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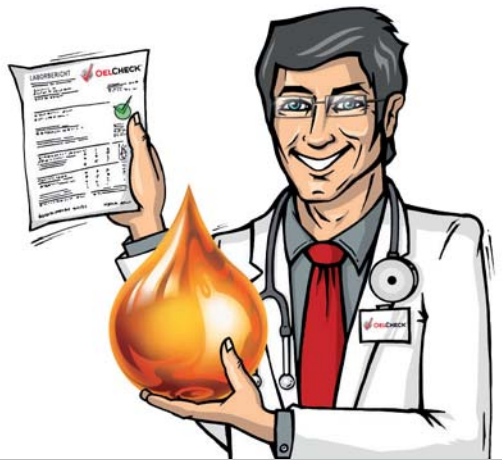


The intelligent giants from Konecranes

Typically Konecranes: intelligent machines combined with intelligent services

Konecranes is among the world's leading manufacturers of hoists and cranes. The „Equipment" division develops and produces industrial and heavy-duty cranes, power plant cranes, port technology and heavy-duty forklift trucks.

Customers include companies in the production, energy and process industries, shipyards, ports and freight terminals. With the aim of „Lifting Businesses™", Konecranes is committed to lifting loads – and to raising the productivity of its customers.

Konecranes was one of the first companies to actively focus on the area of preventive maintenance and to develop modern, innovative service products and diagnostics. In the service division, the company offers services for hoists, cranes and machine tools for all manufacturers. Intelligent machines working hand in hand with intelligent services is already a reality at Konecranes.

Strongly service-oriented, the company is represented across 26 locations in Germany alone. More than 250 qualified service engineers are on hand every day with their perfectly equipped service vehicles to be deployed to customers. The specialists carry out inspections, preventive maintenance and repairs. On board the service vehicles are the practical analysis kits from OELCHECK. Oil analyses are an important part of the maintenance concept for all gears in hoists and crane systems of various types.

Gears made by Konecranes

The production of crane systems has a high production depth. In addition to the often gigantic welded structures, Konecranes also produces all gears, including gear parts. In a gantry crane, for example, there are at least three, usually six hoist, winch and crane trolley gears. Gears with an output power of up to 580 kW and an output torque of up to 380,000 Nm are used here. Gears are treated with mineral-oil-based CLP industrial gear oils in viscosity groups 100, 150 or 220, depending on the type of gears.

The oil volume is between 8 and 320 l. Notwithstanding the oil analyses, the oil is changed at intervals of two or five years depending on the type of gears, the engine group, and the specific system.

Check-up

In the OELCHECK laboratory, all testing devices are precisely tailored to the specific requirements of inspecting lubricants. Installation and calibration of a new device is highly labour-intensive. Preparation can take a considerable amount of time. The standard of our equipment and workflows, as well as the standards we set for ourselves, are nevertheless extremely high. And when a new device is finally put to use, it is crucial that everything is perfectly adjusted.

We give our all to testing customers' lubricants as thoroughly as possible. However, we would like to find out how satisfied our customers are with our services by carrying out another large-scale customer survey. This was planned for the autumn of this year. We consider this type of survey just as critically as we do our testing devices in the laboratory. All of the parameters must be conducive to obtaining meaningful results. We would like to use our survey to put our new customer portal www.lab.report, among other things, under the microscope. The portal allows you to submit and manage samples, as well as control actions, more easily. However, www.lab.report has only been online for a few months. Our customers should have the opportunity to gain more experience of using the portal and its many functions before they evaluate it. We would therefore like to give you some more time and will not be conducting the survey until the spring of 2016. Ultimately our survey is also a test instrument and should therefore provide evidence as objective and reliable as our testing devices in the laboratory.

Yours, Barbara Weismann

Oil analyses for even greater safety

Konecranes uses the OELCHECK gear oil analyses mainly to detect damage at an early stage. Early detection of any damage to the gears, especially in hoist gears, is a key factor when it comes to increasing operational safety. In the worst-case scenario, unplanned and costly production downtime is also avoided.

The lubricant analyses are used in preventive maintenance and CRS (Crane Reliability Survey) inspections to assess the condition of crane systems as part of the assessment of the remaining lifetime. They are an integral part of the „Care" and „Commitment" service programmes. They are also offered by Konecranes as part of all other service programmes and for gear overhauls as a separate product.

The gear oils are checked at least once a year depending on the utilisation of the hoists and crane systems. OELCHECK examines the condition of the lubricants, checking meticulously for signs of possible wear on gearwheels, roller bearings and seals. Checks are also made for contaminants from water from high-pressure cleaners, or dust that can get in via ventilation filters. An element analysis using ICP provides information on the possible content of wear metals and contaminants, as well as the condition of the oil additives. The PQ index includes all magnetisable wear particles, regardless of their size. Additive depletion and oil oxidation are determined by FT-IR spectroscopy.

Working overhead – the gears of the gantry cranes are located overhead. Oil samples can be taken easily thanks to the practical OELCHECK sampling pump.

Planning and inspection with intelligent service system

Konecranes combines intelligent machines with intelligent services. An important element of this is MAINMAN 4, the unique ERP (Enterprise Resource Planning) system from Konecranes. With MAINMAN 4, customers benefit from the following maintenance and inspection features:

- Paperless service for sending inspection reports
- Integrated business and safety reviews
- YourKonecranes.com: a web portal with real-time access to all systems data and services performed
- Modern, comprehensive safety reports in which relevant causes of problems and risks are highlighted.

All laboratory reports by OELCHECK are integrated into the ERP system and archived with a commentary under the respective component. The intelligent system not only offers detailed insights into the condition of the machinery, it also allows routine maintenance work such as adjustments and lubrication. It is an holistic system offering a range of services unparalleled in the crane industry.

Konecranes – a global market leader in Lifting Businesses™

The history of Konecranes dates back to 1910, the year the electric motor repair shop KONE was founded in Finland. Konecranes was founded as an independent company in 1994 when it separated from the company KONE. Today Konecranes is a global market leader in Lifting Businesses™. The group employs around 12,000 people at 600 sites in almost 50 countries.

Further information: www.konecranes.de

OELCHECK innovation –
The IR Index sets new standards

In recent years, FT-IR (Fourier Transform Infrared) spectroscopy has become established as one of the most important techniques for assessing used lubricants. Whether for oils or greases, OELCHECK produces an infrared diagram during every analysis. This examines possible ageing of the lubricant, detects contaminants and identifies mixture with other types of oil. The analysis of the IR spectrum informs the diagnosis of the OELCHECK engineers. Every OELCHECK laboratory report includes a diagram of the infrared spectra of the used lubricant and its fresh counterpart, provided the oil designation has been given. However, extensive knowledge is required to be able to interpret an infrared spectrum. This is provided in specific OilDoc seminars or as online training. For those who do not wish to study the subject in quite as much depth, the new IR index from OELCHECK now offers a reference value to enable a faster understanding when comparing two IR spectra.

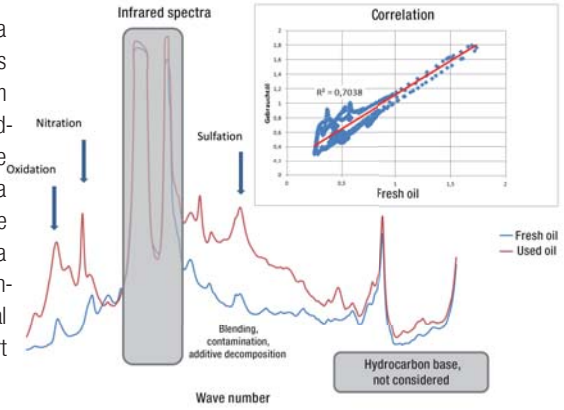
OELCHECK is currently the only laboratory that reliably calculates and communicates this value!

The principle of FT-IR spectroscopy is based on there being different molecules present in the lubricant which, because of their typical chemical structures, absorb infrared light to different degrees with certain wavelengths. Changes in the used oil can be compared to the fresh oil reference spectrum and depicted, calculated and interpreted as a deviation from typical „peaks“ or changes in areas for certain „wave numbers“.
The infrared spectrum of a sample provides information on ageing-related changes in the oil and contaminants from water, soot, other oil or fuel compared to the spectrum of a corresponding fresh oil or reference oil. Every spectrum is as unique as an individual human fingerprint.

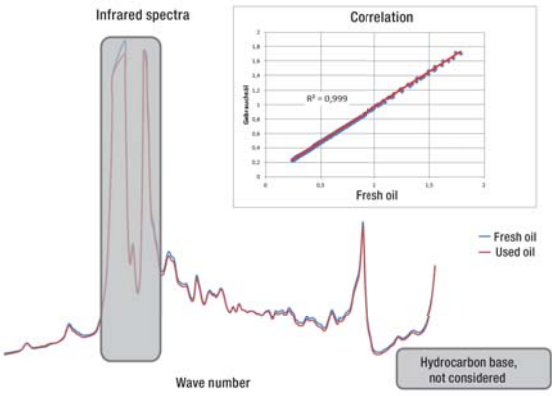
The diagram of the IR spectra of the used and corresponding fresh oil have been provided on the OELCHECK laboratory reports as standard for years. However, this service is now being enhanced with an essential component. OELCHECK has installed two new additional „PerkinElmer Spectrum Two“ testing devices in the laboratory. As state-of-the-art devices, they are not only considerably more compact than their predecessor models, but with an integrated autosampler they also work faster and calculate an IR index using OELCHECK-enhanced software which is now given in all laboratory reports. This means that OELCHECK is currently the only laboratory that reliably calculates and communicates this value!

The IR index allows a faster understanding of the findings of the respective IR spectrum. The higher this is, the smaller the changes in the used oil sample are in relation to the fresh oil or reference sample.
When considering the IR index in question, it is essential that the oil type is known. While a value below 99 could be cause for concern in a turbine oil, for example, the limit for an engine oil is around 85. The IR index is calculated using linear regression. This can be represented visually in a diagram. For each wave number, the absorption in the fresh oil is plotted against the x-axis and in the used oil against the y-axis.

When there is absolute correlation, this produces a straight line. (However, particular regions, such as those with extremely high absorption resulting from hydrocarbon bases, are not relevant and are excluded.) The closer the points being compared are to the straight lines, the lower the deviations. Given that a graph is difficult to read, we do not include one in the laboratory reports, but instead show the two spectra in a diagram (which can also be downloaded and enlarged at www.lab.report). We also give the practical numerical value of the IR index in the laboratory report as a correlation coefficient.



Two examples are shown on the right:
Above: The IR index of a used motor oil is only 70.38! The two spectra deviate significantly from each other in some regions as a result of high oxidation, nitration and sulfation of the used oil. The regression line illustrates this accordingly. The lubricant has aged considerably and must be changed as a matter of urgency. The cause of the extreme ageing must also be identified and remedied.
Below: Here everything is as it should be. The IR index is 99.90. The spectra virtually coincide. Correspondingly, there is virtually no change in the used oil compared to the fresh oil. Further use may still be considered even if the values for the additives and wear elements and the viscosity values fall within the permitted limits.



OELCHECK customers benefit from our experience, unique service and pioneering innovations. For example, as the first laboratory for lubricant analysis, we introduced the PQ index back in 1994. Unlike with elemental analysis using ICP or RDE, with the PQ index magnetisable iron particles are also recorded, regardless of their size. As a key element in the early detection of wear, today the PQ index is a universal standard. OELCHECK has been performing IR spectroscopy for all samples for 25 years and now has approximately 2.5 million spectra in its database. For 15 years the spectra have been printed in the laboratory report and can be downloaded from the customer portal.
With the new IR index, OELCHECK is once again setting standards, providing an important value with a practical application for faster assessment of the two IR spectra being compared. The new IR index is not a substitute for the assessment of the spectra by OELCHECK diagnostic engineers. Rather, users of our laboratory reports can now use the given values of the IR index to gain a clearer understanding, as opposed to making a time-consuming visual comparison of the spectra. This will allow you to see at a glance whether the values of the used oil and fresh oil still correspond to one another to such an extent that no oil change is required.

Six jokers in the pack – The OELCHECK all inclusive kit for wind turbines

QUOTATIONS & ORDERS
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Nowadays wind power can and must be able to keep pace with conventional power plant technology in terms of production and operating costs. Maximum availability is also essential. Optimised, proactive maintenance plans are the key to success, and lubricant analysis plays an important role in this.

While it used to be the main gearbox that took centre stage in oil analysis, nowadays the hydraulics, grease-lubricated main, blade and generator bearings, as well as the pitch gears in offshore plants, are also monitored.

For every one of these components and its lubricant, OELCHECK offers analysis kits with the appropriate analysis scope. However, it is desirable to have as little baggage as possible when ascending to the lofty heights of a wind turbine. **Thanks to the new all inclusive sample kit for wind turbines from OELCHECK, the work of the service engineers is made considerably easier.** Rather than having multiple containers with different coloured caps, the engineers now have just one type of sample bottle. The bottles have been budgeted at the same price. The same type of kit can be used for the lubricants that are being inspected according to requirements, regardless of the wind energy plant component.

When the samples arrive in the laboratory, the **mint green cap signals „Attention! Sample from a wind turbine!“**. The bottles can hold gear or hydraulics oils, as well as grease samples. All of the important information relating to this is provided by the coded Sample Information Form. As before, the scopes of analysis are tailored precisely to the respective lubricant and component.

Six sample containers in the analysis box at a unit price: Six jokers for inspecting gear oils, hydraulic fluids and greases from wind turbines

The service engineers can also make their work even easier by entering the samples into our customer portal at **www.lab.report**, either on their PC or via the QR code on the wind turbine. The laboratory number under which they have entered the samples is stuck onto the container. The Sample Information Form do not need to be completed by hand and enclosed.

Our customer service team will be happy to advise you and will prepare an individual quotation according to your requirements.

NEW! Determining the oxidative stability of lubricating greases

OELCHECK offers special analysis kits for the inspection of lubricating greases and implements for grease sampling (find out more in the Winter 2012 issue of OelChecker). An increasing number of lubricating greases are used for long-term or even lifetime lubrication. Grease manufacturers and OEM design engineers in particular should know the oxidative stability of the relevant greases in advance. After all, even long-term greases age. High temperatures and ambient oxygen above all cause the grease to oxidise.

It is not always possible to assess a fresh grease in a complex roller bearing test, for example the FE 8 with a test run with 10 bearings. Moreover, it is often difficult to find out comparable values, especially of lubricating greases sold outside of Germany.

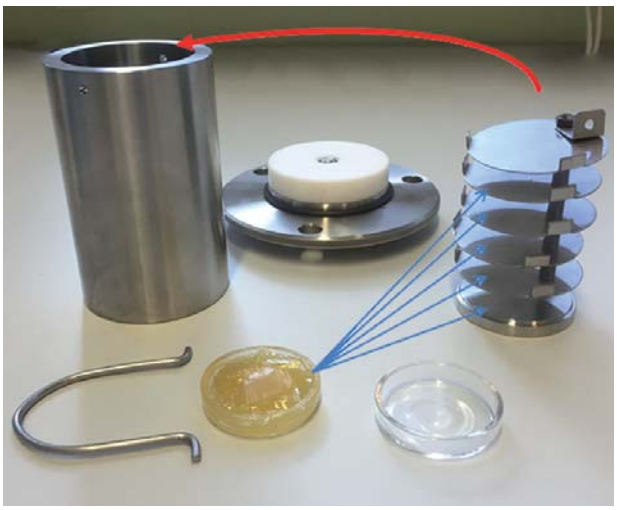
To ensure that consistent information on oxidation-related relubrication intervals can be provided, from now on OELCHECK will also test the oxidative stability of lubricating greases.

The test is conducted in accordance with the guidelines of ASTM D942 and serves, among other things, as a means of comparison and quality control of fresh greases.

For this test, RPVOT test equipment, which is used routinely to determine the oxidative stability of turbine oils, was fitted with an additional piece of apparatus in the OELCHECK laboratory for taking grease samples.

In the test, the lubricating grease is subjected to pure oxygen inside a hermetically sealed pressure chamber at an elevated temperature. The oxygen is consumed by the process of oxidation, which in turn lowers the pressure in the pressure chamber. Given that there are oxidation inhibitors in the lubricating grease, this drop in pressure can be prevented for as long as the additives can buffer the oxygen.

Ageing is simulated for a specified time (typically 100 or 200 h). The result is a drop in pressure during this period. The oxidative stability of the lubricating grease as a whole is determined, not just that of the separated base oil. The values that are ascertained from this process indicate the oxidative stability of the grease in its practical application. The longer it takes for the drop in pressure to register, the better equipped the grease is against premature ageing.

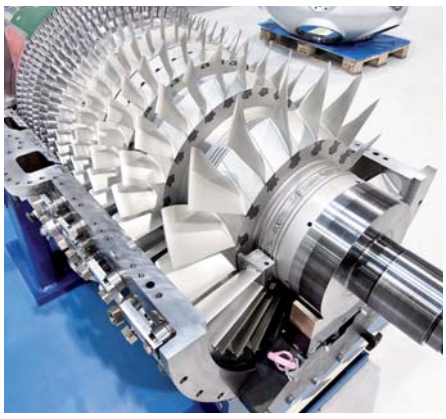


In five Petri dishes, each with a diameter of 40 mm, 4 g of grease are weighed out and spread evenly. Once they have been placed securely in a rack, the Petri dishes are put into the pressure chamber. After repeated injections of oxygen to pressurise the air, the pressure chamber is set to a pressure of 110 psi (approx. 7.5 bar) and a temperature of 99 °C. The pressure is then recorded continually for the duration of the test.

MAN Diesel & Turbo – PrimeServ for China

In China customers also receive one-stop service with MDT PrimeServ (e.g. assembly of a steam turbine).

MAN PrimeServ is the service brand of MAN Diesel & Turbo (MDT) and is synonymous worldwide with first-class after-sales service – 24 hours a day, 365 days a year. MAN PrimeServ has a global presence with more than 115 subsidiaries in all key markets and relevant ports. The company is of course also active in China, with MDT PrimeServ China being developed into an increasingly independent organisational entity. This is due to incorporate all areas of the service division, from sales, project management, technical consultancy, inspections and repairs in the workshops to planned and, in particular, emergency services on-site. Operations are currently based at two sites in Shanghai and Peking. The company also runs a comprehensive service workshop in Changzhou in the east of the country.



View of a 6.9 MW gas turbine

MDT PrimeServ China focuses on gas and steam turbines, axial and radial compressors, geared compressors, screw compressors and expanders. Around 80 service personnel work solely on maintaining turbo machines. Just as they do in Europe, the highly qualified service team offers an outstanding service and first-class technical support. With MDT PrimeServ, customers receive „one-stop service“: an outstanding global network, technical expertise, optimised processes and a strong service mentality.

There is close cooperation with the development sites in Europe. After all, only state-of-the-art, tailor-made solutions are supplied by MDT in China too. Systematic use of original spare parts also contributes to a long service life and efficient operation of the systems. The specialists from MDT PrimeServ China carry out inspections and repairs. They modernise, relocate and expand existing systems. And for emergency cases they are on call around the clock.

Condition-based monitoring

For operators of turbo machines in China, a service package is particularly important when it comes to overhauling complete systems. With „condition-based monitoring“, MDT PrimeServ China plans the machine overhaul in collaboration with you. This also involves ongoing monitoring of certain operational parameters, such as the oil and steam quality, vibration behaviour using vibration analysis, and bearing vibrations and temperatures using online monitoring.

Regular diagnostic assessments, including endoscopies using a borescope, are also conducted on-site. All

Inserting a rotor into the plain bearing

of this helps customers to optimise the availability of their systems and save money.

Hot on the trail of the latest trends with oil analyses

Up to 30,000 litres of turbine oil of ISO-VG 46 are used in a standard system, often over several years. However, only oils that comply with the specifications stipulated by MDT's own laboratory in Oberhausen can be used for this. The lifetime of the turbine oil is ultimately not only dependent on the choice of oil, but on oil monitoring, servicing and cleaning. Turbine oils must therefore be monitored carefully. For around two years, OELCHECK lubricant analyses have been the first choice for routine analyses in China.

The specific range of analyses for the turbine oils was decided upon jointly by the MDT laboratory, the technical consultants in Oberhausen and OELCHECK. As well as monitoring the antioxidants, contaminants are also detected at an early stage. This is important because even slight changes can adversely affect oil ageing, demulsibility capacity, wear protection and foaming characteristics of turbine oils.

Provided that the operating conditions do not change significantly, the oil analyses also provide important trend data which can be used to predict the remaining lifetime of the oil and to plan necessary oil maintenance in-time and proactive. Ideally the turbine oils should be analysed regularly in an OELCHECK laboratory at intervals of 3 to 6 months, with additional feedback from MDT PrimeServ. In China, our laboratory in Guangzhou is responsible for this – another advantage for MDT PrimeServ China and its customers!

The MAN PrimeServ China head office in Shanghai

Higher sustainability and energy efficiency thanks to modern lubricants – just a promise or already a reality?

The two catchwords „energy efficiency“ and „sustainability“ have become almost overused whenever newly developed lubricants are unveiled. But there is still progress to be made in the manufacturing industry when it comes to sustainability, and increasing the energy efficiency of systems and machinery is an important part of this. While it is hard to imagine, the potential for this is still far from being fully realised. It is not only the lubricants used that have an important role to play in this optimisation process, but the consistent monitoring of them through oil analyses. But what promises can be made that are actually realistic? How can lubricants‘ contribution to energy efficiency and sustainability even be quantified? And how should oils and greases be designed to bring about the positive effects that are expected?

Sustainability – the potential is still far from being fully realised

Extending the lifetime of components, as well as that of oil charges, has taken on the sound of a mantra! Modern lubricants should be designed increasingly with the purpose of remaining usable for longer. The mineral oil industry is looking increasingly to better, often synthetic base oils as the simplest way of achieving this aim. In contrast to pure mineral oil refining, the molecular structures of the base oils are changed during the production process in such a way as to create positive characteristics, like an increased ageing stability or improved viscosity-temperature behaviour. Modern high-potency oxidation inhibitors based on salicylates, phenols or amines also help to retard the ageing process of the lubricants during use. Nowadays it is possible even for some high-performance industrial gear and hydraulic oils, as well as turbine oils, to remain in use for over 50,000 operating hours, or around 10 years. Nevertheless, even the best long-term lubricant has its limits.

In contrast to the aim of achieving longer lifetimes, many lubricants are still being changed even when their potential is far from being fully exploited. This means that enormous potential is being destroyed every year. If the approximately 1 million tonnes of lubricant used in Germany alone was only replaced when it was technically necessary, around 30% of that, or 300,000 tonnes/350 million litres, could be saved every year. Although more and more companies are managing their oil change intervals using trend analyses, only a fraction of this enormous savings potential is being realised.

However, rather than changing oils at fixed intervals, OEMs are now increasingly recommending that oils be changed according to their condition. For this purpose, many machine manufacturers offer OELCHECK analysis kits, often as part of their spare parts ranges.

Temperature-dependent oil oxidation

Usage time of the oil charge in h	Conventional mineral oils	Hydrocracked oils	PAO synthetic oils	Ester-based synthetic oils	Glycol-based synthetic oils
40,000	40	50	60	60	65
30,000	45	55	65	65	70
20,000	50	60	75	75	75
10,000	60	70	85	85	90
5,000	70	80	100	100	105
2,500	80	90	115	115	120
1,250	90	100	130	130	135
675	100	110	145	145	150

In an ideal case, conventional lubricants can remain in use in industrial applications at 40°C for 40,000 hours (approx. five years in three-shift operation) without needing changed as a result of oxidation and ageing. The temperature threshold for oxidation-related changes is higher for other types of oils.
As a rule of thumb, for every temperature increase of 10°C the oxidation-related lifetime of oils in Groups I and II halves. For synthetic oils, the baseline temperature is higher and the oxidation-related lifetime halves for every increase of 15°C.

The analyses not only allow oil changes to be made on a condition-dependent basis, they also allow damage to be detected at an early stage, thereby ensuring fail-safe operation of machines and systems. The monitoring of oils and motors in biogas plants, for example, which are exposed to particular risk on account of the often variable, sometimes aggressive gas compositions, prove how well this can work. Lubricant analyses are also the indispensable method of choice when it comes to using new types of lubricant for which there is no empirical evidence to indicate a possible application period.

Higher energy efficiency – just a promise or a reality?

For private individuals, good thermal insulation reduces household heating costs, while service technicians are promised that the energy consumption of their vehicles and machines can be reduced by using selected lubricants. However, given the vague nature of these promises, they are not worth very much. Ultimately the much-touted lubricants tend to be considerably more expensive; buying them should be economically profitable and result in a marked reduction in energy costs.

Before there is a wholesale change in the type of lubricant used, ideally a single system should be changed to begin with, whereby the energy consumption of the system is ascertained under the same operating conditions and the values from before and after the oil change are compared. However, comparing the energy consumption is not always possible, or may only be possible at considerable expense. It becomes very tricky when, for example, lubricant manufacturers claim that the efficiency of the main gears in a wind turbine, for instance, will be increased to such an extent that more electricity will be fed into the grid at the same wind speed as a result of reduced friction loss in the gears. The electricity feed-in from an individual wind turbine is dependent on several factors and it is difficult to verify that the lubricant has had the expected effect.

The prospects of increasing the energy efficiency of engines, hydraulic systems and industrial gears with lubricants are extremely variable. The extent of the lubricants‘ influence diverges significantly. Moreover, every application must be considered individually.

Efficiency, friction loss and the proportion that can be affected by lubricant			
Component	**Efficiency in %**	**Losses in %**	**Proportion affected by oil in %**
Spur gears	97 - 98	2 - 3	0.2 – 0.3
Hypoid gears	88 – 94	6 – 14	2 – 4
Bevel gears	92 – 94	6 – 8	2 – 4
Planetary gears	96 – 98	2 – 4	0.5 - 1
FZG automatic gears	83 - 85	15 - 17	3 – 5
7-speed DSG gears	88 – 91	9 - 12	2 – 3
Worm gears	60 – 75	25 - 40	8 - 14
Electric engine	90 – 95	5 – 10	0.05 – 0.1
Hydraulic system	80 – 90	10 – 20	4 - 8
Petrol engine	20 – 40	65 – 85	up to 6

Engines

To ensure the safe operation of innovative engines and fail-safe use of their exhaust gas treatment systems, appropriately designed engine oils are absolutely essential. At the same time, they should also help to reduce fuel consumption. The requirements for engine oils will be much higher in future. The latest ACEA and API specifications even include engine tests which can detect an energy saving.

In practice, when using appropriately designed engines and under optimal conditions, fuel savings of between 1.8 % and 5.5 % can be achieved compared to a reference oil – usually an SAE 15W40 or 20W50 – by switching to another type of oil with a different viscosity.

In principal, an engine runs more smoothly with a low-viscosity oil thanks to reduced pump and splash losses, and therefore also consumes less fuel. As a result, the trend is toward thinner and thinner engine oils. For example, an SAE 0W16-class engine oil has already been designed for one type of engine, and it is likely that engine oils in SAE classes 0W12 and 0W8 will soon be available on the market.

However, there are also limits to this development. On the one hand, the low-viscosity engine oil must be able to form a resilient film in order to reliably protect the moving parts against friction and wear. On the other hand, there can be problems with evaporation loss (to find out more see OelChecker Spring 2015), which usually increases as the viscosity of the base oils decreases. Some of the engine oil which has evaporated as a result of increased engine oil temperatures in the oil sump is led through the crankcase ventilation system into the air-fuel mixture and burned with it. The combustion residues can then impair the effect of catalytic converters or soot filters.

It is also true that the lower the loss of oil due to evaporation, the lower the oil consumption is and the more stable its viscosity characteristics are. However, low-viscosity engine oils tend to display greater evaporation loss, which can lead to increased viscosity during operation. The originally much-praised low-friction characteristics of the oil therefore decline as a result, while the fuel and oil consumption increases.

The relatively low-viscosity engine oils in viscosity class SAE 0W-30 that are currently available on the market can only be achieved using thinner synthetic base oils. If the viscosity is to be reduced even further in future, this will present a particular challenge for lubricant manufacturers as they will have to endow these engine oils with characteristics that will ensure low evaporation loss, as well as all of the other characteristics that are important for the safe operation of the engines. However, products designed in this way will certainly come at a price. And even the perfect engine oil will only be able to lower the fuel and oil consumption significantly if the driving is suitably prudent. It should also be taken into account that the newly developed oil types can no longer be used wholesale for older engine types, as their components are not designed for such low-viscosity oils.

Hydraulic systems

The performance of hydraulic systems is increasing, and the systems themselves are getting smaller. Reduced gap tolerances in valves, pumps and engines and better surface qualities allow higher operating pressures and enable system components to work more precisely. At the same time, ever increasing system availability, even under extreme operating conditions, is required.

However, smaller oil charges, higher pressures and increased operating temperatures create intensified working conditions which a conventional mineral-oil-based hydraulic oil in class HLP or HLPD can barely withstand. All lubricants and power transmission media also age during their lifetime. This ageing process is caused in part by oxidation. High temperatures, long service lives, high pressures and in some cases even contaminants and wear particles all accelerate the ageing process. In order to delay ageing for as long as possible, the fluids contain antioxidants. However, these can also decompose during oil use, just like extreme pressure agents or anti-wear agents. With the addition of extreme operating conditions, temperatures increase as a result of power dissipation, which further accelerates oil ageing. And throughout this process, the viscosity of the oil also decreases, which is a key factor affecting the efficiency of the hydraulic system.

Extensive tests with vane pumps, gear pumps and piston pumps have demonstrated that the viscosity of the hydraulic fluid has a considerable effect on the efficiency of the pump. Its hydraulic efficiency is dependent on the oil viscosity at the pump inlet, as well as on the pump speed and pressure. Therefore, the oil viscosity not only affects the efficiency of the pump as a whole but the energy consumption as well. For this reason, the viscosity of the hydraulic fluid should remain as constant as possible for the entire period of operation, from start-up right up to high-load operation.

To ensure this, increasingly hydraulic oils with multi-grade characteristics of type HVLP or HVLPD are being used, which, in contrast to HLP oils, have a very high viscosity index of almost 200. In principle, these types of oils have a positive effect on energy consumption because even at temperatures of over 80 °C the minimum viscosity is not exceeded. However, the relatively high proportion of viscosity index improvers often present in the multi-grade oils can impair the air separation ability to such an extent that cavitation damage starts to appear. To avoid this as much as possible, hydraulics manufacturers allow oils that are thinner, with the result that the maximum permissible temperature for use of these types of oils must be reduced. This is the only way to be on the safe side in case of any shearing of the viscosity index improvers. In practice, the use of these multi-grade hydraulic oils at low start-up temperatures is ideal, but at very high operating temperatures they reach their limits. If the fluid becomes too „thin“, the hydraulics in construction machinery, for example, become more difficult to control or start to work imprecisely.

In an attempt to resolve this dilemma, one of the leading international additive manufacturers has designed a special package of hydraulic oil active agents that is used by a number of lubricant manufacturers. The ready-made products, which are usually based on base oils in Groups I or II, meet the requirements of DIN 51524/3 for HVLP hydraulic oils. The new technology allows low-viscosity hydraulic oils to be used over a wider operating temperature range. This means that the efficiency of the hydraulic systems is increasing, while the

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energy consumption of the systems is decreasing. Compared to a conventional HLP hydraulic oil, the efficiency of the machine overall can only be increased by changing the type of oil. In practice, this means higher hydraulic pressures under full load, more precise reaction of the system and, above all, reduced energy consumption, meaning a reduction in the resultant oil temperature and energy-intensive cooling output. The manufacturer of the additive package expects a potential efficiency increase of around 5% and has demonstrated this in mobile hydraulic systems with extensive field tests.
Whether using one of the somewhat expensive fluids included in the innovative additive package pays off simply on account of the reduced energy consumption must be considered on a case-by-case basis.

Gears

Specially designed gear oils are playing an increasingly important role in increasing the efficiency of manual transmission, automatic and hypoid vehicle gears, as well as industrial gears. However, this cannot be achieved, as is customary with engine oils and hydraulic oils, by using a thinner oil in conjunction with structural changes. To improve the energy efficiency of industrial oils, ingenious mixtures of different types of base oils and synergetic additive combinations are used. The gears should be able to transmit power as efficiently as possible. The level of efficiency is equal to the ratio of output power to drive power, while the output power equals the difference between drive power and power dissipation. If at a certain output power the efficiency level increases and power dissipation decreases, then less energy is required to drive the gears. This can be checked, for example, by measuring the power consumption. Minimising power dissipation, which is usually reflected by a lower temperature in a gearbox without additional cooling, also serves as a guide to increasing energy efficiency.
A considerable reduction in power consumption and operating temperature is therefore indicative of reduced friction, lower power dissipation and higher gear efficiency. At the same time, this type of lubricant oxidises considerably less, not least because of the lower operating temperatures, and can therefore be used over a longer period.
The effect of a gear oil on gear efficiency can be examined in practice using, among other things, the FZG's (Gear Research Centre at the Technische Universität München) tension test. Moreover, the programme WTplus, developed at the FZG as part of research projects commissioned by the FVA, is available for calculating the losses and thermal behaviour of complete gear systems.
However, the extent to which the respective gear oil can positively affect the efficiency, and therefore efficiency rating, of a gear type in practice can only be determined by practical application, taking into account the individual operating conditions.

It is beyond question that gear oil can affect efficiency, and therefore energy efficiency. However, it is important to bear in mind the relationships in individual cases. The percentages that are often used in lubricant sales to demonstrate savings potential usually only refer to the efficiency or power dissipation in the gearing.
Here is a simplified example: if the drive power is 100 kW and the output power is 97 kW, then the power dissipation is 3 kW or 3% of the drive power. If a very high reduction in power dissipation of 25% is achieved, then this 25% does not relate to the 100 kW, but just to the 3 kW of power dissipation. This means that the gears need 0.75 kW or 750 W less power. It is doubtful in this case that this 750 W reduction in friction loss would be noticeable in the form of a lower gear oil temperature. Even here, the individual conditions must again be considered carefully and all factors taken into account.

Conclusion

Almost all lubricants can remain in use for longer, provided their use is accompanied by lubricant analyses and the length of intervals between changes are condition-dependent.

Compared to conventional oils, specially designed lubricants have the ability to positively affect the energy efficiency of systems. However, every application must be considered individually and the cost-benefit ratio carefully calculated. As these decision-making processes can often be very complex, the **OELCHECK advisory service** is on hand to help.

ON OUR OWN BEHALF

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Compliance with its own guidelines on quality and organisation of company processes, as well as the implementation of provisions of national and international law are an absolute must for us. Our high quality standards extend to every area of the company. OELCHECK GmbH's quality management system has thus had DIN EN ISO 9001 certification since 1995. In 2001, it then secured DIN EN ISO 14001 certification for its environmental management system. Selected test procedures have been accredited in accordance with DIN EN ISO/IEC 17025 since 2009. The relevant monitoring audits are carried out at regular intervals. In August 2015 our two certifications were reviewed by ALL-CERT Gesellschaft für Zertifizierungen mbH and in September the accreditation was reviewed by the Deutsche Akkreditierungsstelle GmbH. The results were once again impressive!

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