-related aspects is readily available, it's crucial to note that nature-based solutions, like mangrove plantations, often face data availability challenges, resulting in substantial upfront costs for integration into the carbon market. Our experience extends to navigating the evolving landscape of carbon markets. Although data challenges may persist in newer subjects like

nature-based solutions, we anticipate that these issues will likely resolve in the coming years. Moreover, we foresee a future where credits for removal and sequestration will carry a premium in the credit market, making them highly valuable commodities. In essence, EKI tailors its carbon offset solutions to different regions and industries by understanding the specific challenges and opportunities presented, ensuring that the adoption of emission-reducing technologies is both environmentally and economically advantageous.

In terms of thematic expertise, you have worked extensively on renewable energy, GHG mitigation projects, and carbon footprint estimation. Can you share any innovative approaches or solutions you've encountered in these areas that could be game-changers in the fight against climate change?

While I'm not a technology innovator myself, my role at EKI is to collaborate with innovators and ensure the commercial viability of their groundbreaking technologies with eligibility for carbon revenue. However, our commitment extends beyond this aspect. EKI has ventured into community-level initiatives, such as our clean cooking program. Despite facing various criticisms, I firmly believe it's a game changer in the fight against climate change. This initiative doesn't just focus on carbon emission reduction; it also addresses the critical issue of providing clean energy access to the poorest and most remote populations on our planet. In the process, we tackle various other Sustainable Development Goals (SDGs), including gender equality, livelihoods, health etc. Traditionally, the arduous task of firewood collection



accounting and ISO:1464 lead auditor training, how can organizations ensure accurate GHG emissions reporting and what role does standardization play in this process?

future of low carbon development and climate change mitigation, and the role you envision your association playing in this future?

From a business perspective, we firmly believe that going green is not at odds with good business; in fact, it is a profitable venture. We are demonstrating that environmental sustainability and business prosperity can go hand in hand, dispelling the notion of a conflict between business and environmental interests."

fell predominantly on women in villages. To alleviate this burden and reduce emissions, we're transitioning to newer technologies like solar and induction cooking. However, it's important to consider cultural factors. In the context of Indian cuisine, which often involves multi-course meals and frying, technology adoption has been more challenging. On the other hand, in African regions where single-course meals are prevalent, solar and induction cooking technologies are more readily embraced by communities. These endeavors reflect our innovative approaches to address climate change while ensuring inclusivity and sustainability.

The entire GHG accounting process hinges on a fundamental principle of conservatism. Whenever there's any inkling of doubt or even a remote possibility of it, the prevailing standards and measurement models worldwide consistently opt for the most conservative values to proceed. In this context, conservatism leaves no room for overestimation; it's all about ensuring accuracy and credibility. To achieve unwavering accuracy in GHG emissions reporting, organizations should increasingly embrace digital Monitoring, Reporting, and Verification (MRV) systems. These systems must aim to cover 100% of the data sample, especially in scenarios involving distributed projects spanning vast areas. Take, for example, a situation where thousands of acres are under afforestation. Leveraging Geographical Information Systems (GIS) and digital MRV is pivotal, similar to the approach taken with cook stoves. However, the challenge arises when dealing with projects like cook stoves, where it's impractical to physically sample and verify every one of the, say, 100,000 stoves distributed in a remote district. This situation introduces doubt about whether the collected samples are truly representative. In contrast, adopting solar technology offers the possibility of implementing digital IoT-based systems, enabling real-time monitoring of 100% of the installations. This shift toward comprehensive digital MRV is where the industry is heading, addressing past criticisms and bolstering the credibility of credit authentication processes. In essence, standardization plays a pivotal role in aligning these efforts and ensuring accurate GHG emissions reporting.

When we consider EKI's perspective, we hold a substantial presence, influencing around 80% of India's decarbonization market by guiding entities towards the carbon market route. India, as evident from public discourse, is making significant strides in the realm of sustainability and climate change mitigation. It's fair to say that we, informally, have left our footprint on these commendable efforts. India's remarkable progress is crucial, given that our per capita energy consumption is only a third of the world average. This, however, does not mean we compromise on our energy access and efficiency, which is, in part, ingrained in our cultural and systemic practices. India has moved beyond simply replicating practices from the global north and is now adapting and customizing solutions to enhance our systems' efficiency. Furthermore, the Government of India, through initiatives like the Life Movement, is emphasizing conservative consumption as a leading solution. Our involvement as EKI, along with our associates like the Carbon Market Association of India, in these initiatives solidifies our footprint and commitment to this cause.

From a business perspective, we firmly believe that going green is not at odds with good business; in fact, it is a profitable venture. We are demonstrating that environmental sustainability and business prosperity can go hand in hand, dispelling the notion of a conflict between business and environmental interests. As we look to the future, our vision revolves around continuing to influence and support India's sustainable development and climate change mitigation endeavors, making a meaningful contribution towards a greener and more prosperous future. ■

Given your expertise in GHG

Could you share your vision for the

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UPDATES



Source: Internet

DVC Plans 8,000 MW Power Plants Over 7 Years

Damodar Valley Corporation (DVC) is set to invest ₹600 billion in three brownfield power plants in India, aiming for a combined capacity of 8,000 MW within the next seven years. The Centre has granted approval for these plants. Additionally, DVC is seeking government approval for another brownfield project. DVC is also working on 2,500 MW hydel pump storage and battery-powered plants in Luggu Hill, Gomia (Jharkhand), and Panchet (West Bengal). Moreover, they plan to establish 2,000 MW of floating and ground-mounted

solar power plants within their operational areas. The Chairman, Ramnaresh Singh, highlighted DVC's success in meeting its production target of 7,000 MW, supplying electricity to various states and even neighboring Bangladesh. The new thermal power plants will be located within existing DVC power plant boundaries, utilizing existing infrastructure. DVC aims to provide competitive electricity rates, remaining committed to meeting India's growing power demands. ■

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BPCL Inauguration: India's leap towards energy reinforcement!

In a momentous event that marks a significant stride in India's energy and economic landscape, Prime Minister Shri Narendra Modi inaugurated Bharat Petroleum Corporation Limited's (BPCL) ambitious project at the Bina Refineries in Sagar, Madhya Pradesh. The expansion project, which represents an investment of a staggering ₹ 50,000 crore, was unveiled by Prime Minister Modi with a promise of economic growth and development for the entire region of Bundelkhand. Aligned with the vision of a New Bharat, this project has reimagined the Bina Refineries as a modern Petrochemical Complex and is set

to become a cornerstone in India's energy landscape. This ambitious undertaking is aimed at enhancing the energy production capacity from 7.7 million metric tonnes to 11 MMTPA which is expected to go higher than 2200 kilo tonnes per annum. Along with its plans for efficiency in energy production, this project is also expected to open new avenues for employment and economic prosperity. It represents a remarkable collaboration between the government and the private sector in realising India's growth aspirations while reinforcing India's position as a global player in the energy and petrochemical sectors. ■

Global Oil Condition Monitoring Market Surges Towards \$1.5 Billion by 2031

The oil condition monitoring market is on a rapid ascent, harnessing technologies like infrared spectroscopy and predictive maintenance solutions. With a pivotal role in assessing machinery health, it's reducing downtime costs across key sectors, including manufacturing, automotive, and aerospace. The global oil condition monitoring market, valued at \$862.7 million in 2022, is set to scale new heights, reaching an impressive \$1,496.3 million by 2031, marking a remarkable CAGR of 6.35% from 2023 to 2031. This surge is propelled by several factors, including the pressing need for machinery reliability, heightened environmental concerns, and significant technological advancements. Oil condition monitoring ensures machinery operates reliably by scrutinizing lubricant quality, thwarting breakdowns, and minimizing unplanned downtime. The market landscape is fiercely competitive,

featuring major players such as Parker Hannifin Corporation, General Electric, SGS SA, Intertek Group PLC, and Bureau Veritas SA. These industry leaders provide a comprehensive range of products and services. The burgeoning demand for predictive maintenance is a prime driver of market expansion. Oil condition monitoring empowers companies to predict potential issues, cut down maintenance expenses, and extend the lifespan of their equipment. The emergence of advanced technologies like cloud-based systems and IoT opens new avenues for future growth. Investment prospects in this global market are promising, particularly for companies focusing on cutting-edge technologies. As the industry continues to evolve, predictive maintenance through oil condition monitoring remains a pivotal strategy for cost reduction and ensuring equipment reliability. ■

The Lubricant Buzz
UPDATES



Source: Internet



Source: Internet

G-20 Summit 2023: Historic and Bold Commitments Shaping a Sustainable Future

The G-20 Summit 2023 was hosted by India for the first time in Delhi. The theme of this summit was 'Vasudhaiva Kutumbakam' which means 'The World is a Family'. This summit achieved unanimous consensus of the world leaders while addressing the diverse global issues from Russia-Ukraine tensions to raging food insecurity, and sustainable development to the launching of the Global Biofuel Alliance. The Global Biofuel Alliance was one major step taken by the G-20 nations promising environmental well-being and enhanced ideas of sustainability. The GBA is an initiative led by India to develop an alliance of international governments, industries and organisations promoting the adoption of biofuels for better sustainability. This initiative seeks to promote biofuel as a major component of energy transition while increasing environmental opportunities

and economic growth. The International Energy Agency has estimated 3.5-5x potential growth in biofuels by 2050 due to the set Net Zero Targets creating several opportunities for India.

Prime Minister Shri Narendra Modi proposed to hold a virtual session of the G-20 summit. He further handed over the gavel to Brazil and offered the best of his wishes as Brazil is set to take over the Presidency leadership from December 1.

The agreements and commitments forged at the G-20 Summit are poised to influence a path towards a more sustainable and prosperous future. While the leaders have returned to their respective countries, the world eagerly watches to see how these historical agreements will be translated into actions that will benefit all of humanity. ■



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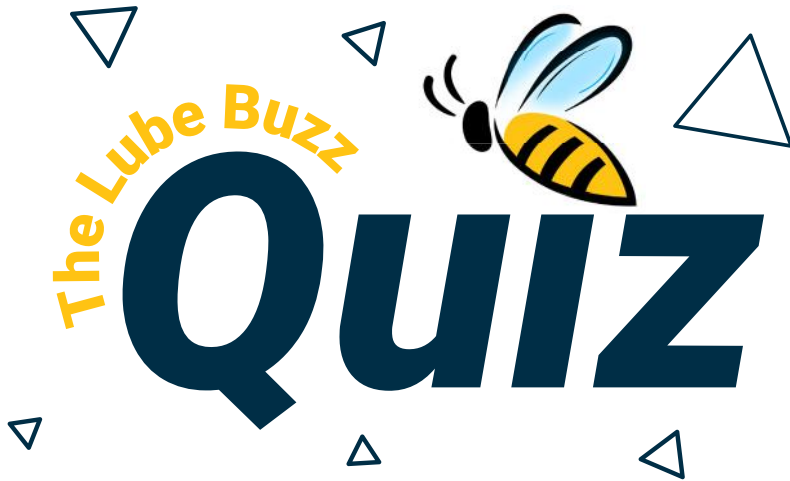
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The Lube Buzz QUIZ



1 What is a condition-based oil change?

- a. Oil change based on high operating temperatures
- b. Oil change based on production units
- c. Oil change based on historical consumption
- d. Oil change based on lubricant analysis results

2 Viscosity numbering system is used to rate the _____ of the engine oil.

- a. Oil temperature
- b. Oil weight
- c. Thickness
- d. Oil gravity

3 Which of the following is the most important property of lubrication?

- a. Viscosity
- b. Thermal Conductivity
- c. Density
- d. Melting Point

4 State True or False : Lubricants act as a coolant to carry away heat.

- a. True
- b. False

5 What does 'CMMS' stand for?

- a. Craft Management Monitoring System
- b. Computerized Maintenance Management System
- c. Clean, Monitor, Maintain, Sustain
- d. Consult Maintenance Manager Supervisor

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Advancing Sustainable Biogas: Highlights from the 2023 WBA India Congress

The World Biogas Association hosted the 2023 World Biogas Association India Congress at the Hyatt Regency Hotel in New Delhi, India with an aim to boost biogas development for countries to achieve Net Zero goals. Leading experts gathered for this two-day forum to discuss biogas industry trends and innovations.

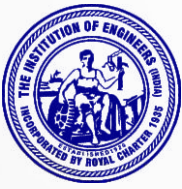
Mr. Harshdeep Singh Puri, Union Minister of Housing and Urban Affairs and Petroleum and Natural Gas, served as the chief guest for the event. He inaugurated the event by watering plants and highlighted the potential of biofuels in reducing carbon emissions in his address. He discussed India's opportunities in this field and announced increased government investment in biofuels research and development. Another notable keynote speaker of the event was Mr. Tarun Kapoor, IAS (Retd), Advisor to Prime Minister, Government of India.

The event featured panel discussions with representatives from government and private energy companies, covering a variety of topics, there was an expert panel on "Developer Pathway | Finance," focusing on strategies. In the "Transformational Biogas Projects: Success Stories

and Case Studies" panel, experts examined India's biogas production potential. They showcased case studies on project development, discussing effective solutions and successful models for utilizing organic resources from food waste and agricultural residues.

In the "Biogas Pathways to 2030 - Outlook and Opportunities #makingbiogashappen" panel, discussions revolved around the biogas industry's long-term prospects. These discussions were in line with emerging markets, including Carbon Capture and Use (CCU) and Bioenergy with Carbon Capture and Storage (BECCS). The panel also highlighted India's ambitions to become a leading producer and supplier of Green Hydrogen and synthetic fuels.

Maintonia Magazine, the only specialized and focused publication on tribology, maintenance and reliability; was honored to be a media partner for this highly successful symposium, joining forces with distinguished organizations such as Kompass International, Petrofinder, Chinimandi.com, Sugar Times, Federal Bharat News, and many others. ■



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IFAT India's 10th Anniversary: Innovative Solutions for a Sustainable Future and Business Expansion

Recently, Messe München organized IFAT India 2023 marking its 10th Anniversary with a spectacular exhibition, introducing several new initiatives to facilitate valuable connections and foster business opportunities. It was a three day long trade fair organized at the Bombay Exhibition Centre, Mumbai. It brought together 400+ exhibiting companies from 25 countries and around 14k+ visitors over the span of three days. The inaugural ceremony was graced by government officials and several dignitaries from the exhibiting companies.

One of the notable features of the Innovation Water Forum and Innovation Waste Forum, was two parallel conference platforms that hosted over 150 distinguished speakers, including environmental scientists, entrepreneurs, corporate leaders, think tanks, and government authorities. The conference sessions covered various key topics, such as applying circular economy principles to wastewater, circularity in fashion and apparel industry, used oil recycling, construction & demolition waste, among others.

The speakers for panel discussion on “Used Oil Recycling” was supported by the Material Recycling Agency of India (MRAI) and Rosefield Energy Tech Pvt. Ltd. Mr. Anshuman Agarwal, the Founder & MD of Minimac Systems was one of the panelists alongside Mr. Sudhir Kumar, Former Advisor NITI Aayog, Mr. Rajesh Nambiar, Chief GM Technical Services, Indian Oil Corporation Limited, Mr. Kalpendra Rajurkar, GM Technology, Veedol Engine Oils, Mr. Sanjay

Bhargava, Chief Technology Officer, IFP Petro Products and Mr. Bhaskaran Nagarajan, COO and Principal Consultant, Rosefield Energy Tech Pvt. Ltd. The session was moderated by Mr. Prabhjot Sodhi, Sr. Programming Director at Circular Economy. The panelists discussed how an opportunity for circularity can enhance material efficiency while promoting the idea of reduction in carbon emission. In his speech, Mr. Agarwal explained how the reform-reduce-reuse model can help achieve impeccable results, contribute towards environmental sustainability and abate carbon emission. The panelists further interacted with the audience through a Q&A round where they answered various queries of the audience. The panel also took the special moment to congratulate and award the volunteers who contributed towards environmental sustainability through various activities such as cleaning the oceans.

Maintonia Magazine, the only specialized and focused publication on tribology, maintenance and reliability; enjoyed its glory in the hands of the panelists. This bi-monthly magazine is read by top management, experts, decision-makers, specialists & engineers.

The 10th Anniversary edition of IFAT India was an interactive and zealous fair where all the exhibitors, panelists and visitors could engage in conversation about the changing trends in the industry. Messe München organizes trade fairs around the world, supported by a network of associated companies, showcasing their global presence. ■



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