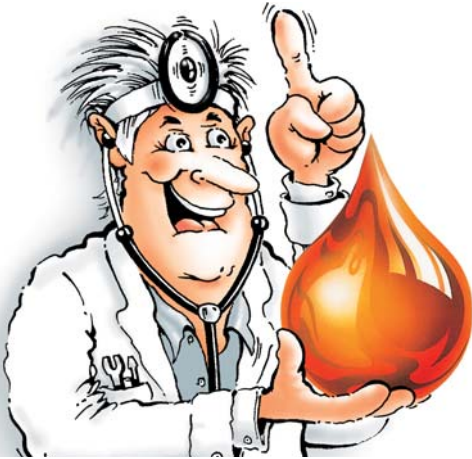




Öl Checker

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SCA – Preventive maintenance at the world's largest container terminal



Hamburg Harbour: container ships at HHLA's Altenwerder container terminal

Immediately after the container ship from Singapore ties up at the 1,400-metre quay of the Altenwerder container terminal in Hamburg, a race against the clock begins. After all, ships don't generate revenue for their owners when they aren't underway. Short layovers are therefore essential, but it's still necessary to transfer 7,000 standard containers. Stevedores are ancient history. Nowadays this previously backbreaking work is handled by sophisticated, computer-controlled transport systems.

Container Terminal Altenwerder (CTA) is one of three container terminals operated by Hamburger Hafen und Logistik AG (HHLA) in Hamburg Harbour. HHLA is one of the world leaders in harbour logistics. CTA is designed for the efficient handling of large container ships, and its high level of automation makes it the world's most advanced container terminal. Here it is not uncommon to see three or four large containers being loaded or unloaded simultaneously. The average ship has 4,000 to 5,000 containers of various sizes on board, and seven million containers on average are moved each year. The ship layover time is around 30 to

50 hours. The current record was set by CTA in January 2008, when the Colombo Express with its 8,750 twenty-foot equivalent units (TEUs) was processed in just 50 hours.

On the harbour side, fifteen gantry container cranes stand ready to unload cargo. Three to five cranes are used for each ship. On the quay side, 84 automated guided vehicles (AGVs) take over the containers. These fully automated transport vehicles operate without drivers and navigate under wireless computer control. No rails are necessary at Container Terminal Altenwerder. A network of more than 16,000 transponders (electromagnetic beacons) is embedded in the ground. As if controlled by an invisible hand, the AGVs travel to the intermediate storage areas specified by their transport orders, without ever getting in each other's way. Their priorities are clearly regulated, and the AGVs obey the right-of-way rules without fail. As soon as an AGV reaches the intermediate storage area with its load, a stacking crane takes over the container. Probably no other bulk storage site in the world is as fast as this one. CTA developed a highly unique concept for optimal utilisation of its fleet of 52 stacking cranes. In each instance, a large gantry crane travels above a smaller crane. Their different heights allow them to work independently, which dramatically boosts productivity and flexibility.

Check-up

Our new building was completed on time before Christmas. The entire engineering department will move into their new group office, with 250 square metres of floor space, before 24 December. It is furnished with modern, ergonomic office furniture and has an acoustic floor and ceiling. The shipping department will follow in early 2010.

On the upper floor we are setting up a cafeteria for visitors to the OilDoc seminars and other events. This floor also has a visitors room and additional offices. Our fitness centre with access to the swimming pool, sauna, steam bath and whirlpool will be located under the roof. The top floor also houses a new, larger seminar room. It is equipped with the latest conference technology. During the breaks, attendees can enjoy a panoramic view of the nearby mountains from the large patio.

We are still in the midst of the turmoil of relocation, but we are all enthusiastic about our new building. With its generous, lucid architecture and technical facilities, such as the air conditioning systems and exterior solar shading, it makes a wonderful impression. However, the most important thing is that with an additional 2,000 square metres of floor space, we finally have enough room for our constantly growing OELCHECK team.


Yours,
Barbara Weismann



motor oil. However, we regard early detection of damage as almost more important than the cost savings from condition-dependent oil changing. Our system is highly networked at the logistics level. If any component fails, there is a direct impact on the entire process. If we have a failure and the system does not operate as planned, the ship loading and unloading processes slow down. Especially in the shipping business, time is money, so every minute of extra layover time leads to lost earnings. Consequently, absolute reliability and maximum operational security of the facilities are our top priority. We definitely practice predictive maintenance at Altenwerder."

OELCHECK cooperates closely with the AGV manufacturer. Our diagnostic engineers are familiar with the situation at SCA GmbH and check their oil samples accordingly. In the lab, the motor and gear oils and hydraulic fluids are examined meticulously for the presence of metallic wear particles that may indicate possible damage, as well as for water or dust contamination. The general condition of the oil or fluid is also determined. Has the viscosity changed? Are the additives still effective? Has the aging process progressed? How good are the sludge-carrying properties of the motor oil? What purity class does the hydraulic fluid achieve? In short, a large number of properties are determined, compared with each other, and assessed by experienced engineers at OELCHECK. The verdict is not always negative. If it is, the lab report is marked immediately with a warning symbol and suitable comments from the engineer are included.

Philipp Mühlenhardt: "We take action if there is even the least suspicion. The oil is changed immediately. We take the next oil sample when the AGV makes its next stop in the shop. If the lab report again indicates high wear or other irregularities, we investigate the case thoroughly. Although we operate right next to the harbour, the occasionally high humidity or water in the air hardly affects our equipment. However, wear can always occur at any time with an AGV. When this happens, the OELCHECK lab detects fine metal flakes or wear particles in the hydraulic fluid or motor oil sample. Soft wear particles in the hydraulic fluid are typically a sign of worn seals or hydraulic hoses. Thanks to the lubricant analyses, we usually have a head start in early damage detection. We can take action before an AGV is crippled by damage and disrupts the entire process."

Tip: On 24 May 2009 the ARD German television network broadcast a report on CTA. The video clip can be viewed on the Internet at www.daserste.de/wwiewissen/beitrag_dyn~uid,3cpmm8oz5b9nu8j~cm.asp



Automated guided vehicles in action at Container Terminal Altenwerder

Next to the storage area, there are four large free-standing cranes for loading containers onto railcars.

The AGVs move back and forth tirelessly. They pick up incoming containers at the quayside, and they bring other containers from the storage area to the ships. These high-tech vehicles are a product of Gottwald Port Technology GmbH (Düsseldorf, Germany), a member of the Demag Cranes AG group of companies. The automated guided vehicles pick up 20-foot, 40-foot and even 45-foot containers, and they work quickly, almost silently, and with three-centimetre precision. They can move forward, backward and sideways, and they can even overtake each other. If a person enters the large working area of the AGVs while they are active, the entire system is stopped automatically. The vehicles have diesel-hydraulic drive systems. The fuel tank holds 1,200 litres of diesel fuel. When its tank is nearly empty, the AGV travels to a filling station. Naturally, refuelling is also performed automatically by a robot.

Every 600 operating hours, each AGV heads to the shop for scheduled maintenance. Here the AGVs are checked thoroughly by the staff of Service Center Altenwerder.

SCA Service Center Altenwerder GmbH is a subsidiary of Hamburger Hafen und Logistik AG. Its 130 employees are exclusively responsible for the maintenance of all CTA facilities. OELCHECK lubricant analyses are a vital part of mandatory scheduled maintenance for the AGVs. Oil samples are taken every 600 operating hours. The analyses encompass the HVLP 46 hydraulic fluid, the low-friction SAE 10W-40 motor oil for diesel engines operating under heavy load, and the GL 5 SAE 85W-90 multigrade gear oil used in the two drive axles of each vehicle.

Philipp Mühlenhardt, SCA Technical Manager: "We change the lubricants according to their condition as determined by OELCHECK in their lab. After all, each AGV holds around 360 litres of hydraulic fluid, 25 litres of gear oil, and approximately 30 litres of



The trendsetting event for science and practical applications

Knowledge transfer is the principal objective of OilDoc GmbH. The company's engineers are acknowledged experts in their fields. They provide advice on lubricant selection, act as independent experts, and provide comprehensive consultation services. They convey their practical knowledge and valuable specialised experience in the OilDoc seminars. OilDoc GmbH arose as part of a spin-off from OELCHECK GmbH. Managing Director Peter Weismann and Chief Engineer Rüdiger Krethe are experienced engineers previously employed by OELCHECK.

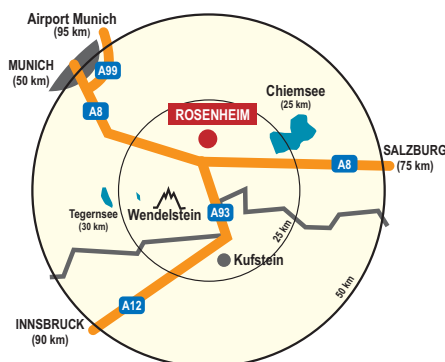


Peter Weismann



Rüdiger Krethe

Now the company has launched an entirely new project: **OilDoc Conference & Exhibition**. The first event will take place in February 2011, followed by new editions every two years. The event venue in 2011 is the Rosenheim Kultur- und Kongresszentrum (Cultural and Convention Centre), which received the EVVC Award in 2008 for the best European convention centre. Situated between Munich and Salzburg, Rosenheim is also very attractive in terms of travel. It is only 50 kilometres away from the centre of Munich.



Dipl.-Ing. Peter Weismann: "The event is a major opportunity for us, and the expectations are very high. Our ultimate aim with OilDoc Conference and Exhibition is to finally create a new platform for discussions on lubrication, maintenance and tribology. A platform in the heart of Europe for renowned scientists and experienced practitioners alike. Here the latest scientific findings and research results will be presented and discussed, along with reports on practical experience. OilDoc Conference and Exhibition will highlight trends and convey new impulses. Renowned international speakers are collaborating with us. The Programme Planning Committee has a corresponding membership. The deadline of the call for papers is 28 February 2010." OilDoc Conference and Exhibition participants can look forward to a three-day event from 1 to 3 February 2011, with more than 70 presentations and a trade exhibition featuring international companies.

Key topics at the OilDoc Conference

- **The state of the art in tribology**
The latest scientific and research findings
- **Condition monitoring – the basis for all forms of proactive maintenance**
Current developments in condition monitoring and lubricant analysis
- **Application engineering – trends for insiders**
How maintenance and lubrication experts master practical challenges
- **Fluid management – innovative and multi-faceted**
How to reduce costs and enhance production reliability with perfect fluid management

Leading companies show their stuff

In the spacious premises of the KUKO Conference Centre, international companies exhibit their products and services, including additives, lubricants, lubricating equipment, filter technology, sensors, centralised lubrication systems, purification services for oil and/or machinery, condition monitoring tools, special-purpose software, laboratory instruments, and much more.

Peripheral programme and promotion



Preparations for the event have been underway for several weeks already. Participants can look forward to an attractive peripheral programme in addition to the conference and exhibition. There are provisions for evening entertainment, as well as a varied programme for accompanying persons.

For the coordination of the event, OilDoc is drawing on the services of commercial specialist Astrid Hackländer. She also advises interested companies on matters related to promotion.

Astrid Hackländer: "OilDoc Conference & Exhibition is the best imaginable opportunity for successful networking. This is where the major decision makers meet their target groups. It would be hard to find a more effective promotion platform anywhere in Europe. Aside from conventional promotion methods, for which we are presently preparing a catalogue, there are any number of exceptional promotion ideas for virtually every budget. However, we reserve the details for individual consultation – after all, your activities should be the icing on the cake that enables you to make a lasting personal impression."

Call for Papers

Be part of the action and take advantage of this unique opportunity to present your latest research results, product innovations and unique services to an international audience of specialists. The deadline of the call for papers is 28 February 2010. For full information, visit www.oildoc.com.

Your partners: OELCHECK engineers



Top left to bottom right: Christoph Rößner, Rüdiger Krethe, Carsten Heine, Hendrik Karl, Klaus Turnwald, Peter Weismann, Steffen Bots, Stefan Mitterer

The OELCHECK diagnostic engineers work in the engineering department. Dipl.-Ing. Peter Weismann, a certified expert on lubricants and working materials, is the Engineering Manager of the entire company. Dipl.-Ing. Rüdiger Krethe, a long-term employee and authorised signatory, is responsible for the management of the diagnostic team.

The diagnostic team: experienced OELCHECK engineers formulate an individual diagnosis for each lab report. They have a sound general understanding of mechanical engineering and are familiar with the production processes of nearly every industry. As tribology engineers, they have extensive practical application experience with all types of lubricants. In addition, the OELCHECK engineers specialise in specific fields as follows:

- Steffen Bots: gear oils, samples from wind turbines, turbine oils
- Carsten Heine: motor oils from vehicles, aircraft and biogas plants, fuels
- Hendrik Karl: hydraulic fluids, bio-oils, oils from construction machinery, filter residues
- Rüdiger Krethe: recirculating oil systems, heat transfer oils, greases, all other areas
- Stefan Mitterer: motor oils, hydraulic fluids, compressor oils
- Klaus Turnwald: industrial gear oils and refrigeration oils
- Peter Weismann: expert opinions

The OELCHECK engineers also provide advice on

- specifying extended oil change intervals;
- optimising and simplifying lubricant types;
- preparing lubrication schedules and selecting suitable lubricants.

As recognised lubrication specialists, they participate in numerous international research projects, standardisation committees, working groups and lubricant committees.

The Technical Secretariat (TS): Daniela Priller, Christoph Rößner and Daniel Saringer are your contact persons for all telephone queries on technical matters. They provide advice on the selection of suitable analysis sets, inform you of the status of your submitted samples, and send you additional information on all aspects of oils. They also handle requests for changes or additions to the data in the lab reports. If you have questions on technical details, they connect you to the engineers.

OELCHECK ENVIRONMENTAL TIP

Selection and disposal of rapidly biodegradable hydraulic fluids

More than 20% of lubricants are not recycled. They leak into the ground or the water and disappear, they form films on components, or they remain in decommissioned machinery. In some cases, incorrect disposal results from inadequate information. In this regard, the impression suggested by the term "bio-oil", supported by the "Blue Angel" or the European daisy symbol, is enormously deceptive. Even oils with this designation should not end up in the environment. Users often think that as long as they use rapidly biodegradable hydraulic fluids, they do not have to take any action if a fairly large volume of hydraulic fluid ends up in the environment (soil or water). Using these synthetic fluids does not free users from the obligation to inform the authorities of environmental spills and to remove the fluid from bodies of water or polluted soil. Furthermore, simply allowing hydraulic fluid to drain into the ground when the fluid is changed is entirely out of the question, even with "bio-oils".

Lubricant disposal is regulated by law, such as the Altölgesetz (Waste Oil Act) in Germany. Bio-oils are not exempted. They are treated in the same way as corresponding synthetic oils or mineral oils. Rapidly biodegradable, environmentally compatible oils should be used by preference for work in environmentally sensitive areas. The storage of working materials is regulated by classifying

them according to their water hazard. Rapidly biodegradable, environmentally compatible oils are usually classified in water hazard class WGK1. There are many test methods for determining whether an oil is a "bio-oil", including tests that are not specific to a particular country. However, not all of these tests actually produce reliable results. In the case of hydraulic fluids, the ISO 15380 standard for environmentally compatible hydraulic fluids, which has been adopted by an international standardisation organisation, can generally be used as a reference. The tests defined by ISO 9439 and ISO 14593, which form the basis for this standard, test the degradability of the fluid in the container or in the machine. However, they do not test whether the "exhausted" fluid will pass the OECD-301x test.

Eco-oils based on polyalphaolefin (PAO) that can be classified as HEPR in accordance with ISO 15380 have synthetic hydrocarbons as their primary ingredients.

The commercially available environmentally compatible HEPR oils can also be rapidly biodegradable. As preformulated mixtures, they can also fulfil the requirements for rapid biodegradability specified in CEC-L-33-A-93. Many data sheets for hydraulic fluids and other lubricants state that they are rapidly biodegradable in accordance with CEC-L-33-A-93.

In other words, it is not absolutely necessary for

an oil to pass the ISO 9439 or ISO 14593 tests for environmentally compatible fluids if it is not claimed to be compliant with ISO 15380. The requirement for using bio-oils, which is often specified by public authorities in blanket terms in tender invitations without citing any standards, can be met by the CEC test, among others.

A few properties that make the long-term use of HEPR oils especially attractive were described in the Spring 2009 issue of ÖIChecker (pages 1 and 2).

OELCHECK tip:

When selecting a hydraulic fluid for use in an environmentally sensitive area, proceed carefully and check the manufacturer's specifications, the requirements of the equipment manufacturer, and the regulations of the public authorities in detail. This way you will be on the safe side if anything untoward happens.

If you change a system from a hydraulic fluid based on mineral oil to a rapidly biodegradable hydraulic fluid, always pay careful attention to the fluid conversion guidelines. Flushing procedures are necessary because the fluid volume in the tank is usually only around 30% of the total fluid volume. The mineral oil content must be less than 2% after the conversion. This can be checked with the OELCHECK bioset. A higher concentration of mineral oil can cause the bio-oil to lose its rapid biodegradability property.

Magic moments for the entire family in Europa Park



Europa Park promises magic moments in the winter season as well up to 10 January (source: Europa Park)

Europa Park (Rust, Germany) can look back on one of the most successful business histories in Germany. Officially opened in the summer of 1975, it drew 250,000 visitors that summer. Today the family-run business is second only to Cologne Cathedral as the most popular tourist destination in Germany. With more than four million visitors, Europa Park is by far the largest amusement park in Germany and the world's number-one seasonal park in visitor volume. More than 78 million people have visited the park since its founding. The Mack family has invested 550 million euros in the attractions (around 100 in total) and international shows that guarantee fun and entertainment for the entire family on the 85-hectare grounds. Europa Park has long since become more than just a traditional amusement park; it is also a renowned conference site adjacent to the Karlsruhe–Basel motorway and a popular location for events and television productions. With four 4-star resort hotels, it is also a favourite getaway destination for visitors from everywhere in Europe.

Rust has something to offer for everyone. Boredom is an unknown term there. Furthermore, all of the staff follow the motto of Roland Mack: "Our guests deserve only the best, and that's exactly what they receive from us." There are many attractions waiting for the visitors, with various thrill levels to accommodate different ages and personal tastes. Regardless of how fast a ride may be, safety always comes first. For several weeks each year, TÜV experts carry out safety inspections to check aspects such as speed and braking effectiveness as well as the subjective ride experience, and they conduct staff audits. Europa Park was the first amusement park in the world to be receive the new safety certificate of TÜV Süd Bau und Betrieb GmbH.

At a height of 75 metres, the glass lift cabin of the Eurotower provides a panoramic view of the Rhine Valley, the Schwarzwald, the Vosges range, and the entire Europa Park grounds with their top-quality rides. For pure thrills, you can't do better than the Silver Star, the largest and highest roller-coaster in Europe. With a height of 73 metres, a maximum speed of up to 130 kph and enormous centrifugal forces up to 4 g, it delivers a unique combination of sensation, speed and weight-

lessness. First the train must climb more than 70 metres to the highest point of the start, as the tension mounts. You've hardly recovered from the subsequent plunge before you ride over a succession of ups and downs toward the horseshoe bend near the end. There the train rises like a rocket, rounds a curve, whips to the side and throws itself with breakneck speed into a 120-degree curve. You hardly have time to catch your breath before you travel over the next bump and return to the station at the end of a 1,620 metre ride.

More than 200 tradesmen are employed at Europa Park, including around 30 mechanics and 30 electricians or electronic technicians, who look after the maintenance of the rides. In the early morning before the visitors arrive, and occasionally during operation, they check all of the safety functions every day. They are massively busy in November. The park is closed then, and the most important components of all the rides, such as the drives and brakes, are completely dismantled and meticulously inspected.

The motto here is early damage detection. The ultimate aim is to ensure that the rides never have to stop. Lubricant analyses have been a fixed part of the maintenance programme for many years now. OELCHECK inspects the hydraulic fluid and gear oil of several rides at least once a year. Driving these apparently lightweight attractions and controlling their motions requires high-pressure hydraulic systems holding several hundred litres of fluid, a large number of gearboxes and gearmotors with fully synthetic gear oils, and thousands of roller and journal bearings lubricated with long-term grease. The oils used in the main attractions are analysed. They include the Euro-Mir, whose orbiting cabins dive at a speed of 80 kph; the Matterhorn-Blitz; the

Atlantica SuperSplash, which is especially popular on hot summer days with daredevils who relish a long dive into cool water; and of course the ultimate roller-coaster: the Silver Star.



Thrills on the Silver Star, Europa's largest roller-coaster (source: Europa Park)

HVLPD 46 multipurpose hydraulic fluids are used here. Thanks to their detergent properties, they can absorb up to 2% water without any lasting adverse effect on the operation of the hydraulic system. The multigrade characteristic results in nearly constant travel and braking behaviour under varying temperature conditions, such as cold conditions at the start of operation and hot conditions under full load. This makes fluids of this type especially suitable for use in outdoor hydraulic systems. Depending on the gearbox type, the maintenance technicians use CLP 220 high-additive industrial gear oils or, especially for the many gearmotors with worm-gear transmissions, CGLP 460 synthetic oils based on polyglycols.

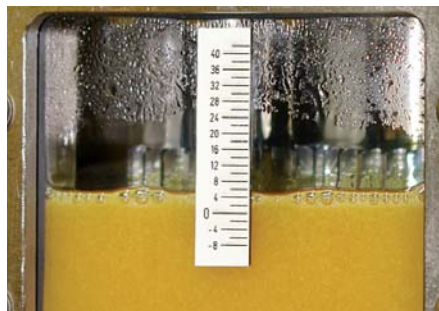
Operations Manager Dipl.-Ing. (FH) Achim Stoß: "We change the oils at fixed intervals, usually every two years. The lubricant analyses performed between changes by OELCHECK are very important to us for early detection of any damage. This sort of early damage occurs very rarely, and thanks to preventive measures before serious damage occurs it can be corrected without interrupting ride operation. After all, we have an obligation to our visitors: they want to enjoy their leisure time at Europa Park without any problems. We ensure that they can enjoy the rides without any trouble and with maximum security."

Flender foam test for gear oil analyses

In the past, OELCHECK used only the method specified by ASTM D 892 or ISO DIS 6247 to determine the tendency of gear oils to form surface foam. This involves blowing air through a porous stone into the oil sample in order to produce foam. In this test, the formation and decay of the surface foam is observed (see the Spring 2002 issue of OilChecker). However, this method does not correspond especially well to practical conditions. For this reason, an instrument for test device for the Flender foam test has now been installed in the OELCHECK laboratory. It has the advantage of corresponding closely to practical conditions. The Flender foam test yields especially valuable information when mixtures of different types of oils or impurities cause excessive oil foaming. It is an internationally recognised test method. Leading gearbox manufacturers insist on proof of a successful Flender foam test for fresh oil before they recommend a gear oil for their drives.

A member of the Siemens group of companies, A. Friedr. Flender AG is one of the world's leading manufacturers of components for mechanical and electrical drive systems. Its wide range of products extends from individual components to complete drive systems for virtually all industrial applications. As an expert in drive technology, Flender also focuses intensively on all issues related to

tribology and lubrication technology. The Flender foam test was developed in this context, originally as an in-house test designed to serve as an important criterion for judging the foaming tendency of oils, in particular industrial gear oils. Flender and other renowned gearbox manufacturers insist on a low foaming tendency for any gear oil to be included in their list of recommended lubricants. The test has become so well established internationally that a working group is now developing an ISO standard for it.



Foaming oil in the test fixture

Modern gear oils contain many additives to enable them to achieve the performance level necessary to provide adequate wear protection. Due to the use of new types of base oils, and especially due to EP additives, these oils have an increased tendency to foam formation in use. To suppress surface foam formation, foam inhibitors are added to the gear oil during production. They are usually based on high-viscosity silicone compounds. The formation of surface foam is not always a cause for alarm.

The hazard potential is low unless the surface foam forms a stable layer on top of the oil with a thick-

ness of several centimetres and remains intact for 30 minutes or more after the gears stop moving, or the foaming is so strong that foam is expelled from vent filters and other openings. Excessive foam formation can seriously degrade the load-bearing capacity of the lubricant film between the flanks of the gear teeth or in the bearings due to the inclusion of small air bubbles in the lubricant film.

Causes of unusually strong foaming:

- The foaming behaviour of the fresh oil is inherently close to the limit.
- Long storage can lead to separation of the anti-foam additives, since foam inhibitors are not dissolved in the oil but instead emulsified.
- Removal of antifoam additives by filtration. These additives, which are added relatively late in the process of oil production, are microdrops that, unlike all other additives, can become trapped in 5- μ m filters.
- Insufficient oil volume, excessive pumping rate or excessive speed.
- Too much of the previous oil with other additives remains in the system after an oil change (mixing should always be less than 10%).
- Improper addition of an anti-foam additive to existing oil.
- Impurities such as dust or gasket materials, fitting paste, grease, degreaser, residues of machining fluids, and paint ingredients degrade the foaming behaviour.
- Outside air sucked in after an inspection or oil pump repair.
- Incompatibility with other types of oil (mixing is clearly present).
- For example, with a new gearbox the first filling of gear oil may mix with residual amounts of a flushing oil with a detergent additive.
- Failing to drain the oil cooler when the system is changed to a different type of oil. An excessive amount of the previous oil is still present in the gearbox.

There are also other possible causes.

Problems with excessive foam formation often occur with conversion from a mineral oil to a synthetic oil, for example in mobile hydraulic systems with conversion from a mineral oil to a bio-oil or in the gearboxes of wind turbines. Excessive amounts of the previous oil can also remain in oil pockets or double-acting cylinders if the oil is changed to a different product when the equipment or system is cold (not warmed up).

How the Flender foam test works

- Sample volume: 1 litre
- The oil is left standing for at least two hours before the test, so that any entrapped air can escape.
- The actual test fixture consists of a closed gearbox with a transparent pane, which is marked with a scale graduated in percent.
- A set of equal-sized gearwheels with an outer diameter of 54 mm and a module of 2 mm is fitted at the middle of two vertical shafts.
- The test housing is first cleaned with no residue and dried.
- Approximately 1,000 ml of the oil under test is poured in until it reaches the middle (0 point of the glass scale) of the horizontal gearwheels and warmed to room temperature (25 °C). The colour and temperature of the sample are recorded.
- The set of gearwheels is then rotated at 1405 rpm for five minutes. This strongly agitates the oil and entraps air in the oil. This results in foam formation.
- Before, during and after the test, the increase in the oil volume can be read directly in percent from the graduated scale on the glass pane.

However, other factors can also be read from the scale after the end of the test. It is possible to distinguish between the actual surface foam and the underlying oil/air emulsion or the "pure" oil. The regression of the foam level is recorded at fixed time intervals for a period of 90 minutes. In this way, the time-dependent behaviour of foam development and regression is documented. The foaming characteristics of an oil are assessed on the basis of the volume increase exhibited by the oil under test one minute after the test fixture stops moving.



Flender foam test apparatus

Even if the manufacturer confirms that two oils can be mixed together, the compatibility of oil mixtures with regard to surface tension and additives is a different story and is usually ignored by oil manufacturers. It can happen that a mixture of two oils produces high foam levels even if both of the original oils have excellent foaming characteristics. Foam occurs when air or gas bubbles with diameters ranging from 5 µm to a few millimetres are formed by turbulence, rise to the surface in quiet regions such as the oil tank, and remain intact there. The strength of the foaming tendency of a particular gear oil and how long it takes for the foam to disperse can be tested in advance in the laboratory.

One way to do this is to use the “static” foam stone test specified in ASTM D 892 or ISO DIS 6247. However, this method for testing gear oils does not correspond to practical conditions as closely as the “dynamic” Flender foam test, which is now used in the OELCHECK laboratory. The latter test is especially suitable for testing the foaming characteristics of mixtures of different gear oils actually used in practice. The increase in volume is assessed as follows according to the Flender test:

- up to 5%: good foaming characteristics
- up to 10%: satisfactory foaming characteristics
- up to 15%: marginally acceptable foaming characteristics
- more than 15%: unacceptable foaming characteristics

Gearbox and bearing manufacturers assume that the load-bearing capacity of the gear teeth or bearings is adversely affected with a volume increase of more than 15%. Oils or oil mixtures with such high

Precise chlorine determination with the new TOX-100

Chlorinated additives are rarely used with modern lubricants and machining fluids. Nevertheless, chlorinated ingredients can still be present in oil samples, in particular used oil from gas or biogas engines and cooling lubricants. The fuel gas in facilities that operate with landfill gas or biogas is sometimes contaminated with chlorinated compounds. Chlorine can end up in the oil during combustion. There it poses a high risk to the engine components. In combination with high temperatures and moisture, aggressive acids that cause corrosion and pitting can be formed.

In the past, chlorinated compounds were added to some machining oils. Some of these old stocks of chlorinated materials are still being used up. In addition, some special blends still require chlorinated additives.



Placing the sample boat in the instrument

Another consideration is that mandatory separate collection and disposal are required for used lubricants and emulsions with excessive chlorine contamination (collection category 3 according to the German Waste Oil Ordinance).

However, disposal considerations are not the only reason why it is important to know whether an oil is contaminated with chlorine. This can be a very decisive factor in the analysis of damage to biogas facilities. However, precise determination of chlorine content was not possible with the previous

values are therefore not recommended by Flender or other gearbox manufacturers. Additionally, used oil with an elevated foaming tendency has a distinctly higher dielectric constant than fresh oil.

Local sensors for measuring oil level, oil quality and moisture that operate on the principle of electrical conductivity do not give reliable results with oils that have strong foaming tendencies, and they often cause costly false alarms.

instrument, which operated on the principle of energy-dispersive X-ray fluorescence. With the new TOX-100, OELCHECK now has an instrument for the microcoulometric determination of the chlorine content of oils, fuels and greases. It guarantees very high precision, even with extremely low concentrations. A sample amount of 20 to 100 mg (0.1 g) is sufficient. This corresponds to approximately two drops of oil, which are taken using a Pasteur pipette and placed in the instrument. The lower detection limit is 1 ng of chlorine. The chlorine content is stated with a precision of 1 ppm in the lab report.

The main parts of the instrument are an oven and a titration cell. The oil sample is fed into the oven in a small boat. There it is burned at a temperature of 1,000°C with the addition of oxygen. It is essential to obtain complete oxidation of the sample. This causes all of the chlorine present in the sample to be converted into chloride ions.

The combustion gases are flushed into the titration cell with the gas flow. Among other things, this cell contains a silver electrode in an electrolyte solution. An electric current causes a continual flow of silver ions into the solution. If the combustion gases contain chloride ions, the ions react with the silver ions. This reduces the silver concentration of the solution, and the current must be increased to compensate for the loss of silver ions in the solution. When all of the chlorine present has reacted, no additional current is necessary to produce silver ions and the measurement is complete. The chlorine content of the sample is calculated from the current consumed for the measurement. Now the boat travel back out of the oven to its initial position and is ready for the next measurement.

Chlorine determination is a special test and is not included in any analysis set. It is only available as an economical individual test on request.

Our advice:

in case of unusual behaviour with gear oils, especially after an oil change, have the foaming characteristics of the fresh and used oil tested before your gearbox loses too much oil due to expelled foam and runs dry or you are irritated by false alarms from sensors.



ÖlChecker

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QUESTION TIME

As an indication for low-temperature use, the data sheets of oil manufacturers state the pour point or solidifying point. Should the oil not be used below this temperature?

OELCHECK:

The pour point and solidifying point are characteristic values for the physical properties of a lubricant at low temperatures. However, they do not say anything about its actual behaviour at low temperatures. These two terms are often used synonymously in common language. Yet, they are not identical.

The pour point is the lowest temperature at which the oil still flows. The solidifying point is the temperature at which the oil "solidifies". It is the point where the cooled oil no longer flows under the influence of gravity. The solidifying point is usually 3 to 5°C lower than the pour point.

"Solidification" of an oil is caused by the crystallisation of the paraffins in the base oil. If the crystals join to form a network at low temperatures, the oil takes on a waxy, solid consistency. Naturally, the lubricating properties of an oil change when it solidifies. In particular, the oil supply fails because it can no longer be pumped. However, the first signs of crystallisation can already be seen before it reaches the solidifying point and actually solidifies with the consistency of Palmin or lard. The paraffin flakes make the oil milky or cloudy. The tem-

perature at which the bottom of the container can no longer be seen is defined as the cloud point.

The cloud point and the pour point are determined in the laboratory by observing the oil while it is cooled slowly. This measurement is performed by an automated device at OELCHECK.

Only limited conclusions regarding the actual behaviour of the oil at low temperatures can be deduced from these characteristics. Consequently, motor vehicle manufacturers do not specify the solidifying point, but instead measure the actual viscosity at certain temperatures below freezing. For instance, with a multigrade motor oil rating such as SAE 10W-40, the winter rating indicates that the viscosity of the oil should not be less than 7,000 mPa·s at -25°C. For the winter grades (0W to 25W), the Society of Automotive Engineers (SAE) also specifies the minimum temperature at which the oil can still be circulated with a pump. This is primarily important for cold starts in the winter, since the oil must be pumped quickly to the lubrication points immediately after the engine starts. Some engine and gearbox manufacturers even have their own low-temperature tests because they do not see any relationship between the pour point and actual practice.

Precisely defined limits are often not available for industrial lubricants. The pour point is often mistakenly regarded as the limit. Hydraulic system manufacturers recommend that as much as possible, the viscosity of the fluid should not be more

than 1,000 mm²/s for low-temperature starts. Start viscosities above 100,000 mm²/s can cause problems with gearboxes and may make preheating of the oil necessary.

OELCHECK can determine whether an oil actually has the necessary viscosity for the intended application at a specific temperature by measuring its viscosity/temperature profile in the laboratory. We already discussed the VTP in detail in the Spring 2007 issue of OilChecker. It is available at www.oelcheck.de for downloading.

Extra tip:

If an oil reaches a temperature below the cloud point or the pour point while in storage, in most cases this does not cause any problems if the oil is subsequently warmed up slowly. However, this does not apply to frost-sensitive products containing water and products that can be mixed with water, such as emulsions for machining metals or HFC hydraulic fluids. To be on the safe side, you should not store lubricants outdoors or expose them to extreme temperature variations. The container "breathes" with temperature variations, which can allow moisture to form in the container and contaminate the oil.

See the Winter 2007 issue of ÖlChecker or detailed information on the proper storage of lubricants (available under "Downloads" at www.oelcheck.de).

OELCHECK is always ready to answer your questions about tribology and lubricant analyses. Send us your questions by e-mail (info@oelcheck.de) or by fax (+49 8034/9047-47).

SEMINARS



In our OilDoc seminars, experienced engineers share their practical knowledge and valuable specialised experience in the fields of lubrication, lubricant analysis and tribology. The next series of seminars begins in the spring of 2010. They are devoted to machine monitoring by means of oil analysis in various application areas: hydraulic systems, engines, and industrial applications. In addition, we are once again organising a seminar on using oil analysis for optimal lubricant management and machine monitoring. Participants will learn everything they need to know to improve system availability and extend oil change intervals, as well as how they can directly reduce operating costs as a result.

The "Machine Monitoring with Oil Analysis" seminars for hydraulic systems, engines and industrial applications are offered at two levels: introductory (basic knowledge) and advanced. They thus cater to the needs of novices as well as experts.

The OilDoc seminars are held at OELCHECK headquarters in the Upper Bavarian town of Brannenburg, 60 km south-east of Munich. In addition to this series of events, we can organise seminars with contents tailored to your needs, including on your premises.

For detailed information and registration forms, please visit www.oelcheck.de. Your contact person is Rüdiger Krethe.

2010 seminar dates

1–3 March	Machine Monitoring with Oil Analysis for Engines
4 March	Advanced Seminar: Engines
8–10 March	Machine Monitoring with Oil Analysis for Hydraulic Systems
11 March	Advanced Seminar: Hydraulic Systems
15–17 March	Optimal Lubricant Management
12–14 April	Machine Monitoring with Oil Analysis for Industrial Applications
15 April	Advanced Seminar: Industrial Applications