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OELCHECKER

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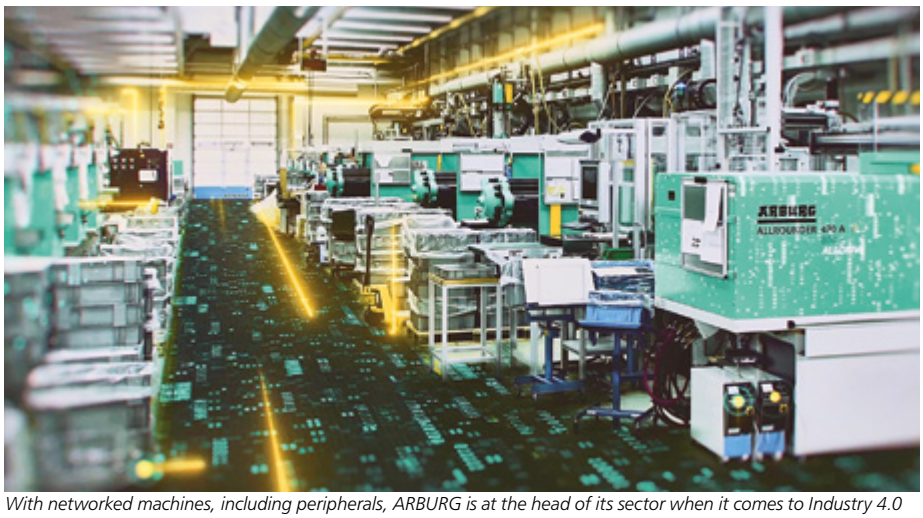
ARBURG – Your competent partner for efficient injection moulding



With networked machines, including peripherals, ARBURG is at the head of its sector when it comes to Industry 4.0

Plastic is booming!

A total of 348 million tons of plastic products were produced worldwide in 2017; that's a 3.8 percent increase on the previous year. And these products include far more than just plastic packaging. Among other things, plastics are also used to manufacture components for the automotive industry, electronic communication and entertainment devices, and medical equipment. When it comes to getting more out of plastics, the German mechanical engineering company ARBURG has the ideal solutions.

One of the world's leading manufacturers of machines for processing plastics, ARBURG is also a pioneer in its sector, driving development in key areas such as production efficiency, Industry 4.0, and digitalization.

The company's product range encompasses hydraulic, hybrid, and electric ALLROUNDER injection moulding machines with clamping forces between 125 and 6,500 kN, while the Freeformer additive manufacturing system, together with robotic systems, client and sector-specific turnkey solutions and other peripherals, rounds out ARBURG's wide variety of modular machines.

ARBURG puts manufacturing efficiency at the heart of everything it does, and does so with the entire value chain in mind. Its objective is to ensure that ARBURG's clients can manufacture their plastic products to the highest quality standards and at minimal unit costs, from individual parts to large-volume production.

Whatever the injection moulding task at hand, ARBURG has just the technology and the processes that their customer needs - in modular form and individually tailored. Its machines are manufactured exclusively at ARBURG's German main plant in Loßburg, Baden-Württemberg, where a first-class customer support experience is also provided on-site by ARBURG's global sales and service network.

Hydraulic oils to meet the highest requirements

Hydraulic, hybrid, and electric ALL-ROUNDER injection moulding machines require high-quality hydraulic oils. In the case of smaller machines, the quantity of oil used is generally between 40 and 80 litres, whereas mid-sized machines can use as many as 320 litres. The large hydraulic and hybrid ALLROUNDERS use between 400 and 800 litres of oil. In addition to lubricating, cooling and protecting pumps and moving components, the main task of hydraulic oils is power transfer, including provision of dynamic injection and retention forces. The clamping force

Check-up

Nobody knows OELCHECK better than our employees. And it's their honest judgement of our company in the latest employee survey of October 2018 that we have to thank for making us winners of the DREAM COMPANY Award again, which we first brought home in 2009.

This award recognizes companies which have distinguished themselves with an exceptionally employee-friendly and appreciative corporate culture. That OELCHECK meets this exacting requirement is amply demonstrated by what the people who work for us had to say. And as far as they're concerned, OELCHECK is a company that its employees are happy to recommend to others! Among other things, they appreciate our excellent teamwork culture, our ideally equipped workspaces (including air conditioning), and the ready availability of all of the resources they need to perform their jobs to the highest standard. The socially-minded attitude taken by our management is also reflected in the social benefits that we provide for our employees. Special emphasis is placed on promoting health in the workplace, for example, with a gym and fitness courses, a sauna, and a swimming pool available, together with unforgettable annual team events and an accident insurance policy for every employee that also covers non-occupational accidents.

Thanks to the votes of our co-workers and the fulfilment of other criteria, OELCHECK will now enjoy the status of DREAM COMPANY for another two-year period. The results achieved by the company in the survey have improved consistently since its first edition in 2009, even while the number of people that we employ has doubled during this time. Meanwhile, we have achieved a fantastic overall score of 80% in the DREAM COMPANY Awards ranking. This is no coincidence, but instead impressive proof of just how much value we place on an employee-friendly and appreciative corporate culture. And this isn't just a matter of management either; our employees have their part to play as well. At the end of the day, it's both dream bosses and dream employees that OELCHECK has to thank for its success as a dream company!

Yours, Barbara Weismann

spectrum of ARBURG injection moulding machines ranges from 125 to 6,500 kN.

For the ALLROUNDER models, HLP 46 fluids are the most commonly used, although HVLP 32 fluids are also used in individual cases. The majority of these are highly refined, mineral-oil based hydraulic oils with zinciferous additives, which give the oils EP characteristics. Partly or completely synthetic HVLP hydraulic oils or zinc-free fluids are also increasingly being used, however. Meanwhile in the food and pharmaceutical industries, physiologically harmless hydraulic oils with NSF-H1 registration or with kosher or halal certification are often used.

ARBURG specifies hydraulic oils with the following characteristics:

- Very good lubricity and high shear stability
- Outstanding EP and anti-wear protection and good ageing characteristics
- Very good air release time and minimal foam formation tendency
- Excellent demulsifying capacity and water separation
- High thermal resistance with low oxidation tendency
- Extremely good seal compatibility
- Good filterability, including a 1 µm filtration system
- Partially synthetic or synthetic fluids with a high viscosity index, and mineral oil-based HVLP oils without long-chain VI improvers
- Available worldwide, and always with the same level of performance.

Whatever the country in which a mineral oil company produces its lubricants, the fluids used in ARBURG injection moulding machines must always be of a consistent quality. The same requirement is posed by many internationally active machine manufacturers. When it comes to selecting base oils, this factor has an enormous impact. Until the turn of the millennium, hydraulic oils were manufactured predominantly from class I and II paraffin-based base oils. Today, increasing use is made of class III hydrocrack oils, as well as class IV synthetic oils based on poly-alpha olefin (PAO). These base oils can be produced worldwide with identical characteristics, although often only with difficulty. They give the hydraulic oils not only better oxidation stability, but also and most importantly a significantly higher viscosity index, so the viscosity of the oils is less sensitive to temperature.

In order to produce an HVLP oil with multigrade features from a mineral oil-based monograde HLP oil, special VI improvers must be added to the base oil. These consist mostly of long-chain hydrocarbon molecules, which contract at low temperatures and stretch at high ones. These are not shear-stable beyond a duration of use of over 10,000 operating hours, however, so their positive effect on the viscosity of the HVLP oils diminishes over the duration of use. This is why ARBURG specifies the use of mineral oil-based hydraulic fluids that do not contain any shear-sensitive VI improvers.

Oil analyses are a part of maintenance

For the operators of ARBURG injection moulding machines, OELCHECK lubricant analyses are an important part of monitoring oils and systems. An annual oil analysis is an integral component of the ALLROUNDER maintenance schedule. For even better monitoring, ARBURG recommends regular trend analyses at intervals of six months. This allows contamination and oxidation trends, as well as possible component failures, to be identified at an early stage. In the event that sources of errors are discovered, machine availability can be increased with preventative maintenance. In the case of large and heavily utilised machines, many operators use synthetic-based hydraulic fluids in addition to running trend analyses for condition-based oil changes. Based on OELCHECK lab reports and in consultation with ARBURG, oil change intervals of 20,000 operating hours can in many cases be extended, thereby significantly reducing expenditure on costly synthetic oils.

Analysis kits are always to hand

Most oil samples are taken by the plant operators. In order to be able to react quickly on-site and take oil samples at short notice, however, every ARBURG service engineer always has their own OELCHECK all-inclusive analysis kits to hand. If, for example, filters need to be changed unusually often, the oil shows increased foam formation, or there are doubts about the type of oil used or its quality, then these analyses can provide useful information. They help service engineers to quickly determine the causes and take appropriate action without delay.

Further information: www.arburg.com

E-mobility: Our expertise is in demand

Our colleagues Dr Thomas Fischer, Head of Scientific Research, and Arne Simon (MSc Chemical and Process Engineering), tribologist, are participating in a new **DIN committee** dedicated to the **electrical characteristics of oils**.

The committee is concerned with the **electrical characteristics of oils in relation to e-mobility**. Oils used in this sector must provide both lubrication and insulation, which is why the committee has the objective of identifying suitable methods for measuring the electrical characteristics of oils, including conductivity, permittivity, breakdown voltage, and dielectric dissipation factor.

Examining these electrical characteristics will reveal which oils are suitable for use, and will furthermore make it possible to monitor the ageing and alteration of oils.

As participants in this DIN committee, our OELCHECK colleagues are contributing their many years of expertise in lubricant and operating fluid analysis to the task at hand.

OELCHECK analysis kits: now also in Cyrillic

Since 1 November 2018, **LUBESERV** has been acting as an agent for marketing OELCHECK analysis kits in Russia, whilst also providing consultation on analysis-related questions. Following the current induction and training phase that will be completed by the end of January 2019, sales in Russia will be launched on an official basis. Our contact partners for Russia and China will be waiting to meet you in person at OELCHECK's booth at the OilDoc Conference in Rosenheim.

From 1 February 2019, processing and dispatch of lubricant samples from Russia and the CIS will be handled smoothly and conveniently by Lubeserv, which has its headquarters in Yekaterinburg. As with our exclusive agent in China, examination of the samples and diagnosis based on the lab results will naturally be carried out by our colleagues in Brannenburg. Our Russian customers will then receive their lab reports in the usual format, but in their native language and printed in the Cyrillic alphabet.

Sales of the analysis kits in Russia and transportation of the samples to Brannenburg will be handled by LUBESERV. The close cooperation established between OELCHECK and LUBESERV means that we can guarantee our Russian customers, as well as German machine manufacturers who require analysis data from this region, a smooth process for their lubricant and operating fluid analyses.

Contract signing with (from left to right) Paul Weismann (OELCHECK Managing Director), Oxana Gernlayn (LubeServ) and Steffen Bots (LubeServ)

Do you need to have samples from Russia or the CIS analysed?

Get in touch with us by phone on +49-8034-9047-250, or by email at sales@oelcheck.de.

Working together – winning together

Leading global brewery has its oils from China checked at OELCHECK

We have recently gained a major new customer in China: the breweries of **Anheuser-Busch InBev**. AB InBev is the largest brewery group in the world in terms of beer sales, and is also market leader in China where it has more than 40 breweries.

In China and many other countries, the company is best known for the US beer brand Budweiser. This is not its only big-name beer, however, with major German brands like Beck's also part of the group's product range.

The company anticipates that oil analyses from OELCHECK will help to optimize oil change intervals for its production and bottling machines. The majority of the chiller, gear, and hydraulic oils used by the company are presently changed once per year. Adapting to condition-dependent oil changes based on oil analyses offers enormous potential savings in this respect. The analyses should also permit better, more proactive early detection of damage, thereby helping to avoid unplanned downtime. Due to the full utilization of the Chinese breweries, every minute of unplanned downtime results in enormous costs and production losses.

AB InBev is entrusting the oil analyses for its refrigeration and CO_2 compressors, hydraulic presses, bottling plants, and mixer drives to our laboratory in Brannenburg. As is the case for all companies in China,

samples will be handled by OELCHECK's exclusive agent **LUBECHECK CHINA**, where Julie Qiu and her team not only sell our all-inclusive analysis kits, but also provide on-site support for questions relating to sampling and kit selection. They even translate the Chinese questions on the information forms and the diagnoses in the lab reports, and provide perfect all-round service that many customers in China have already come to value.

A new building is on the way

With the number of employees and samples on the OELCHECK premises constantly on the grow, things are starting to get a little bit cramped. That's why in 2019 we'll be building a brand new building that reflects our aspirations, including modern office and meeting spaces as well as a large cafeteria.

To make room for the new building, the car park presently located next to our head office at Kerschelweg 28 will have to go. The resulting proximity of the three buildings will ensure close and ideal cooperation between all of our departments. A new car park for 90 vehicles located close to our company buildings is already in the final stages of construction, and will be finished before the end of 2018.

Small sample, big benefit!

All-inclusive lubricating grease analysis by OELCHECK

Rolling and glide bearings, constant-velocity joints and open chainwheel drives generally have one thing in common: they are lubricated with grease. This applies in particular to more than 80% of rolling bearings, which are available in many different forms. Lubricating grease is involved in 75% of bearing failure incidents. For example, the grease may be contaminated, bled out, oxidised or aged, burdened with wear particles, or simply not present in an adequate amount. The good news is that if you use OELCHECK lubricating grease analyses to stay informed of the condition of the lubricating grease concerned, you can take countermeasures promptly and avoid failures.

Over 10% of the samples processed every day by OELCHECK (as many as 2,000) involve lubricating greases – which must be assessed just as thoroughly and reliably as oils, coolants and fuels. However, lubricating grease analysis is not straightforward due to the small sample volumes, and only a few labs worldwide are able to do this. One of them is OELCHECK. We have laboratory equipment that has been adapted to our wishes, as well as many years of experience in the assessment of grease samples.

Your ace for bearing lubrication: OELCHECK lubricating grease analyses

- Detect bearing wear and its causes at an early stage
- Distinguish between mechanical and corrosion wear
- Timely warning of lubricant oxidation and ageing
- Identify contaminants and their origins
- Detect mixing with other greases
- Helps with the optimisation of lubricant amounts and relubrication intervals

Lubricating grease analyses from OELCHECK make a major contribution to operational reliability and have a positive impact on maintenance costs.

All-inclusive analysis kits: for all applications and all issues

The handy OELCHECK all-inclusive analysis kits are a good choice for testing lubricating greases. However, the values provided by the test parameters in kits 1 and 2 are only suitable for trend analyses and assessment of fresh greases. For analysis of used grease with kits 3, 4 or 5, additional tests are performed to enable OELCHECK tribologists to make a comprehensive assessment. All-inclusive analysis kits 3 and 5 are specifically matched to the corresponding applications and issues. Our OELCHECK tribologists will be pleased to answer your questions about choosing the right analysis kit

Kit 1: The elements
The start of every analysis

After visual evaluation and photography of the lid, the sampling tube and the sample bottle, we determine more than 20 elements for every lubricating grease sample. Along with wear and contamination particles, we examine the active ingredients and additives already present in the fresh grease. Using atomic emission spectroscopy (AES) with the rotating disc electrode method, in which a small amount of grease is applied to a target turntable, up to 21 elements are determined quantitatively and stated in the lab report in units of mg/kg (ppm). These values are divided into three categories: wear elements, contaminants and additives.

- **Typical wear elements**
  Iron, chromium, tin, copper, lead, nickel, aluminium, molybdenum and zinc, as well as concentrations of vanadium, titanium, silver, antimony, manganese and tungsten. Elevated iron and chromium values, for example, indicate wear of a rolling bearing. Copper and zinc indicate wear of a brass bearing cage.
- **Typical contaminants**
  Silicon, calcium, sodium, potassium, aluminium, cadmium and bismuth. Silicon (dust) and calcium (lime) in particular, as deposits from hard water, can promote wear. Sodium can also come from salt water and cause corrosion wear.

New equipment deployed

We have equipped our laboratory with two new FT-IR spectrometers, each with an autosampler.

Each of these instruments can examine 480 samples in sequence. That allows 960 samples to be analysed in one night by these two devices alone. OELCHECK is already well equipped for further growth in the number of samples. With this new equipment set-up, we are again a pioneer because it has not yet been deployed in any other lab for lubricants and operating fluids. During the development process, we worked closely with the suppliers Axel Semrau GmbH & Co. KG for the autosamplers and Thermo Fisher Scientific GmbH for the FT-IR spectrometers. As a result, the instrument system is precisely tailored to our needs and makes the work easier for our staff.

We have additionally equipped our laboratory with another ICP-OES spectrometer. That means we now have five instruments available for the vital element analysis.

- **Typical additives and thickeners**
  Lithium, magnesium, calcium, phosphorus, zinc, barium, silicon, aluminium, molybdenum and boron. Their values are compared to those of the fresh grease. A change relative to a previous sample or the fresh grease can indicate mixing or reduced grease performance.

Kit 2: Kit 1 + iron particles and base oil modification

The basis for further assessment

In addition to the element values in kit 1, OELCHECK includes the Particle Quantifier (PQ) index in the scope of all-inclusive analysis kit 2 to identify even the smallest iron particles that can still be magnetised. AES is not able to stimulate particles larger than 2 µm strongly enough for reproducible indication. By contrast, the PQ index includes all particles present in the grease that are able to react to a magnetic field. Our OELCHECK tribologists know the relationships between the determined iron content in ppm and the PQ index and are able to make clear statements regarding the condition of the bearing concerned.

- For example, a high iron value with a relatively low PQ index is a sign of corrosion. Rust particles are barely magnetic, but they are so small that they can be measured with AES.
- A high PQ index together with a low AES value is a sign of contamination or material fatigue.

Furthermore, in kit 2 and above the base oil type and its modification by water or temperature is determined using FT-IR spectroscopy. The base oil is usually the main ingredient of a lubricating grease, with a share of more than 80%. The thermal characteristics and oxidation resistance of the base oil are decisive for the working temperature range of the grease, and in part for its ageing characteristics.

Fourier transform infrared (FT-IR) spectroscopy is based on the fact that the molecules in a grease absorb infrared light at specific wavelengths to different degrees due to their typical bond types. The Fourier transform makes the values readable, and the molecular vibrations can be shown in an FT-IR diagram. This produces peaks at relevant wave numbers, depending on the molecular bond. The deviations of the peaks at specific wave numbers can be recognised by comparing the FT-IR diagram of a used grease with the diagram of the fresh version of the same grease. Our OELCHECK tribologists can draw clear conclusions from this. FT-IR spectroscopy gives them the following indications:

- Whether the examined grease contains a mineral or synthetic base oil
- Whether a different type of grease than expected has been used
- If greases have been mixed or the wrong grease was used for relubrication
- Potential additive deterioration if the grease contains high-pressure additives, for example based on zinc phosphate compounds
- Any water penetration greater than 1%
- Whether a mineral oil-based grease has been oxidised and aged due to exposure to high temperature or lack of relubrication

However, when ester-based components are used, FT-IR spectroscopy cannot provide unambiguous information about their oxidation because the oxygen molecules present in the ester absorb infrared light in the same wave number region as the oxygen double bonds resulting from oxidation. In this case FT-IR spectroscopy meets its limits. As an alternative, a RULER test in an OELCHECK lab indicates whether the grease concerned has been overheated.

Kit 3: Kit 2 + quantitative water content

Against corrosion and rust

If too much water penetrates into a lubricating grease, more frequent relubrication is necessary. However, that is the least of the problems. If the grease cannot withstand the water, the soap structure changes and the grease becomes weak and soupy. In many cases the seals cannot contain the grease and it leaks out. If a grease is burdened with too much water, there is a risk of rust and corrosion, leading to bearing damage. On lubricating surfaces with high relative motion, water-induced cavitation often occurs.

All-inclusive lubricating grease kits 3 to 5 include determination of the exact water content in ppm using titration according to the elaborate Karl Fischer method. Too much water in the grease (more than 150 ppm) can have serious consequences.

In the Karl Fischer method, a small amount of grease is weighed into a tube that can be hermetically closed. The water is then slowly driven out of the grease in a lab oven at a temperature of 120 °C. The evaporated water, together with nitrogen, is fed through a hollow needle to a titration tube. There it reacts electrochemically with a specific solution. The water content of the grease in ppm (mg/kg) can be read precisely from the inflection point of the titration curve.

When assessing the analysis results, the OELCHECK tribologists also consider the relationship between the water content and the element values determined by AES. From that they can often see whether the water came from condensation, rain, tap water or salt water. This makes it easier for the customer on site to stop the water penetration. If the grease is contaminated with calcium, potassium, sodium and/or magnesium, that is usually a sign of hard tap water. In many cases, water has penetrated from high-pressure cleaning. If the above-mentioned elements are only present in low concentrations in the used grease, that is usually a sign of ‚soft' condensation or rainwater. If the sodium share clearly predominates, the water is probably salt water.

Kit 4: Kit 3 + residual oil content & bleeding test

Against loss of lubrication performance

As you might guess, bleeding out is not a good situation for a lubricating grease. When a grease bleeds out, it loses a considerable part of the base oil necessary for lubrication. If there is not enough oil present in a used grease, the impact can be dramatic. In the production of a lubricating grease, a boiled thickening agent, called the soap, is added to a base oil. The thickener holds the base oil in its sponge-like structure and slowly releases the oil to the lubricating surface. „Bleeding out" means that the oil flows too quickly and uncontrollably from the thickener structure. The grease dries out and can no longer perform its lubrication tasks. In many practical cases, excessive loss of base oil from a grease is initially only noticeable from strong oil fouling of the seal area and a need for more frequent relubrication. In such cases an immediate examination of the grease using OELCHECK all-inclusive kit 4 is recommended. In addition to the analysis methods in kits 1 to 3, it includes determination of the residual oil content.

For that purpose, the grease sample is heated to 60°C in the OELCHECK lab and held at that temperature for six hours. The percentage of the base oil lost from the thickener structure during this period is then determined. After that, the value for the used grease is compared to the value for the fresh grease. The following conclusions can usually be drawn from the results:

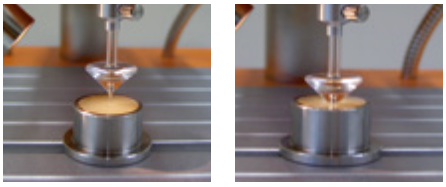
- **Base oil loss between 5 and 25%:**
  The grease can continue to be used without any change to the relubrication interval.
- **Base oil loss significantly higher than 25%**
  The grease is no longer suitable for use. To avoid damage, the causes must be determined promptly.
  - Due to high shaft speeds, loads or vibrations, the grease is simply unsuitable and its working temperature range is too low.
  - There have been errors in handling. The relubrication amount was too small. Incompatible greases were mixed. The grease was used for too long or not relubricated. In that case, the base oil is usually also oxidised or aged.
  - The grease is contaminated with water, acids or alkalis.
- **Base oil loss less than 5%:**
  If very little base oil escapes from the used grease, that is also not a good sign. In many cases, the grease has already been bled nearly dry. The bearing surface is starved of lubrication. Relubrication as quickly as possible is therefore necessary, or the relubrication interval must be shortened. It should also be checked if the grease that is being used is basically suitable for the task.

Kit 5: Kit 4 + penetration number: For a comprehensive assessment

With all-inclusive lubricating grease kit 5, the OELCHECK tribologists can comprehensively describe the condition of the grease and the lubricated component. Kit 5 is based on the tests of the previous kits, augmented by determination of the consistency by means of the penetration number. The consistency number expresses the relative stiffness of lubricating greases. Lubricating greases are assigned to nine consistency classes according to the classification system of the US National Lubricating and Grease Institute (NLGI). This makes it easy to see, for example, if a grease can be easily pumped through a central lubrication system.
However, the grease consistency can change during use. If it becomes significantly stiffer or softer, there is a risk to the component lubricated by the grease. That's why determination of the penetration number, and with it the consistency, is included in the scope of OELCHECK all-inclusive analysis kit 5.

NLGI-classes	Penetration numbers	Consistency at room temperature
000	445–475	Very liquid
00	400–430	Liquid
0	355–385	Semi-liquid
1	310–340	Very soft
2	265–295	Soft
3	220–250	Semi-solid
4	175–205	Solid
5	130–160	Very solid
6	85–115	Extremely solid

NLGI classes: Penetration numbers and consistency



Cone penetration - cone above grease and after 5 minutes

The penetration number is determined by pressing a standardised cone into a specific amount of grease. At the start of the test, the tip of the cone is just touching the surface of the grease. The cone then penetrates deeper. Its penetration depth after five seconds is measured in units of 0.1 mm. That gives the penetration number, which in turn determines the consistency class of the grease. The softer the grease, the deeper the cone penetrates. The penetration number is high, and the NLGI class is low.
OELCHECK compares the consistency classes or penetration numbers of the used grease and the corresponding fresh grease. That leads to the following conclusions:

- **Higher penetration number** =
  Softer consistency, lower NLGI class:
  - The grease may be contaminated with water or another liquid.
  - Mixing with a grease that has a different thickener or base oil type.
  - The grease has been exposed to high loads and mechanically sheared.
- **Lower penetration number =**
  Stiffer consistency, higher NLGI class:
  - The grease has become stiffer due to a lack of relubrication or bleeding.
  - Excessive loading by vibrations and/or working temperature range too high.
  - The pumping pressure of the central lubrication system is too high; the pipe cross section is too small.

Brief: Lubricating greases

Lubricating greases are commonly used in situations where a lubricating surface cannot be perfectly supplied with oil. In addition to providing optimal lubrication, in many cases lubricating greases must also seal lubricating surfaces and protect moving parts against wear and contamination. They should attenuate shock loads, and ideally they should be suitable for lifetime lubrication. However, there are limits to what greases can do. Unlike liquid oils, they are not able to dissipate high temperatures or remove contaminants and wear particles from the friction surface.

Lubricating greases are manufactured by stirring a liquid base oil into a suitable thickener. Additives, and in some cases solid lubricants, are mixed in to reduce friction and provide wear protection. Lubricating greases contain 70 to 95% base oil, 3 to 30% thickener, 0 to 10% additives, and at most 10% solid lubricants. As the main ingredient of a grease, the base oil essentially determines its lubricating and performance properties. Mineral oils, synthetic oils, and in some cases vegetable oils are used as base oils.

Thickeners are divided into metallic soaps (such as lithium, sodium, calcium, barium or aluminium) and non-metallic soaps (such as bentonite, polymer resin or silica gel). As carriers for the base oil, they form a cross-linked, sponge-like structure. This structure holds the oil and releases it to the lubricating surface in a controlled manner.

Certain properties of a lubricating grease can be strengthened and/or specifically modified by additives. If a grease has to work under especially severe conditions or have emergency running properties, solid lubricants such as graphite, molybdenum disulphide (MoS_2) or PTFE (Teflon) are additionally mixed in. A grease containing more than 40% solid lubricants is called a paste.

Lubricating greases
Making sampling easy

With the all-inclusive analysis kits from OELCHECK and our basic equipment, you are perfectly equipped for properly taking reference samples of used lubricating greases.

The basic equipment

Taking samples of lubricating greases is a bit more complicated than taking samples of liquids.
However, the low-cost **OELCHECK Grease Sampling Kit (Z-3)** considerably simplifies this task and should be part of your basic equipment.

It contains a syringe and a 20-cm tube, which can also be reordered in bulk. There are also three spatulas with different sizes for taking samples of grease located between the bearing and the seal or in the bearing cage, and a cloth for cleaning the used spatulas.

An all-inclusive analysis kit for lubricating greases from OELCHECK

Each prepaid OELCHECK all-inclusive analysis kit for lubricating greases contains:

- A transparent sample bottle with a lid in the kit colour
- A transparent tube for the syringe of the grease sampling kit (Z-3)
- A specific Sample Information Form with a self-adhesive lab number for labelling the sample bottle
- A pre-addressed, leak-tight return envelope
- A UPS return voucher for free shipping to our laboratory

Determination of more than 20 analysis values and interpretation of these values by an OELCHECK tribologist are also included in the kit price. The clearly formulated lab report with images and individual values is usually sent by post or e-mail on the second working day after receipt of the sample. It can also be retrieved at any time from www.lab.report.

Important: Only properly taken samples provide valid results.

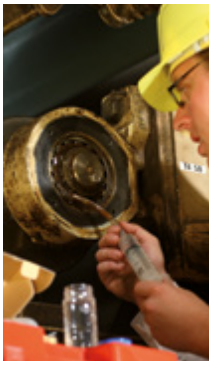
- Make sure that as much as possible, **no fresh grease** is included when you take the sample. The sample should come from the area where the grease does its work. You should therefore visually check, based on the change in colour or structure, that you have **actually sampled used grease**. Conclusions regarding the condition of the components lubricated by the grease are only possible with analysis values from used grease.
- Please ensure that the **sampling aids are clean**. Before taking the sample, clean the area around the grease sampling point. Avoid contamination of the sample by dust, water or deposited seal particles.
- For trend analyses, **always take the samples from a specific point** using the **same sampling procedure**.
- You should preferably use the aids in the **OELCHECK Grease Sampling Kit**. Metal particles from a screwdriver or particles from a wooden spatula can corrupt analysis values.
- **Never mix grease samples** in the same sample bottle, even if they come from the same component but from different lubricating surfaces.
- If you are not sure that we already have the grease in our database, please also send a **sample of the fresh grease** with your first sample of used grease for analysis, **for use as a reference**.

Even small amounts of lubricant are sufficient. OELCHECK needs only relatively small amounts of grease for analysis of lubricating greases.
For example, only about 3 g of grease is needed for the determination of more than 30 individual values with all-inclusive analysis kit 3. That corresponds to 3 cm of grease in the tube, a bit less than a teaspoon.

Spatula or syringe?

With samples from large rolling bearings, fresh grease containers or relatively open grease sampling points, the grease can usually be sucked directly into the tube with the **vacuum syringe**. With less accessible components or narrow lubrication gaps, which are often also close to the seal, you will usually need to use one of the **spatulas** from the sampling kit.

Grease sampling with the syringe



- Fit the tube on the conical tip of the syringe.
- Suck up the used grease into the tube opening. Depending on the type of construction, select:
  - A drilled grease sampling hole closed by a screw
  - An inspection opening
  - A removed grease nipple or the connector for the central lubrication line
- Using the syringe, suck the required amount of lubricating grease into the tube. Do not allow the grease to contact the syringe. That is essential so that you can reuse the syringe.
- Avoid sucking too much air in the grease sample.
- Pull off the tube, fold it in the middle, and place it in the sample bottle with the fold facing up. That makes it easy to remove in the lab.

In the case of dismantled rolling bearings, you should suck the used grease into the tube from the cage area and between the rolling elements. With relatively small bearings it is better to use a spatula.
With large rolling-contact bearings (over 1,000 mm), take the grease from the sampling bores provided for that purpose. The sampling points should be close to the bearing races in the main load-bearing area.

Sampling with a spatula

- Mix the grease with the spatula or by slow rotation, in order to obtain a representative sample amount.
- As much as possible, the grease sample should be taken from the following places: the running surfaces, the web of the bearing cage, or from both sides of the bearing balls or rollers.
- Scrape the grease from the spatula into the lid of the sample bottle or somewhere in the sample bottle, and then securely close the sample bottle.

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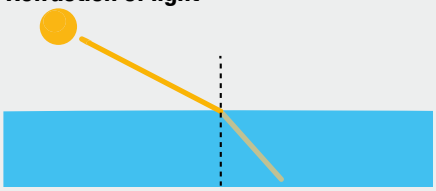
Q & A

OELCHECK checks not only our gas engine oils, but also coolants from these engines. The lab reports for coolants now also include the refractive index at 20 °C. How is this value determined? What does it mean if this has changed? And is a refractive index relevant for oils as well?

OELCHECK:
Every fluid has a characteristic refractive index. Its interpretation relates to the concentration of specific substances in the fluid. Coolants consist mostly of water mixed with ethylene glycol or propylene glycol. The refractive index can be used to determine the percentage of glycol in the coolant. As different types of base oil also vary in terms of their refractive index, this value is also helpful for identifying mixtures of different oil types, among other things.

Refraction of light



The refractive index has its origins in optics. When light passes from one medium into another, the rays of light are refracted at the junction, changing their direction and their speed. Figuratively speaking, the ray of light bends. The strength of the effect depends on the refractive index of the medium.

Determining refractive indices with a hand refractometer

The easiest way to determine refractive indices is by using a hand refractometer. This device measures the behaviour of light at the junction between a prism and the material being tested.

A typical application is measuring the sugar content of grape must, which is a criterion in determining the quality of wine. Particularly in the case of foodstuffs, the refractive index is still traditionally given in °Brix, or in the case of wine in °Oechsle.
In metalworking, hand refractometers are an essential tool for monitoring the concentration of oil-in-water emulsions. Refractometers can also be very helpful when a mixture of incompatible oils needs to be checked.

Exact values can only be determined in the lab

Due to the different wavelengths of light, using a hand refractometer is not the most accurate way of determining refractive indices. The value varies slightly at these different wavelengths, and is also affected by the light source and temperature. Even the human eye perceives colours slightly differently depending on differences in wavelength. In order to exclude deviations and to make values truly comparable, a specific wavelength that can only be produced under laboratory conditions has been defined for the determination of refractive indices. Sodium D line light is produced when table salt is burned in a gas flame, It consists of the wavelengths 588.9951 nm and 589.5924 nm. In our lab reports for coolant fluids, we state the refractive index determined at this wavelength at a media temperature of 20 °C.

The higher the refractive index of a medium, the more strongly the light refracts. By way of illustration, a vacuum has a refractive index of 1.0, the refractive index of air (1013 mbar) is 1.000272, and drinking water has a refractive index of 1.333. Ethylene glycol, which is used to prepare coolants, has an index of 1.43.

When a refractive index is needed to indicate a relatively exact quantitative share of glycol in water, it is therefore better to have this determined in a laboratory.

Refractive indices of coolants and oils

OELCHECK measures refractive indices using the RX40 Refractive Index Cell Module from Mettler Toledo. This produces the wavelengths of light required with high accuracy, and determines refractive indices within a value range of 1.3200 to 1.7000. The refractive index can then be used to determine the mixing ratio of two components.

In the case of coolants, the concentration and quantity of ethylene glycol or propylene glycol mixed into the water are determined. This is important information, because the glycol content affects the thermal characteristics of the coolant. Concentrations of inhibitors, which give the water additional protection against corrosion, can also be determined in this way. As it is difficult to identify exact proportions of ethylene and propylene glycol using the refractive index alone, OELCHECK also determines the density of the coolant mixture. Comparison of these values then makes it possible to make a clear assessment.

In the case of base oils of varying origins and compositions, refractive indices enable us to get to the bottom of what mixtures contain. In order to do this, we generally measure not only refractive index, but also density, viscosity index, and IR spectrum.
The values for hydrocarbons (mineral or synthetic), esters, and glycols vary less than they do in the case of water-glycol mixtures. For silicone or perfluorinated polyether (PFPR) based oils, on the other hand, there are clearly distinctive values. Particularly with mixtures involving silicones and PFPEs, which are not compatible with other lubricants, the consequences can be very severe.
Silicone oils, such as those used in some non-water miscible metalworking fluids or as insulating oils in transformers, must remain entirely free from other types of oil. PFPE-based lubricants, which have an exceptional performance capacity at high temperatures and are resistant to chemicals, must likewise not be contaminated with other lubricants.

Determining their refractive indices in the laboratory allows mixtures that are hazardous with regard to these products to be easily identified.

**OELCHECK is ready to answer any questions you may have about tribology or lubricant analysis.
Contact us by email (info@oelcheck.de) or by fax (+49 8034 9047 47).**