



OELCHECKER

Circulation: 9,500; 3 issues a year since 1998
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Bauer Maschinen revolutionises special foundation engineering



Bauer trench cutters allow trench walls to be constructed even in difficult ground conditions and extreme climatic conditions.

Special foundation engineering devices from the Bauer Maschinen Group are characteristic on a world-scale. They started with the construction and manufacture of earth drilling machines as there were no suitable devices for anchoring holes and bored pile production on the market in around 1970 for their own Bauer foundation engineering company in Bavarian Schrobenhausen.

Therefore, the building contractors at Bauer designed and manufactured the first anchor drill for their own needs and in 1976, the first large diameter heavy-duty drilling rig followed. The machines were originally only intended for use in their own company but in the mid eighties, they moved to open sale as the major construction groups demanded Bauer devices. Since the end of the sixties, special foundation engineering machinery from Bauer has stood for the highest performance, quality and innovations. Bauer Maschinen GmbH designs and manufactures rotary drilling rigs, trench cutters and

all associated tools and since 2001, it has been operating independently on the market within the Bauer Group.

When Bauer developed the first trench cutter in 1984, the limits of trench wall technology were expanded significantly. Scarcely any foundation engineering method has changed construction in such a lasting way as the introduction of the trench cutter. The basic concept of wall manufacture is broadly unchanged since the introduction around 60 years ago. A continuous through wall is manufactured from a series of individual rectangular elements. The open, dredged or milled out trench is supported with a thixotropic suspension during excavation. A fluid is designated as thixotropic if the viscosity breaks down during a constant shear over a certain amount of time and rebuilds after suspension of the shear stress. A well-known example is ketchup, which needs to be shaken so that it pours from the bottle. Next, a reinforcement cage made from structural steel is hoisted into the open trench segment. After that, the area is filled with concrete and self-hardening soil concrete using a concreting pipe. At the same time, the rising concrete displaces the specifically lighter supporting suspension. It is pumped up, cleaned and used again to support a new trench. After the concrete has hardened, the cutting of the secondary trenches between the primary trenches and its filling takes place. In order to

Check-up

To improve is to change; to be perfect is to change often. This quote comes from Winston Churchill, the former British prime minister. It is more than 60 years old but it still remains just as valid. Even if we probably never really achieve it, perfection remains our major aim. At OELCHECK, we are always changing in order to get even better. This is all for our customers because we want to offer the best service to them. To this end, we are currently working on two large projects.

On 1 January 2014, we are switching to SAP Business One. Our previous merchandise management has served us loyally since 2001 but it has now reached its limitations. In particular, new tax guidelines cannot be implemented at all or only with a great deal of inconvenience. Our employees have been intensively trained so that the switchover to SAP Business One will pass off smoothly and our customers and suppliers will only notice the new design of our offers and orders, invoices and credit notes.

Our software developers are also working under extreme pressure alongside an external company on an essential relaunch of our web portal. Some well-known functions are being optimised in the process and lots of new ones are being added. Amongst other things, the recording of data on new specimens of already recorded machines will also be possible on mobile devices „on site“. In the course of the first quarter of 2014 this means: curtain up for the new OELCHECK web portal – with a new look and many additional useful functions which will simplify the work of not only the customers but also the OELCHECK employees.



Yours, Barbara Weismann



achieve a connection that is as close as possible between the two trenches, the joint is provided with suitable sealing elements using trench wall grabbers. 40 to 80 metres in depth can be achieved with the method based on excavator buckets. This conventional excavation is difficult on hard ground and impossible on rock. Trench walls can be manufactured in the most difficult ground conditions only by using Bauer trench cutters. Two typical examples of this are the trench wall for the Dhauliganga embankment dam project in the Indian Himalayas and the trench walls for the embankment dam of the Peribonka hydropower station in Canada where hard rock of up to 120 m depth had to be cut into. The cutting machines work at -20 °C as well as at +40 °C. They are successfully used in remote regions in the Arctic circle but also in the vibrant centres of large cities such as Hong Kong, Tokyo, Turin or Moscow.

The Bauer cutting system is made from many independent components which are coordinated with each other according to use, depth and ground type. The main components are: trench cutter, cutting control, twisting mechanism, hose guidance system and carrier.

The core item of the system, the actual trench cutter, is made from a steel frame on the underside of which two hydraulically operated gear cylinders are arranged which rotate around the horizontal axis in opposite directions. Different cutting wheels are assembled on the gears depending on the ground

type. Through the rotation of these cutting wheels the ground material is continuously loosened under the cutter, crushed, mixed with the suspension in the trench and fed to a vacuum outlet. In order to be able to wear the strokes occurring during the smashing of large rocks undamaged, there are damping elements installed between the cutting wheels and gears for the protection of the transmission. Close above the cutting wheels, there is a hydraulically operated rotary pump. It continuously carries the suspension concentrated with the cut material upwards and from there on to the processing plant. In soft ground and when using hard suspensions, the capacity of this pump is crucial for the excavation output. Cutting transmission and feed pump are protected against harmful concrete entry using a pressure equalisation system. The output of a cutting machine is dependent on the feeding force, designated by the weight of the cutting machine and the torque of the cutting wheels. Both factors mutually influence each other. In order to achieve an optimal excavation output, the Bauer cutting systems are equipped with a particularly sensitive, electronically controlled feed winch for the control of the contact pressure.

Although the Bauer trench cutters are extremely robustly designed, the hydraulics system and gear cylinders must be carefully maintained. Finally, they should work reliably both at areas at the equator and also in the extreme north of Canada. In the process, the conditions of use could often not be more

challenging and the surroundings more adverse to machines. The cutting machines work for example immersed in the supporting liquid (bentonite) up to depths of 150m with a high bandwidth of the operating temperatures and changing pressure conditions. The gears, drive motors and control systems are exposed to extreme contamination and water levels, high temperatures and strong vibrations.

The maintenance of the devices is mostly assumed by the users using a detailed maintenance plan provided by Bauer. Upon request, for example for rented devices, the service will also be assumed by Bauer. However, regardless as to who carries out the maintenance work, Bauer always recommends that an accompanying monitoring of the components filled with oil using OELCHECK lubricant analyses in its machine documentation. In the event of an extended warranty, they are even mandatory.

The hydraulics systems are operated with 700 to 1,400 litres of mineral oil-based or „bio“ hydraulic fluid, depending on the cutting. The oil corresponds to the guidelines of the carrier, whose system it also comes from. The gear cylinders require 30 to 130 litres of synthetic gear oil each.

For the hydraulic liquids, the lubricant analyses together with the impurity check mainly serve as an excellent instrument to control the oil change intervals in a condition-based manner. The oil change intervals are fixed for the highly loaded gears. Here, Bauer uses the analyses principally to assess the wear and tear of gears and their components and the functionality of the gaskets.

In addition, the analyses also always provide important information if irregularities occur. In this way, they also detect the cause for a sudden dark colouration of a hydraulic oil from a trench cutter. In the laboratory, an impurity of the hydraulic oil was discovered through engine oil. Thanks to this information, the Bauer service technicians were able to specifically search for the defect without long delays. The engine oil had entered the hydraulics system through a power take-off in the diesel engine. Once detected, the cause was quickly fixed and the hydraulics protected from possible resultant damage.



NEW

OELCHECK identifies solid impurities in lubricating greases



OELCHECK laboratory manager, Jan Hubrig, at the OLYMPUS special microscope

With almost 10,000 tests of used lubricating grease specimens this year, OELCHECK is the world-leading service laboratory for waste grease analyses. Affordable analysis sets are available for the routine inspection of lubricating greases. Almost all everyday problems can be covered off with the testing methods included in the kit.

In addition, further special tests are available, for example for experimental observations or questions in connection with stock disturbances. One of these is the determination of the amount and type of particles and solid impurities which are found in the lubricating greases used. Mostly, such particles which originate from slowly running rolling bearings or swing bearings are visible in the grease specimens to the naked eye ($>70\ \mu\text{m}$). Alongside soft particles from the grease ageing and solid impurities (dust) from the surroundings, such greases often contain metallic wear debris from the components of the bearing such as bearing cages, tracks or rolling elements. The shape, hardness, amount and size of the solid impurities influence the service life of the rolling bearings. Therefore, increasingly higher demands for improved cleanliness are placed not only on the oils but also the lubricating greases.

For the determination of stubborn component parts there is a method defined in DIN 51813 – however only for fresh greases – of how solid materials of over $25\ \mu\text{m}$ in piece size can be quantitatively detected through high pressure filtration using a filter with a $0.025\ \text{mm}$ pore size from a large fresh grease amount of $0.5\ \text{kg}$. This method is not suitable for waste grease analyses. Processing the specimens in accordance with this standard is only used in the OELCHECK laboratory for the tests not requiring much effort.

$5\ \mu\text{m}$ through the LDE arc, with which the individual component parts are stimulated.

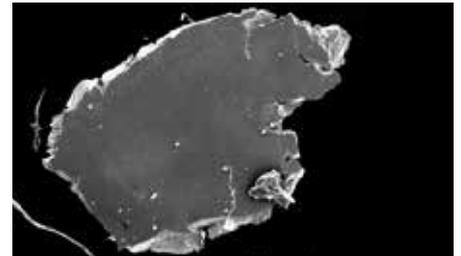
If there are visible particles ($>70\ \mu\text{m}$) in a waste grease specimen, the identification of the elements is not always precise. Here, conclusions can be drawn on the wear condition of the lubricated elements with the „Identification of the content of stubborn materials“. However, this method only functions for soap thickened lubricating greases without solid lubricants. Three grams of lubricating grease are required.

In order to be able to filter out the impurities from the grease, the solid grease must be dissolved. This occurs with intensive stirring after adding a solvent mixture of methylene chloride, ethanol, heptane and acetic acid under temperature influence. By destroying the soap structure, the grease becomes liquid and can be filtered. The solid particles are separated during filtration with a special $10\ \mu\text{m}$ Teflon membrane. After washing out and drying, the membrane can be used to calculate the percentage of solid materials using a differential weighing. In the laboratory report, the content of solid impurities appears with a particle size of over $10\ \mu\text{m}$ as a mass in mg/kg . An image of the membrane from which the shape of the particles follows is supplied. OELCHECK does not only identify the content of solid impurities in the grease specimen but also carries out some further tests. Only using this method can even more precise conclusions be drawn on any wear processes.

The particles caught in the Teflon filter are recorded with the help of an OLYMPUS special microscope. The large particles are recorded individually and microscopically scanned in incidental light mode. All particles appearing darker in the grey scale of the membrane are photographed with a high-resolution CCD camera. Through differing reflection using polarised light, a distinction can be made between metallic and non-metallic impurities. This informa-

tion as well as the shape and colour of the particles provides the diagnostic engineer with important information on the type of the materials present (cage, rolling elements, inner or outer ring) and a possible wear process (outbreaks due to fatigue, wear due to hard impurities and corrosion).

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Metal particle under the scanning electron microscope

If particles remain on the Teflon membrane and the amount of remaining grease used is still sufficient, a further analysis with the REM-EDX method presents itself. REM stands for „scanning electron microscopy“ and EDX for „energy dispersive X-ray spectroscopy“. In order to record the particles with this, the dissolved grease must however be filtered with a gold filter membrane. The membrane is then observed and evaluated under a vacuum with the scanning electron microscope. In the process, an electron beam goes in a certain pattern over the enlarged depicted object. The interactions of the electrons with the wear particles on the filter are used to create an image. The electron beam has a relatively small diameter, hits the particles separately and provides images with a very high resolution.

The energy dispersive X-ray analysis spectroscopy connected to the REM serves to determine the elemental composition of the material. If an electron from the electron beam in an atom of the specimen hits an electron close to the nucleus from its position, this is immediately filled in by a high-energy electron from a higher electron orbit. The energy difference is established in the form of an X-ray quantum. The X-rays that result are each characteristic for a certain element. The composition of the particles is recognised using special detectors. Wear processes can be located even more precisely through the metal alloys determined in this way such as FeCr, CuPbSn.

CM Technologies – condition monitoring on the high seas

Skilled labour is demanded on drilling platforms, freighters, cruise or container ships. If a technical fault occurs on a „factory at sea“, the crew must get to grips with it themselves. External service engineers are only available again in the next shipping port. Maximum operational safety and a comprehensive condition monitoring system are therefore particularly important at sea.

The condition of the drive units and also pumps, cranes, winches and many other systems need to be constantly monitored. In addition, the quality of the drinking water, the safety of waste water and even the cooling and boiler water must be checked. For this range of tasks CM Technologies GmbH/ Elmshorn, known previously as Kittiwake GmbH, offers tailored solutions with online and offline monitoring systems. Depending on the system type and operating conditions, the following technologies are combined:

- lubrication and fuel monitoring on site using CMT rapid test devices.
- regular analysis of specimens in the OELCHECK laboratory
- vibration analysis for early damage detection
- monitoring of physical parameters (speed, rotation speed, pressure, temperature and output) using sensors.

The monitoring of large marine engines is one of the core competences of CMT. Passenger and medium-sized cargo ships are often driven by four-stroke diesel engines with an output of more than 50,000 kW. By contrast, large cargo and container ships are powered with slowly running two-stroke diesel engines with a driving power of up to 10,000 kW - the rotation speeds achieve between 35 and 100 rpm. Up to 14 cylinders are installed in series. The force is transmitted directly on to the propeller. At full speed, speeds of up to 25 kn (45 km/h) are achieved. The weight of a engine of about 13 m high and 32 m long is almost 3,000 tonnes. Two different oil types are used in a slow-running two-stroke diesel engine.

- An SAE 50 (sometimes also SAE 40) cylinder oil is injected directly into the individual cylinder or fed in using a central lubrication pump. It must not only lubricate but primarily it must protect the components from corrosive wear by neutralising combustion residues. Most of it is burned with the fuel. In the process large ships use 2 tonnes and more of cylinder oil per day. Remaining quantities are caught on the cylinder shroud as



Removal of a representative oil specimen from the engine of a marine engine.

„drip oil“ which then is analysed in the lab for the optimisation of the relubrication quantity.

- An SAE 30 or SAE 40 system oil lubricates the connecting-rod bearings and all other moving parts of the engine using a complex circulation system. The system for engine transmission lubrication takes a lot more than 10,000 litres. Normally the oil is never changed completely but a partial change of a maximum of 30% always takes place depending on oil analyses.

Only monograde engine oils are used. In the process the cylinder and system oils and the oils for four-stroke marine diesel have a considerably higher alkaline reserve (BN) than oils for car or truck engines due to the combustion of high sulphur fuels. The check of engines and power units on ships should take place as far as possible without human intervention. The monitoring of general machine condition, wear behaviour and oil situation with a single sensor is still a thing of the future. However, CMT has developed an optimal solution with its monitoring systems. The systems combine different monitoring modules in one unit. The installation near the lubricating oil system is simple. Effective distance maintenance is possible through data transfer. All online sensors from CMT can be combined in such a way that metallic abrasion and wear, the oil situation, oscillations and vibrations, temperatures and other parameters can be recorded. CMT offers an extensive service for installation, startup or repair of the condition monitoring systems. Service technicians from the company also go on board as a matter of course. In addition, there is a network of agents available at all central locations round the globe.

CMT carries out special training and seminars so that everything runs perfectly at sea. Finally, a good understanding of condition monitoring by the ship crews has a direct influence on the lifetime and reliability of the systems. The training sessions also include the subject of „Oil - the elixir of life“. In particular, the oils for marine diesel engines have extreme challenges to overcome. Normally, HFO (heavy fuel oil) is used as fuel. Its quality not only varies constantly but it is also relatively heavily polluted with water, silicon, nickel vanadium and above all sulphur. However, the engine oil of the four-strokes and the cylinder oil of the slowly running two-strokes not only have to cope with pollution from the heavy oil but also with changing feeding rates and humidity. In order to be able to neutralise the sulphur, which can still be up to 4.5% at the moment, oils with a high base number (BN) of up to 100 are used. If the base number decreases too much, there could be damage from the aggressive effect of the acids which result from the combustion of sulphur. The CMT online sensors should recognise changes in the oil early which possibly could be indicative of a wear process or of inadequate lubrication. In order to err on the side of caution, CMT also recommends additional regular lubricant analyses. In order to be able to offer the ship customer a tailored laboratory analysis service in this area, CMT and OELCHECK have gone into partnership. They are a necessary addition particularly for trend analyses. The laboratory in Brannenburg offers more possibilities to test an oil systematically than the sensors or the rapid test method on board. The ship engineers receive comprehensive information on wear values, impurities, the oil condition, the

important titrated base number and the remaining oil additives with the analysis results which have comments.

In addition, the OELCHECK engineers make important suggestions in their comments on problems with the system or the oil. Analysing the „drip oil“ involves the influence of the heavy oil polluted with sulphur and other impurities on the cylinder oil of the large two-stroke diesel engines. Then there are, for example recommendations to check the sulphur content of the heavy oil and adjust the dosage of the cylinder lubricating oil accordingly. If the cylinders are supplied with too much oil, it can also

quickly result in deposits on the piston crown as well as a greater impact on the environment and to the purse strings. Too little lubrication, however, leads to increased wear and also often to a piston seizure. Through a leak on the stuffing box of the piston rod, increased entry of cylinder oil into the circulating oil can occur. Through this, more than 10,000 litres of oil are then limited in performance in such a way that a partial exchange has to take place. Nevertheless, it is only when the oil analyses show that too much cylinder oil has gone into the circulating oil that those responsible on board have the capacity to isolate the cause of it.

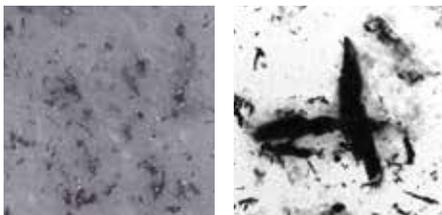
OELCHECK has become an important partner of CM Technologies GmbH over the years. The analysis sets for the most diverse of usage scenarios and the tools for taking specimens are a permanent feature of CMT's range. Through this partnership, lubricant specimens from ports all around the world arrive almost daily at OELCHECK in Brannenburg.

www.CMTechnologies.de

OELCHECK TECHNOLOGY FOCUS

What filter deposits reveal ...

Modern gears, motors or hydraulics - they are all designed to become more compact and energy efficient yet deliver a higher performance. This trend often also comes with increasing operating pressure and more precision-manufactured components. Higher demands are made of the quality and purity of the lubricant. Consequently, many systems are also equipped with increasingly finer main and secondary current filters. Accordingly, the proof of external and dirt particles in oil as well as the determination of the purity class have an increasingly decisive role to play in lubricant analytics. Admittedly, caution is also advised when it concerns oil purity and filtering



Representative section Largest particle

Three crucial aspects are to be considered:

- Trend analyses show „everything is in the green area“. Operators are often inclined to extend the check intervals if the required high degree of oil purity is confirmed. However, if changes suddenly occur in the oil, they will no longer be discovered in time.
- The fine filters can be effective to the extent that, in some cases, the active substances of the oil can also be filtered out. Mainly additives such as silicone de-foamers, viscosity index improvers or detergents are affected by this. If they remain hanging around in the filter, they themselves can impair the productive capacity of the lubricant.
- Worn particles from wear processes, or foreign particles registered from the outside, can and should be held by the filter. During sampling, such particles do not end up in the sample container. As a result, important data medias that

otherwise tell us about problems during lubricant analyses are extracted from the oil.

- Consequently, waste oil from a system with optimal filtration merely reflects an incomplete picture of the lubrication and system status. In these cases, the analysis of the filter deposits completes the actual discovery first.

A case study in practice

The person accountable had been aware of the critical state of the gearing of a highly loaded rolling mill drive in a cement mill for a long time. The ordered replacement gear wheels, however, were only be assembled during the major revision some months later in order to avoid an operational stoppage. The gear was closely monitored by lubricant analyses. The attrition values determined were measured over weeks in the tolerable range and alarming deviations were not recorded. However, a filter change was then signalled on the basis of a changed differential pressure. The maintenance workers noticed a suspiciously high loading of the filter with metal abrasion. During an inspection made at short notice, a tear was discovered - along with many outbreaks (pittings) - which indicated an imminent tooth-breakage. The gear had to be exchanged as quickly as possible.

Had the lubricant analyses failed in this case? Why hadn't the laboratory flagged this up in time? Could something like this happen again?

The maintenance workers wanted to know precise details. They sent in an oil specimen again. This time too the investigation results were within the tolerated range. Both the PQ index for the total amount of magnetisable iron in the sample and the portion of iron particles determined with the ICP spectrometry, which are smaller than 3 µm were not alarmingly high.

But quite different values were to be seen in the filter deposit investigation. For this purpose, the deposits of a 50mm x 50mm piece were extracted in the laboratory using solvent. Here, metallic wear particles with a diameter of up to 80 µm and large dirt particles with a diameter of up to 100 µm were manifested.

The filter deposits, and not the gear oil, were the deciding data media in this case.

However, it was not simply the proof of wear that was conveyed here. The large dirt particles had to have penetrated into the gear oil from the outside. During a further gear examination, it was ascertained they had got in through a defective ventilation filter. From this, the cause of wear was also found.

Extract filter specimens correctly

Oil checks can be made with the OELCHECK analysis sets and a sampling pump, or removed cleanly, quickly and simply via a built-in valve in front of the filter. With residue from the filter cartridge, this is a little more intricate because we do not need the complete filter; rather we need a 50mm x 50mm large representative piece of the filter mesh only.

Please do not send us the entire filter in any case.

As a laboratory, we do have the mechanical scope to remove filter mesh. This would also result in additional costs for you for its disposal. You can send the filter mesh of approximately 50mm x 50mm in a pre-paid sample container.

We demonstrate how you can remove a representative piece of filter mesh as an example from a completely enclosed main current filter of a wind energy system (also see www.oelcheck.de/downloads).

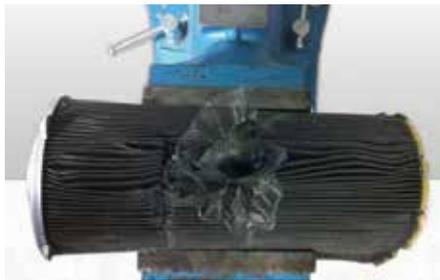
1. Remove the filter and let it drip out.



2. Locate the metal filter housing (only if the filter is built into metal housing). First unlock the casing at the flared flange. Open the sheet housing using a corner slider or an iron saw. While doing so avoid a contamination of the filter material.

Note: Wearing protective clothing is strongly advised.

3. Usually the filter material is channelled from the outside inwards. The actual 2 or 3 layered filter material is protected by a metallic fabric. Remove this with the help of wire cutters or a cutting knife in an area that is representative and well streamered.



4. Now cut a representative piece of the multi-layered filter mesh (approximately 50mm x 50mm). Avoid contact with the bit of filter that has connective fabric or housing.
5. Send the material to our laboratory in a pre-paid sample container with „residue analysis“ noted on the sample submission form. State the sample number as the reference which the appropriate oil sample will be analysed under.



The filter analysis in the OELCHECK laboratory

After an initial optical appraisal of the sample fabric, the diagnostics engineer will choose the analysis procedures. As filter residue cannot be used like oil samples with our test equipment, the devices are either re-equipped or modified procedures are used.

PQ index - searching for iron

The PQ index tells us about the content of magnetisable iron as a dimensionless numerical value. If this value is clearly higher than the index found in oil, insignificant wear does not appear with the iron-containing components of the aggregate from which the filter originates. The PQ index works independent of the particle size. The test principle uses the fact that iron abrasion interferes with the magnetic field. The quantity of all magnetised iron particles (in this case, rust particles are not magnetisable) in the filter residue is determined in a magnetic-inductive manner. The index, which is named after the Kittiwake „Particle Quantifier“ testing equipment and called the PQ index for short, indicates the measurement result.

The RDE determines additives and wear

RDE stands for Rotating Disk Electrode. The filter residue becomes stimulated after wetting, where necessary, with pure „0-ppm control oil“ directly on a „function cog“. In the arc that forms during a high voltage of 10 kV between the residue-occupied graphite disk and a graphite rod electrode fitted over it at a distance of 5mm, all applied elements are agitated and made visible by the spectroscopy.

With the determination of 27 elements come solid or sludge-like wear and contaminant particles and additive components which have been deposited on the filter cloth.

The ATR-FTIR recognises oil type, impurities and blending

The principle of FT-IR (Fourier Transform Infrared) 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 to the specimen can be compared to the fresh oil reference spectrum and depicted, calculated and interpreted as typical „peaks“ with certain „wave numbers“. For the study of filter residue, we use a special variant of infrared spectroscopy. The ATR infrared spectroscopy (attenuated total reflection) is based on a weakened („attenuated“) total reflection. It proved especially effective in the case of checks on opaque materials.

The ATR-FTIR provides information about oil mixtures with foreign oil and impurities, such as water, from oil-moistened filter residues. Changes in the case of additive composition (additive sludge) must also be recognised. Through comparison with the deposited spectra of fresh oil, the procedure provides information reliably and quickly whether an unknown oil is a mineral oil, „bio-oil“ or synthesis oil.

Microscopic particle counting

If the filter residue contains bigger particles which indicate a wear process or dust contamination, we recommend supplementary microscopic particle counting. For this purpose, the residue must be rinsed out of the fabric with a solvent mixture. After that, the mixture is filtered with a pore size from 0.45µm to 2.5µm so that the particles remain on a filter membrane.

This membrane is examined under our special OLYMPUS microscope. In addition to the categorisation of size classes, the particle analysis also makes qualitative statements possible. It is a distinction between reflective, metallically bright, coloured or black particles. Fibres or deposits of lubricating grease are recorded and evaluated separately. Representatively chosen particles are measured two-dimensionally and categorised by their longest extension. This task is finished with a high-resolution CCD camera integrated into the microscope with image analysis software. Making use of polarised light, representatively enlarged photographs are drawn up, from which the diagnostics engineer makes the selection for the laboratory report.

LEIPA - world-leading with quality products based on scrap paper



Leipa produce high quality paper from scrap paper, which is equal to those of primary fibres.

Every year, the almost inconceivable amount of 1,000,000 tonnes of scrap paper is processed at the Leipa Georg Leinfelder GmbH factories - more than 100 lorry loads per day. At the Schrobenhausen / Bavaria and Schwedt / Brandenburg sites, offset paper for catalogues and magazines, as well as paper packaging, are made from cardboard and corrugated base paper (so-called test liners). Around the world, Leipa operates from the first paper factory which makes scrap paper into high-quality paper for colour print magazines to a quality, which is equal in all relevant characteristics to paper made of primary fibres.

In the Leipa factory in Schwedt, three paper machines are in use. In this case, the large Voith paper machine PM 4 alone produces approximately 360,000 tonnes of high quality magazine paper a year. Unforeseen machine stoppages and the resultant production losses need to be avoided at all costs. Therefore, a proven system of preventative maintenance and regular machine monitoring is permanently integrated into all operations.

Special attention is paid to the lubricants, their maintenance and monitoring. At the end of the day, they represent a high cost factor with the large amount of several thousand litres in the rotational motion systems. Therefore, the longest possible oil change intervals are to be implemented. At the same time, the secure operation of the paper machines depends on the lubricants. Regular oil analyses provide the corresponding information for proactive maintenance.

The hydraulics and circulating oil system of the wet part of the PM 4 require 6,000 litres. The largest tank is the „Nipco Kalander Hydraulik“ on the PM 4 with 16,000 litres. The tank for the centralised

chassis lubrication for the drying cylinder takes 9,000 litres of synthesis oil. More than 600 bearings are supplied with it. The rotational motion oil is exposed to extreme loads, especially in the drying cylinder. The steam-heated paper machines work operationally in principle under a „hood“ in an up to 80°C environment with up to 90°C humidity. Permanent temperatures of up to 95°C occur at the bearings. In addition, vapour or moist air can penetrate directly into the lubricating rotational motion system at the sealed labyrinths of the drying cylinder stocks. Whilst cooling, water from condensation can then displace itself in the bearings and the oil tank. The water content on the bottom of the tank must be assessed on a daily basis without fail. Too much water is driven out with a thin film evaporator in which the boiling point of water is decreased by vacuum so it vapourises at approximately 60°C. Fine lint can also affect the oils. Oxidation products of oil, along with paper particles, can block the allotting valves of the central lubrication system, and therefore inhibit the distribution of oil, for instance. The maintenance workers in Schwedt have equipped all hydraulic systems and central lubrication systems with quick-couplings in order to connect additional mobile filter systems and a vacuum evaporator in the secondary current for the removal of dirt particles or water. The water content of the oil cannot exceed 100 ppm. Thanks to the strict observation of these limits, the amount

of downtime essentially sank and the lifetimes of the overall components were doubled.

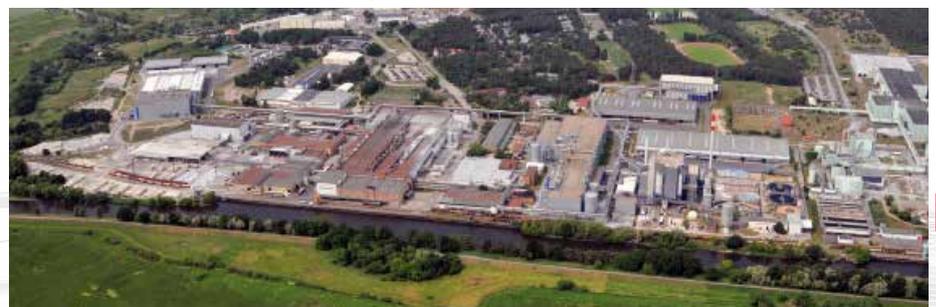
Should paper machine oil achieve a long service life, function reliably and show a positive effect regarding energy efficiency, it is not done with generic „off-the-peg“ oil. After repeated filter blockages and the formation of deposits in the tank and housing cases of the central lubricant system of the wet part of the PM 4, a well-known petroleum company developed an innovative product with a novel additive specifically for this application. It was tested at Leipa in a large-scale field test that was set up. After many promising results, the PM 4 was converted to the new rotational motion oil in 2010. The change was a great success. Amongst other things, gear temperatures were lowered by up to 10°C. A clear indication of reduced friction and therefore a longer service life for the components. The energy consumption of the gears demonstrably reduced by around 3%. Because of the decrease in oil temperature by 10°C, the service life of the oil doubled. Even at the formation of deposits, the new oil had positive effects. The filters now achieve an endurance of nine months instead of two months which was the case before.

Much of the success within the scope of maintenance at Leipa could only be achieved by the application of the OELCHECK lubricants analyses. The analyses provide the deciding factors for almost all maintenance measures to do with lubricants and hydraulic fluids. Overall hydraulic and central lubrication systems are recorded in the maintenance plan. Oil samples are then taken regularly and examined by OELCHECK.

The maintenance workers no longer change the oil in a time-controlled manner rather in accordance with the lubrication state as per the laboratory report. They recognise trends early on and act accordingly. In addition, the use of mobile cleaning equipment is controlled optimally also on the basis of the laboratory results. The necessary knowledge related to the oil is kept up-to-date by regular visits to OilDoc seminars and symposiums.

Further information: www.leipa.de

The Leipa factory in Schwedt / Brandenburg.





Oilchecker - an OELCHECK GmbH magazine

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Q & A

In the laboratory reports for the engine oils of our petrol engines, a „soot index“ has recently been listed under the heading „oil condition“. A soot index with petrol engines - is there a reason for it at all?

OELCHECK:

The topic of soot content in motor oil is always linked to black oils from diesel engines. Oils in gasoline engines have become increasingly darker too over the years. However, is it also soot that is making these oils become darker here?

But let us first look at the formation of soot particles and their evaluation in used oils from diesel engines. Soot particles are produced here during diesel combustion and they can also reach the engine oil. On engines with the common-rail-method, the load can become extremely high - especially with very fine soot particles. A soot content of more than 2% in oil increases the viscosity, works abrasively, reduces heat emission, leads to deposits and damages the service life of an engine. The detergents added to all engine oils (additives containing calcium or magnesium) keep the engine clean. It prevents such soot deposits, which originate mainly in the piston ring groove or the outlet valve. The active substances also function as dispersants, keep the particles in suspension and, amongst other things, transport to the filter in which they are retained. But the number of soot particles in the oil increases excessively due to an error in the injection system or by incorrect valve timing - not all additive particles can be kept in check. The anti-redeposition power of the engine oil decreases, the danger of deposits increases. In this case, the viscosity of the engine oil also increases - it thickens. Fail-safe lubrication can no longer be guaranteed particularly during a cold-start. Fuel consumption rises simultaneously. The soot content in diesel engine oils - for which value limits are stipulated by most motor manufacturers - is determined in accordance with DIN 51452. However, the infrared method of measurement was expressly designed to determine the soot content of diesel engine oils. In this case, the soot content - which is indicated as a percentage -

does not, however, directly flag up a change of the additives responsible for motor cleanliness. To do this, the dirt-suspension and dispersion capability is determined with the help of the „dot test“. With this test, a drop of engine oil is dripped onto a special filter paper. If the additives still show sufficient dispersing effect, the drops spread evenly under temperature. If obvious rings appear, this is a sign of insufficient anti-redeposition capability or also too much fuel in the oil.

However, not just diesel but also petrol engine oils can become severely discoloured through soot. The direct fuel injection procedure used (air, spray or wall-led) is responsible for reinforced soot problems - even if at a lower level than that of the diesel combustion engine. Often modern engines are affected which results in soot with much finer particle sizes as with a diesel engine. If problems still occur with the engine control system, the engine oil load increases with black oxidation products, reduced anti-wear additives or with soot from an imperfect combustion in such a way that it can lead to e.g. wear of the camshaft chain.

Although motor manufacturers have still not yet produced a value limit for soot in gasoline engine oil, mainly owing to the fact that soot content in petrol engine exhaust gas shall not become a topical until after 2017, more and more customers ask us to measure the soot content in gasoline engine oils and report them as such in laboratory findings.

We first looked more closely at a large number of different gasoline engine oils used by means of conventional soot measurement. Nevertheless, a quantitative soot measurement, the way it works with diesel engine oils, is not transferable to petrol engine oils. In principle, the soot particles in a petrol engine are considerably less and the overall content is clearly lower. With the FT-IR method, the soot amount can be shown as rounded to 0.1%. Repeatability lies as 10% relative to the mean value. With gasoline engine oils, most values are expected as under 0.1%, i.e. below the precision measurement of the technique. Values over 0.1% are classified as „high“. Therefore, the soot determination according to DIN 51452 does not work for petrol engine motors.



Dirt carrying capability is determined via a drop of oil on filter paper being evaluated with a CCD Photometer DT 100, and therefore it seemed reasonable to expand this method so that the proportion of soot in a petrol engine could also be found through the intensity of the black colour of the drop. Today we are able to differentiate the soot contents more precisely at between 0.01% and 0.4%. In addition to infrared spectroscopy, a change due to more or less soot can be determined by the blackness of the oil dot. As reference liquids with exact soot content are not available and also processes such as the TGA (thermo-gravometric analysis) are too inaccurate at such low levels of soot, for several weeks we have been showing the soot in gasoline engine oils not in % but rather as a soot index in the form of a dimensionless number instead.

The soot index is an „in-house method“ by OELCHECK which we have however also defined limits for. E.g. a soot index of >0.3 in waste oils from a petrol engine, according to previous experience, indicates a possible problematic change with the direct injection process. An increased change in combustion temperatures or a change in thermal oil load could also be the cause of more fine soot particles finding their way not only into exhaust gas, but also into the engine oil.

We will refine the changes found in the soot index even more and calibrate them intensely with the help of our customers' practical experiences. In this way, we can evaluate possible causes and effects even more individually and in addition comment more specifically on the laboratory findings.

**If you have questions about tribology or lubricant analysis, OELCHECK can answer them.
Send us your questions by e-mail (info@oelcheck.de) or by fax (+49 8034-9047-47).**