Summer 2017

OELCHECKER

INSIDER INFO • PARTNER FORUM • TECHNOLOGY FOCUS

CONTENTS

Best practice – the analysis service for ADDINOL gas engine oils

The use of ADDINOL gas engine oils is supported by a unique analysis service in which OELCHECK has a key role.

ADDINOL gas engine oils are state of the art. Developed in cooperation with leading additive and engine manufacturers, they are tailored to meet the numerous complex requirements of gas engines The use of the gas engine oils produced in Leuna is supported by a unique analysis service in which OELCHECK has a key role.

From natural gas to special gas operation, the German company has the right engine oil for every area of application and all operating conditions. These oils have been approved by leading international engine manufacturers. The engine oils are subject to extremely high demands, above all when it comes to lubricating gas engines, which are run using biogas or gases from landfill, mine pits or wastewater treatment plants. ADDINOL was one of the first lubricant manufacturers to realise that it could only overcome these demands by using specially designed gas engine oils. ADDINOL continues to play a pioneering role in this industry today. ADDINOL Eco Gas 4000 XD, for example, is a low-ash gas engine oil designed by the company to already meet future emission regulations set to become ever-more stringent.

R&D as a core area of expertise

For many years, ADDINOL has been working in close cooperation with leading OEMs on the development of its gas engine oils. This starts with carefully selecting the base oils and additives that are evaluated in the company's in-house laboratory. Before a new gas engine oil is approved for use in field tests by individual manufacturers, it is subject to a range of tests in the laboratory. The parameters of the manufacturers in conjunction with the extensive load tests differ in terms of duration, evaluation criteria and priorities. The required operational life varies from manufacturer to manufacturer and may last for up to 16,000 hours of operation. A practical, strictly monitored test phase comprising one or two engines is required to obtain an approval. At the end of every field test is the appraisal stage, during which the individual components are evaluated after the engines are dismantled.

Check-up

We often feel like time is simply flying by and not just when we are on holiday. I still remember the very first edition of OELCHECKER, which was published nearly 20 years ago. Since then, another 60 or so editions have followed in its footsteps. When it was created, the design – just like the other media channels that arose over the years – was forward-looking and modern.

In the last year, we updated the appearance of our documents to keep pace with the times. We are bidding a fond farewell to the Oil Doctor, who has appeared on the front page of our customer magazine – in a revised design from 2013 – since the very first edition of OELCHECKER. This is because the symbol of the doctor no longer feels contemporary for a modern lubricant analysis laboratory where the expertise of our employees and modern lab equipment are the critical factors.

We are not just keeping our finger on the pulse with the redesign of our customer magazine. A number of radical changes has occured to web design in the last few years, with the triumph of smartphones and tablets playing a key role. To ensure that the digital entrance to our company reflects the cutting-edge nature of our laboratory, our website will soon be relaunched with a revamped layout. We go into more detail about this process in this issue of OELCHECKER.

Of course, an attractive design is nothing without the content to back it up. This is why we have made improvements to our range of analysis services once again. In the current issue, we present our new service for practical QR-Codes, which you can use to enter your samples quickly and easily. As usual, we have also compiled a broad selection of interesting articles about lubricants for your reading pleasure. Even when the months seem to fly by in the space of a few days, OELCHECK always keeps up with the times.

Yours, Barbara Weismann

OELCHECK lubricant analysis

Over the course of many years, ADDINOL has accumulated a wealth of field test experience along with more than a million key values from practical applications. These values are analysed by OELCHECK, which checks more than 250,000 key values per year. Regularly inspecting the condition of the oil is essential to ensure that the gas engine runs correctly. OELCHECK uses lubricant analyses to define key values, on the basis of which regular oil change intervals are determined within the limit values set by the manufacturer. The use of gas engine oils by ADDINOL is always accompanied by analyses of this kind. From the start, the company exclusively wanted OELCHECK for the analysis of the oils, as no other independent laboratory has the same specially developed test equipment, delivers results as quickly, or maintains a consistently high level of quality over such a long period of time.

OELCHECK subjects every sample from a gas engine to a critical examination. It observes viscosity and increases in viscosity, as well as oxidation, nitration, wear elements and impurities. The acidification of the oil is subject to an extremely rigorous inspection.

In particular, acidifying elements have to be absorbed and neutralised in oils from gas engines run on special gases. However, at a certain point even the capacity of ADDINOL gas engine oils is reached. It is critical to change the oil before the engine is corroded by these acidic components. The acid number (AN) indicates the degree of acidification. The base number (BN) provides data about the basic reserve that is still available and that is able to neutralise the acids. However, the base number does not show the neutralising capability of an oil for all acidic compounds, which can occur in the oil when running gas motors on special gases. This is why the i-pH value (initial pH value) is also always determined in these cases. This value provides key additional information about the impact of used gas engine oil with „free" corrosive acids.

The expertise of ADDINOL

ADDINOL determines the optimum oil change intervals based on the results of the lubricant analysis. The effort and expenditure required on the part of the customer is extremely low, as ADDINOL provides them with the complete analysis kits. All the customer has to do is send their oil sample to the laboratory. After two working days at the latest, they receive a lab report from ADDINOL containing all key individual values and a specific recommendation on how many hours the oil may continue to remain in service until it needs to be changed or analysed once again. The report also remarks on the state of wear of the engine and any impurities caused by engine coolant or dust. The information provided by ADDINOL on how to use the oil in future is extremely accurate, as nobody knows the company's oils better than ADDINOL itself. ADDINOL combines the lab results recorded by OELCHECK with an in-house matrix, which is based on the engine manufacturer's limit values, key values from field tests, and data recorded by OELCHECK over the course of thousands of practical applications. The specific on-site operating conditions are also taken into consideration. This guarantees that the oil and the system are consistently monitored. The customer can schedule oil changes and maintenance work with pinpoint accuracy. In terms of service life recommendations, ADDINOL takes the limit values prescribed by the respective OEMs into close consideration, as overstepping the limit of even one of the values may endanger the warranty. ADDINOL's in-house evaluation matrix and the lubricant analyses from OELCHECK enable the various limit values to be correctly observed. Provided the laboratory report does not have any recommendations to the contrary, the operator does not have to do anything – except to send oil samples to OELCHECK at regular intervals and change the oil at the time specified by ADDINOL.

ADDINOL – Improving performance

ADDINOL is a fully independent company in the German mineral oil industry and is represented through a network of distribution partners in more than 90 countries around the world. ADDINOL high-performance lubricants are developed and produced according to the latest standards at the long-established chemical industry site in Leuna, Central Germany. The company, whose history goes back to 1936, provides intelligent solutions that ensure optimum lubrication while taking a responsible approach to protecting the environment. Many of the high-performance lubricants substantially increase the energy efficiency of systems and engines, frequently remain effective for much longer periods than conventional products, and increase the service life of the lubricated components.

Further information: www.addinol.de

www.oelcheck.de

A new information centre for lubricant analyses

In close cooperation with the team at WPWA, an innovative advertising agency in Munich, we are giving our website, oelcheck.de, an all-new makeover which is ideal for viewing on any mobile device. The website will be online from 15 September.

The new website will be responsive, meaning that the content will adapt to the size of the screen on which it is viewed. It is not just the design that is being refreshed either: the menu and user interface have been completely rebuilt, with key links being placed centrally on the site. The new, clearer navigation menu is now in the website's header section, and opens when you click on it. It retracts when not in use, providing the content on screen with more space.

The abundance of oil analysis information already available on the site has been restructured. Case examples collected from our customers previously under the heading „Lubricants on duty" can now be accessed via **„The Stories of Oil"**. Much of the content previously listed under „Knowledge from A-Z" has been used as the basis for our new **OELCHECK wiki** page. In addition to answers to standard questions, the wiki contains current information about oils, lubricating greases, fuels and coolants, and analysis methods.

A number of industrial branches have their own sub-pages on the website. In addition to customer case studies, the pages contain information about the use of lubricants in the various branches. Recommendations on the **most suitable analysis kits** for each branch are also listed here.

The **Newsroom** is home to all current OELCHECK news. As well as website announcements and new developments, you can browse content from our Facebook, YouTube, Xing and LinkedIn channels.

You can use the new **kit comparison module** to compare all of OELCHECK's all-inclusive analysis kits with one another. Simply go to „Compare all kits" and select only those kits you wish to compare. The module then provides you with an overview of the test methods included in the individual kits. You can also access the new **product shop** directly via the website. The shop features the **ordering assistant** from the previous version of the website.

The new OELCHECK website is available in German and English for visitors all over the world.

We are leaders in the field of lubricant and operating substance analysis – our new website will go online on 15 September at **www.oelcheck.de**.

The new QR-Code service for our customers

When you use our practical **OELCHECK-App**, you simply print your QR-Code to scan your machine data or use the one from the previous laboratory report.

As this may result in a substantial amount of work for large-scale machine stocks in particular, we are pleased to provide the following special service (available now):

On request, OELCHECK can provide you with your QR-Code as a 4.5 x 9 cm oil- and weather-resistant sticker.

The code can be attached quickly and permanently to a surface close to the sampling point after cleaning it and removing any impurities. This makes it much easier for customers who do not yet use the App to make the switchover to this technology.

Scan the QR-Code and send your machine data to OELCHECK!

New test method for fuels: carbon residue in accordance with DIN EN ISO 10370

While the types of diesel available to purchase at garages meet the DIN EN 590 standard specified on the fuel pump, the quality of the diesel may vary, especially when purchased from foreign outlets. This may be the result of mixing or diluting the fuel, impurities or improper installation of the fuel tank. If, in a worst-case scenario, this leads to a fault in the operation of a diesel engine and a delay in working with the affected machine, it is advisable to check the quality of the fuel as well. An analysis is able to indicate whether the diesel used in the engine meets the standard or whether it has been contaminated.

The presence of carbon residue is listed as a key test criterion for diesel in DIN EN 590. Fuels should be as free of residue as possible when burned. The use of a type of diesel that contains too much carbon residue can lead to the formation of deposits in the injection nozzles or hot spots on the engine. The engine may then be affected to the extent that it comes to a standstill.

To help you find the cause of faults or provide you with assurance when using a certain type of diesel, OELCHECK now provides a service that **checks the carbon residue level in fuels based on the Conradson method**. This test is common for oils in heat transfer systems and compressors.

A larger diesel sample is required for the test. This is why OELCHECK provides one-liter aluminium bottles to be used as all-inclusive sample containers. For the test, a 100 ml sample of diesel is taken and distilled until 10% distillation residue remains. From this residue, 3 grams are weighed out and placed on the Conradson testing apparatus and carbonised at a temperature of 500 °C. The remaining carbon deposits should amount to less than 0.3 % in a diesel that meets the DIN EN 590 standard. The entire distillation test method and carbonisation process takes just under two hours.

Now used for fuel analysis: Micro Conradson test apparatus

Distillation takes place in a specially designed fractionating column. The Conradson test uses an apparatus that meets the DIN EN ISO 10370 standard (also used for oils). Carbon residue values that are too high indicate the presence of asphaltenes, dust, or highly viscous, ash-forming deposits.

A carbon residue analysis goes side by side with the standard OELCHECK analysis kits for fuels, which are used to determine more than 20 individual values.

Recertification audit

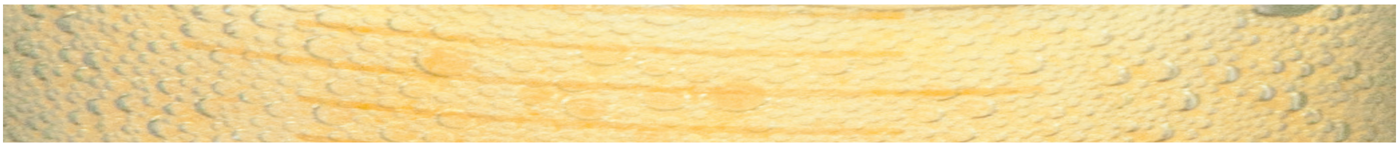
ISO 9001 and ISO 14001 passed once again

We believe it is essential to observe national and international standards in laboratories, adhere to in-house guidelines on quality and the organisation of business processes, and meet legal provisions. All company departments are subject to our stringent quality requirements and meet the standards that apply to the environmental management system. OELCHECK GmbH‘s proven quality management system has been continuously certified according to DIN EN ISO 9001 for more than 20 years. This was augmented by certification of the environmental management system according to DIN EN ISO 14001 in 2001. Monitoring audits are performed at the intervals specified by these standards.

In July 2017, we successfully passed a recertification audit for both certificates by ALL-CERT GmbH, a special accreditation company. Both certificates are available to download from our website‘s download centre.

Aside from these certifications, OELCHECK has also been certified to perform selected test methods in accordance with DIN EN ISO 17025 since 2009.

Air and foam in oil



Excessive air in oil and excessive foam on the surface of the oil are two uninvited guests that maintenance technicians would prefer to avoid in their day-to-day work. This is because air bubbles in or on the surface of the oil can cause serious problems and therefore need to be kept in check. We show how the intake of air and the formation of foam are related and how lubricant analysis methods can be used to help to resolve this problem and prevent it from happening altogether. The OELCHECK laboratory is well equipped to respond to queries of this nature and has been officially listed as a provider of the Flender foam test following an audit by Dr Gajewski at Siemens Mechanical Drives.

Increased air content and its effects

All oil contains air. Depending on the type and viscosity, it may have an air content of up to 11% dissolved in its molecular structures. This baseline situation is not a problem. If the temperature or pressure is increased, air may be discharged from the oil, thereby reducing the oil's oxygen content – which otherwise facilitates oxidation – and potentially slowing the oil aging process. However, the air content may rise if, for example, the intensity of the bond changes due to impurities or by mixing together oil types with different properties. Fluctuations in pressure and temperature in particular can cause the air – whose volume is too high for it to be dissolved in its entirety – to become isolated in the oil as individual bubbles. Due to their low specific weight, these bubbles rise to the surface and burst. Usually, isolated air dissolves much more slowly in oil once it has become separated. This may also lead to the external intake of air.

If the air absorption capacity in the oil is insufficient, it is often easy to detect air bubbles simply by looking at the oil. In addition to the oil frequently looking cloudy or milky, this can lead to serious issues (above all in high-pressure systems present in hydraulic units or turbines), including:

- Increasing compressibility of oil
- Declining output capacity of pumps
- Impaired lubricating effect through to a lack of lubrication
- Seal wear
- Declining cooling efficiency
- Increased oil oxidation
- Cavitation with selective material removal, often accompanied by noise
- The ‚diesel effect', where air pockets are compressed to the point that they ignite. Soot particles are created during this process and the oil becomes black.

Air release (LAV)

To minimise these negative effects or exclude them altogether, an oil needs to be able to separate surplus air as quickly as possible. This behaviour is determined in the laboratory and is referred to as its air release (LAV). The LAV value depends on the base oil type, additives, viscosity and temperature. Impurities and/or mixtures can also play a role in the size of the air bubbles. As an oil's air release time changes during its service life, it is recommended that OELCHECK performs a special test on samples taken from hydraulic and turbine units. The LAV of a used oil in comparison to that of a fresh oil or a previously analysed trend sample can reinforce assertions as to the cause of an operating fault or damage, and offers an indication as to its continued usage. Conclusions as to why the LAV value has deteriorated can usually be drawn after looking at other values gained from an analysis.

To determine the LAV in a standardised manner in accordance with DIN ISO 9120 and ASTM D3427, the time (in minutes) is measured in which it takes for the air, which is discharged into and initially dispersed in the oil, to be separated again up to a residual content level of 0.2 Vol. %. Preheated air is then discharged via a nozzle at a fixed pressure over a specific period of time into a 200 ml sample of the oil to be analysed. The dispersed air bubbles then escape from the oil over time with the aid of the oil's density. This process is recorded graphically until the volume no longer changes. The time it takes from when the air intake is switched off until the point at which the density no longer changes is the air release time.

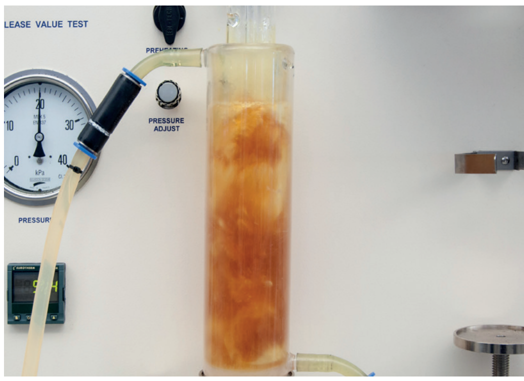
Good output values guarantee that the oil can be used for a relatively long time. This is why the LAV of brand-new hydraulic or turbine oils should not exceed the limit values specified on the bottom right.

Increased LAV – corrective measures

If the LAV value in used oil has increased significantly in comparison to the preceding sample or fresh oil, there are few measures that can be taken to

Determining the LAV in the OELCHECK laboratory using the Analis P 688 testing standard lab

correct this. If other data such as silicon or water show that impurities may be the cause for this, it may be beneficial to clean the oil once more. If changes in the volume of additives or the viscosity indicate that the oil has been mixed with another type or if the IR spectrum suggests that the oil has oxidised, nothing can be done except to change the oil. Adding another element to the mix, e.g. anti-foam additives, is generally counterproductive.



The preheated air is blown into the oil...

Air separation characteristics for fresh oils
Limit values of traditional requirement standards

ISO VG/type	32	46	68	100	(150)	(>320)
Turbine oil DIN 51515, ISO 8068	5	5	6	-	-	-
HLP/HM hydraulic fluid DIN 51524/2, ISO 11158	5	10	13	21	32	-

Why oil foams

When determining the air separation characteristics, air bubbles rise to the oil's surface and dissolve into the air. Only the „saturated air" remains in the oil. The moment of truth comes if the air bubbles that have risen to the surface do not burst straight away. If this process continues for a long period of time, the bubbles form a layer of foam on the surface of the oil. This foaming tendency can therefore have an extremely negative effect on the oil, despite the LAV – measured via the density in the oil phase – not yet showing any striking results. Whether foam forms on the oil depends on its surface tension, viscosity, operating temperature and air intake method. Impurities, oil mixtures and oil oxidation all exacerbate the oil's foaming tendency.

Foam and its effects

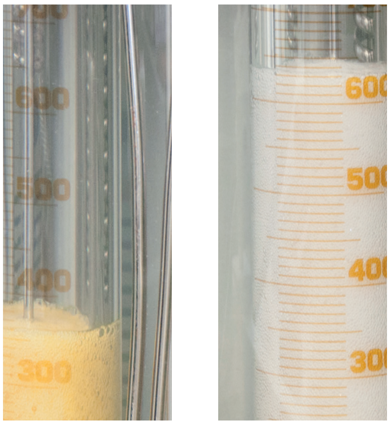
Refilling the oil is not a problem if the air bubbles that rise to the surface of the oil burst quickly. However, this is not the case if the following effects are observed:

Stable blanket of foam on the surface of the oil

This may impair the cooling effect and lead to a rise in operating temperature. The oil then becomes more oxidised and wears out more quickly. The operating viscosity can also be reduced in places.

Oil/air emulsion throughout the oil reservoir

Along with the negative effects that arise due to the presence of a blanket of foam, the sensors that monitor the oil level are impaired. In this case, pumps may start to draw in a mixture of oil and air instead of pure oil. In a hydraulic system, this can lead to cavitation and the ‚diesel effect'. Foam in bearings prevents a hydrodynamic lubricating film from being created. Foam in the gear unit often leads to significantly higher operating temperatures due to diminished friction performance. Furthermore, the oil ages at a faster rate and the operating viscosity is reduced.



Oil after 5-min injection and 10-min settling time

An overflow of foaming oil

Leaks caused by oil overflowing from a unit or gearbox – along with loss of oil and environmental contamination – simply do not bear thinking about. That said, they unfortunately occur time and again. In addition to the aforementioned risks, a loss of oil from excessive foam can result in insufficient oil in the system and therefore a lack of lubrication.

Foaming tendency

Determining the foaming tendency in the OELCHECK laboratory using the Analis P 643 testing standard lab

Oils used in gear units, turbines or hydraulic systems are subject to a special testing rig in the laboratory in order to determine its foaming behaviour in practice in accordance with ASTM D 892 and ISO DIS 6247. The test looks at how long it takes before the foam disintegrates. Preheated air is discharged via a spherical, porous stone into a 400 ml sample of oil to be tested. This leads to an air in oil dispersion in the form of fine bubbles. These bubbles rise to the surface and create a layer of foam. The foam volume is measured immediately after the air is switched off and again after 10 minutes have elapsed. There are no generally valid limit values for an oil's foaming tendency. However, the development of the trend and the change in comparison to fresh oil do constitute criteria for assessment. The VGB guidelines for turbine oils with a limit value of 600/0 ml/ml can be used for orientation purposes. However, each case must be assessed individually.

The Flender practical foam test

The Flender foam test was developed due to the fact that determining the foaming tendency via „foam bricks" has only limited applicability in practice. The practical test is primarily used for assessing gear oils, particularly when a combination of oil types or impurities have resulted in excessive oil foaming in the gears. In addition, leading gear manufacturers require gear oils to have passed a Flender foam test before approving it for use in their gearboxes.

The testing method was originally used by A. Friedr. Flender AG as an in-house test for assessing the foaming tendency of industrial gear oils. The company merged with Siemens AG in 2010 and commenced operations under the name Siemens Mechanical Drives. Today, it is the Group's specialist for gears and couplings. The „Flender" brand name has been retained. The extensive product portfolio ranges from individual components to complete drive systems for virtually all industrial applications.

Today, the Flender foam test is standardised according to ISO 12152. Furthermore, Siemens Mechanical Drives now lists the laboratories approved for the Flender foam test following an audit commissioned by Siemens. For the audit, the independent laboratories must have the requisite test benches and trained staff, must be certified or accredited, and must publish the test results in a standardised report. OELCHECK is currently one of very few laboratories officially appointed by Siemens Mechanical Drives to perform the test.

In the Flender foam test, a gearbox housing is filled with 1,000 ml of oil. A gear pair with equal-sized gear wheels is used to stir the oil for five minutes at an RPM of 1405 min^{-1} at 25°C. The gear pair sits horizontally to the halfway point – the centre of the gear wheel – in the oil sump. The high RPM and the half-submerged gear wheels enable the oil to be stirred at a high speed, which draws in air. This leads to the formation of foam in all types of oil, and the oil volume increases as a result.

The oil level can be read before, during and after

Flender foam test – a reading is taken of the increase in oil volume

the test via a graduated scale on a glass pane in the wall of the gearbox, and the change in the oil's volume can be stated directly as a percentage. An oil's foaming tendency can be assessed based on the percentage increase in volume displayed by the test oil one minute after the test rig is stopped. The oil/air dispersion volume (%) can be calculated five minutes after stopping the rig. OELCHECK directs a camera at the glass pane to record the test run and stores the data accordingly.

The test results are classified as follows according to the specifications of Siemens Mechanical Drives:

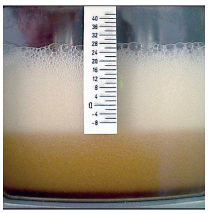
Rise in oil volume one minute after stopping (%)

- < 5% good
- < 10% satisfactory
- < 15% acceptable
- > 15% not acceptable

However, these values are only valid for the text gearbox and the standardised method. They are based on the experience of Siemens Mechanical Drives gained through meeting the requirements for oils in Flender gear units. The 15% stated above is not an actual limit for foam formation in gear units.

Volume rise in oil/air dispersion five minutes after stopping (%)

In general, an increase of up to 10% is tolerated. This limit value of 10% free air is set by leading pump manufacturers to avoid cavitation. The five-minute time window is the result of design guidelines issued by Siemens Mechanical Drives, and relates to the minimum ratio of oil volume and pump capacity.

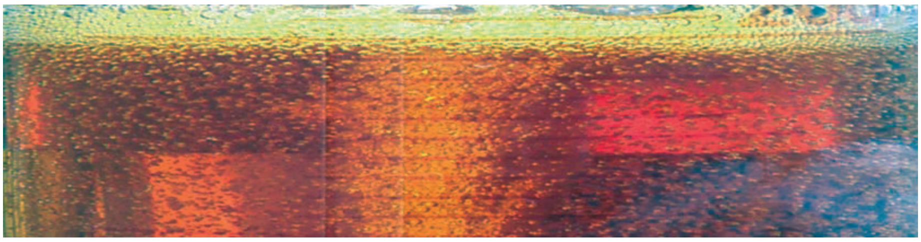


Rise after 1 min

Rise after 5 min

> ***Would you like to find out more about water and air in oil and foam formation?***
>
> You could attend the OilDoc seminar, „Additives for Lubricants and Monitoring", which will be held on 27 and 28 November 2017, or register for the „Water and Air in Oil" online training course, which will take place from 17 November 2017. For further information, visit oildoc.de

How to avoid foam



Supplementary air, impurities, mixtures and anti-foam additives – these four factors have a major effect on exacerbating an oil's foaming tendency. The formation of foam can be avoided by observing a few basic rules.

Supplementary air

The oil pump may draw in so much fresh air with the oil that it can no longer be separated.

Causes may include:

- Worn seals
- Leaks in the hydraulic pump or pipes
- Fill level in the tank is too low or too high
- Change in flow conditions in the tank or the pump's intake manifold.

Contaminants

The type and quantity of impurities govern the resulting effects. If the oil contains water and/or dirt particles, the air bubbles are retained in the oil in a dispersed manner. If the oil is old, reaction products from the oil oxidation process can, for example, change the surface tension so that the air bubbles that have risen to the surface no longer burst. In other words, oil maintenance and oil aging have a major effect on the oil's foaming tendency.

In some cases, the foam can be reduced by filtering it more effectively. Nevertheless, the oil should regularly undergo lubrication analysis in order to detect oxidation and impurities in good time.

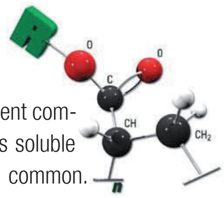
Mixtures

Foam rarely forms in systems with non-alloyed or mild-alloyed oil charges. However, the more additives an oil contains, the greater its tendency to foam. To counteract this effect, oils are charged during the production process with anti-foam additives that are usually based on silicone.

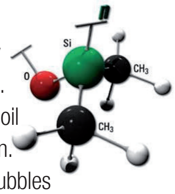
Caution when working with oil mixtures containing different additives. Even if oils are approved for the same application or meet the same specifications, this does not mean that they are compatible with one another. Foam can still form if an oil with a low concentration of additives is mixed with a product containing a high concentration of additives. Mixing synthetic oil with mineral oil can change the surface tension.

An oil analysis can be performed to quickly find the cause. A complete oil change is usually required after this. To avoid having to perform these high-cost measures, take care not to mix the oil types. Proper lubricant management is the best form of insurance against this.

Anti-foam additives



Foam inhibitors are polar active agent combinations with a component that is soluble in oil. Silicon-based materials are common. However, not every foam inhibitor contains silicon.



Anti-foam additives are systematically added to lubricants during production. They inhibit the cohesive force of the oil molecules and reduce surface tension. This makes the oil film covering the air bubbles thinner, meaning that they burst more easily, which reduces the chance of foam formation. If an excessive amount of foam develops during operation, the anti-foam additives may have been filtered out. They should not subsequently be added by the end user, as an overdose can be counterproductive. The polar active substances in the foam inhibitor provide the basis for the air and oxygen to bind, with the result that the oil ages more quickly. The lower surface tension reduces the size of the air pockets in the oil (i.e. below the surface of the oil). The oil's air release is then impaired. In general, always be careful when retroactively adding anti-foam agents.

Only a lubricant analysis is able to effectively determine the condition of the oil and its additives. An OELCHECK diagnosis of the values recorded during the analysis provides a strong basis for deciding which measures to take.

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QUESTION TIME

Zirconium – why does this element pop up in lab reports?

OELCHECK:
For many years now, automotive manufacturers have been able to reduce fuel consumption rates and CO_2 emissions while improving the performance of the engines that they produce. The latest generation of engine oils – known as „fuel economy oils" – are also making a signifi cant contribution. These engine oils, which are categorised as the new SAE classes 0W-16 and 0W-20, are 50% less viscous than the most common standard oils used today in viscosity class (X) W-40 (viscosity of approx. 7 mm²/s at 100 °C compared to approx. 14 mm²/s). This much lower viscosity reduces the rate of inner friction loss in the lubricant. Furthermore, modern, friction-reducing additives (or ‚friction modifi ers') positively infl uence fuel consumption. Between 1 % and 3 % more fuel can be saved through the use of these less viscous engine oils, with the percentage very much depending on the conditions of use of the engine in question.

However, viscosity is the most important property of oil when it comes to creating a protective lubricating film between all moving parts in the engine. The lower the viscosity, the thinner the lubricating film is on the parts, which increases the risk of wear and coming into contact with rough surfaces. Basic oils with a high stability and excellent viscosity temperature characteristics (or high viscosity index) are used in fuel economy oils, meaning that the oil does not become too viscous at high temperatures. Despite this, the engines in which these special oils are used also have to be structurally modified to cater for the lower viscosities and thinner lubricating films.
Fuel economy oils have now been adopted for use in many new vehicles, and it is extremely likely that in future, their qualities will be taken advantage of in other industries as well. Users should, however, be cautious about using these oils in older car engines. The low-viscosity engine oils should really only be used in engines where this has been expressly approved in advance. If this approval is not received, their usage may lead to increased wear and tear and even damage to the engine.
Despite this, vehicle manufacturers fear that these low-viscosity fuel economy oils may be used in older engines anyway due to their advantages – this is despite the fact that these special lubricants are not suitable for use. To find out about the oil type used as quickly as possible in the event of engine issues, zirconium (Zr) is used as a marker in many fuel economy oils for passenger cars. This element is especially suitable to be used as a marker, as it does not serve any other purpose in the lubricant and cannot arise as an impurity or wear element. As such, if zirconium is detected in an engine oil sample (at a rate of approximately 20 mg/kg for fuel economy oils), this proves that a fuel economy oil has been used.

OELCHECK now specifies the zirconium content along with around 30 other elements via ICP. However, zirconium is only listed in the lab report for engine oil analyses and only if the content is more than 1 mg/kg. The zirconium content indicates whether fresh and used oils comprise fuel economy engine oils. This makes it simple to determine the type of fresh oil to be applied or type of oil that was used in the event of damage.

This useful marker is already in widespread use. For example, all fuel economy oils approved by VW have to contain zirconium.

OELCHECK is ready to answer any questions you may have about tribology or lubricant analysis.
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