FUCHS Industrial Lubricants

Innovative lubricants need experienced application engineers

Every lubricant change should be preceded by expert consultation on the application in question. Only then the best lubricant system can be selected. Experienced FUCHS engineers will be glad to advise on products for the application in question and also on our full range of lubricants.

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PLANTO

Rapidly biodegradable industrial lubricants

LUBRICANTS. TECHNOLOGY. PEOPLE. FUCHS

LUBRICANTS. TECHNOLOGY. PEOPLE.

We focus consistently on high-quality lubricants and related specialties.
We develop innovative and holistic solutions for a wide variety of applications.
We value the high level of commitment of our employees and their trusting interaction with one another.

Facts and figures

Company: FUCHS Schmierstoffe GmbH, a company of the FUCHS Group
Headquarters: Mannheim, with facilities in Mannheim and Kiel
Product range: A full range of more than 2,000 products and 6,000 articles
Certifications: DIN EN ISO 9001:2008, ISO/TS 16949:2009, DIN EN ISO 14001:2004 BS OHSAS 18001:2007, KTA 1401
References: Leading lubricant OEM for the German automotive industry

FUCHS has developed, produced and sold lubricants and related specialties for more than 80 years – for virtually all areas of application and sectors. With over 100,000 customers and 50 companies worldwide, the FUCHS Group is the leading independent supplier of lubricants.

A team of more than 700 specialists across Germany works to guarantee the satisfaction of our customers. Whatever their requirements, we have the ideal lubricant for their specific applications and processes. In our technology center we link interdisciplinary expertise in a quick and efficient way – and work on innovative lubricant solutions to meet the demands of today and tomorrow every single day.

FUCHS lubricants stand for performance and sustainability, for safety and reliability, for efficiency and cost savings. They represent a promise: technology that pays off.

Index

The world of biodegradable industrial lubricants

Transport, construction, municipal vehicles

Virtually all vehicles operate outdoors in one way or another, carrying all manner of resources on board. These include fuels, engine oils, gear oils, hydraulic oils, antifreeze, etc., which present a not inconsiderable danger to us and our environment in the event of a spillage or accident.

These dangers can be avoided by using special hydraulic oils such as **PLANTOHYD** and **PLANTOSYN** for the mobile sector.

Applications:
Harvesting machines, construction machines, trucks and municipal vehicles, ditch cleaning equipment

Agriculture and forestry

Forests, fields and Alpine green areas are highly sensitive ecosystems and their modern utilization has long had to be economically viable. Chainsaw lubricants are so-called loss lubricants which, even in their latest versions, enter and remain in the environment when used.

FUCHS focuses on sustainability and economic efficiency and for this reason has developed the rapidly biodegradable **PLANTO TAC 68** chainsaw oil, which complies with the special requirements of the European Ecolabel.

Applications:
Forestry, land management, agriculture, chain saws, landscaping

Marine

Water is the most important basic source of nutrition, and is often derived from groundwater or rivers. These important reservoirs are almost exclusively polluted by watercraft, e. g. by propeller greases, chain or rope lubricants and many more.

The FUCHS products **PLANTOSYN, PLANTOGEAR** and **PLANTOGEL** enable this pollution to be avoided. All PLANTO products, which have been awarded the European Ecolabel, may be used in accordance with the new Vessel General Permit (USA).

Applications:
Fishery, navigation of waters, sail boats and motorboats, locks, oil platforms, dry docks

Energy industry

Renewable energies such as wind power and rapidly biodegradable lubricants share a common background: preservation of the environment and resources.

FUCHS PLANTO lubricants have proven ideally suited to wind energy plants with the most challenging lubricant requirements.

The FUCHS products **ECO HYD S PLUS** and **GEARMASTER ECO 320** were developed specially for application in wind energy plants and are approved, rapidly biodegradable gear oils.

Applications:
Wind energy

Mountainous regions

The most important aspect for commercial use of rapidly biodegradable lubricants in mountainous regions is the preservation of an unspoilt and clean environment.

FUCHS offers a special range of PLANTO products that fulfill environmental protection requirements. These include the **PLANTOSYN** und **PLANTOLUBE POLAR**. products, which also ensure the best possible lubrication of machinery in mountainous regions.

Applications:
Piste preparation, ski lifts, snowmobiles, snow cannons

Water management

The use of lubricants and greases in areas where they will come into direct contact with water demands a particularly high degree of protection against pollution.

Greases are needed for gears, pumps, hubs and much more, for drinking water treatment in sewage plants or for operating locks.

Alongside excellent performance and a high level of water resistance, the lubricants also need to be rapidly biodegradable in order to protect the environment.

For such applications, FUCHS offers numerous products, including the rapidly biodegradable **PLANTOGEL ECO 2 N** and **PLANTOGEL ECO 2 S** lubricating greases, which have also been awarded the Ecolabel (EEL).

Applications:
Sewage plants, water treatment, docks, locks

Development of ecological lubricants at FUCHS

The dream of environmentally friendly lubricants is nothing new. Indeed, FUCHS was one of the first companies to enter the market with rapidly biodegradable lubricants back in the 70s, and since then FUCHS has invested heavily in researching and further developing these lubricants.

The reward for all this hard work: a priceless and unparalleled wealth of expertise and practical experience. Because one thing is certain: A good product alone is not enough. The user also needs competent advice when choosing the right product, switching over to rapidly biodegradable lubricants and for application. It really pays off to have an expert partner by your side –

every day.

1975

PLANTO TWIN
rapidly biodegradable two-stroke engine oil for outboard motors

1985

PLANTOTAC
biodegradable chainsaw oil based on vegetable base oils

PLANTOHYD N
rapidly biodegradable hydraulic oil based on vegetable base oils

1987

PLANTO
mould release oil based on vegetable base oils

1989

German Blue Angel (“Blauer Engel”) for **PLANTOTAC N**

1990

PLANTOCUT & PLANTOFORM
low-emission cutting and quenching oils

PLANTOGEL N
lubricating greases based on vegetable base oils

1991

German Blue Angel (“Blauer Engel”) for **PLANTO** mould release oil

1993

PLANTOMOT
world’s first biodegradable engine oil

1994

PLANTOGEL S
lubricating greases based on synthetic base oils

PLANTOGEAR
biodegradable industrial gear oil

1996

German Blue Angel (“Blauer Engel”) awarded for **PLANTOHYD** biodegradable hydraulic oils

2000

PLANTOHYD S NWG
synthetic hydraulic oil, non water polluting

2003

GEARMASTER ECO
rapidly biodegradable high-performance gear oil based on synthetic esters for wind energy plants

2008

PLANTO Enviro
biodegradable hydraulic, twostroke and chainsaw oil according to EU Ecolabel (EEL 2005/360/EC)

2013

EU Ecolabel for **PLANTOGEAR S-range** and **PLANTOSYN HVI-range**

2014

EU Ecolabel for **PLANTOGEL ECO 2 N, PLANTOGEL ECO 2 S** and **PLANTO TAC 68**

1970 | 1980 | 1990 | 2000

PLANTO –
REAL BIOGENIC LUBRICANTS

The perfect marriage of nature and state-of-the-art technology

The new products from the PLANTO range are biogenic lubricants. In the past, so-called "bio-lubricants" could generally also be manufactured from oil products. Biogenic lubricants, on the other hand, contain a very high share of renewable raw materials. As such, they represent a further development of the "bio-lubricants", taking into account the source of the raw materials as well as environmental compatibility.

For example, the carbon content derived from renewable raw materials is more than 50 % for hydraulic fluids with the EU Ecolabel; for chainsaw oil this is over 70 %, for two-stroke and gear oils more than 50 % and for lubricating greases in excess of 45 %.

Our rapidly biodegradable PLANTO products are based on synthetic esters or vegetable oils: This means that the natural oils are stabilized through chemical modification such that the finished products fulfill and surpass the required technical performance.

Awarded the – EU Ecolabel (EEL)

The EU Ecolabel so called "Euro-Marguerite"

One global goal: protecting the environment

"Sustainability" has become a much-used buzzword over the last few years. However, we are only slowly becoming conscious of the finite nature of many resources and of the consequences of using lubricants. Renewable raw materials combine environmental friendliness with sustainability.

For example, so-called biogenic lubricants manufactured from renewable raw materials are predominantly CO_2-neutral, rapidly biodegradable and are thus more environmentally compatible than lubricants based on mineral oil.

As the awareness of the importance of environmental protection grows, ever more consumers are realizing that they can play an active role in protecting the environment by using products that pollute or damage the environment as little as possible.

The meaning of the EU Ecolabel (EEL)

The goal of the Ecolabel is to highlight products that – compared to conventional products – reduce the impact on the environment and thus make a contribution to environmental protection and sustainable development.

The EEL is the official Ecolabel of the European Commission. "Marguerite" is a simple and reliable way to inform consumers of good, environmentally friendly quality. All products labeled with "Marguerite" have been independently tested for compliance with strict ecological and functional criteria.

Products awarded the EEL are a lesser burden on air, water, ground and human health than conventional mineraloil based products on the market. Moreover, products with the EEL can be more cost-effective than their conventional or comparable mineral-oil based counterparts, and added value can often be achieved during use.

The Ecolabel is for the following product groups:

- Hydraulic fluids
- Lubricating greases
- Chainsaw oils
- Mould release oils and other total loss lubricants
- Two-stroke oils
- Gear oils for industrial and marine applications

EU Ecolabel
www.ecolabel.eu

The objectives of the EU Ecolabel (EEL)

The EU Ecolabel according to 2011/381/EU was created with the following specific objectives:

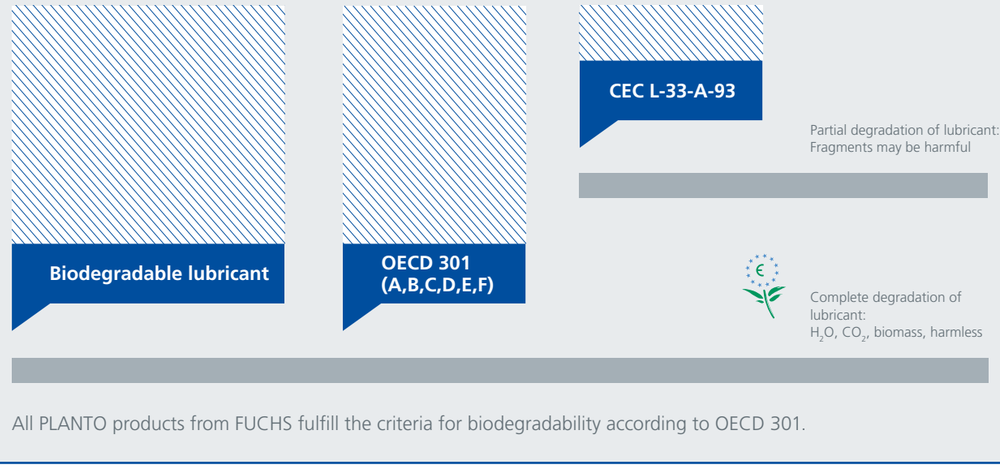
- Definition of standardized technical and ecological quality standards for "bio-lubricants"
- Reduced pollution of water and ground
- Reduced CO_2 emissions
- The "Marguerite" label makes it very easy to recognize the high quality of biodegradable lubricants from FUCHS

The EU Ecolabel – requirements of lubricants according to 2011/381/EU

- Biodegradable (according to OECD 301 > 60 %)
- Aquatic toxicity (OECD 201, 202 and 203)
- Halogen compounds and nitrite compounds not used
- Organometallic compounds not used
- Proportion of renewable raw materials > 50 % for oils (> 45 % for greases)
- No hazard to the environment or human health
- No relevant risk declarations (R-phrases)
- Requirements for rapidly biodegradable hydraulic oils acc. to DIN ISO 15380
- Technical performance of gear oils acc. to DIN 51517-3
- Technical performance of chainsaw oils acc. to the requirements of the KWF test

Requirements of rapidly biodegradable lubricants

Test method



All PLANTO products from FUCHS fulfill the criteria for biodegradability according to OECD 301.

What does "biodegradable" mean?
There is no single definition of the term "biodegradable". The process of biological decomposition generally proceeds in various steps. In the first step of partial biological degradation, fragments of the initial material are formed, which can still be damaging to the environment. Only when the initial material has fully degraded to H_2O, CO_2 and biomass is a lubricant said to be fully biodegradable.
In contrast to CEC L-33-A-93, the OECD 301 test analyzes the full biodegradability of lubricants.

Biodegradability according to CEC L-33-A-93 is no longer the state of the art for the rapidly biodegradable lubricants on the market today. Although the CEC L-33-A-93 standard from 1993 was updated with CEC L-103-A-12 in 2012, the ultimate biodegradability tests according to OECD Guideline 301 are generally authoritative today.

The six test methods according to OECD 301
OECD Guideline 301 is divided into six different test methods: A, B, C, D, E and F. A fluid is designated biodegradable when the dissolved organic carbon (DOC) has reduced by at least 70 % in all six test methods within 28 days or the theoretical oxygen demand (ThOD) and theoretical carbon dioxide production ($ThCO_2$) is at least 60 %. These requirements relating to the biodegradability of lubricants also apply for the EU Ecolabel. Test methods B, C and F are applied for water-insoluble products such as oils or greases and are therefore authoritative for FUCHS. Water-soluble products such as the RENOLIN PG 46 hydraulic oil are tested according to OECD 301 C.

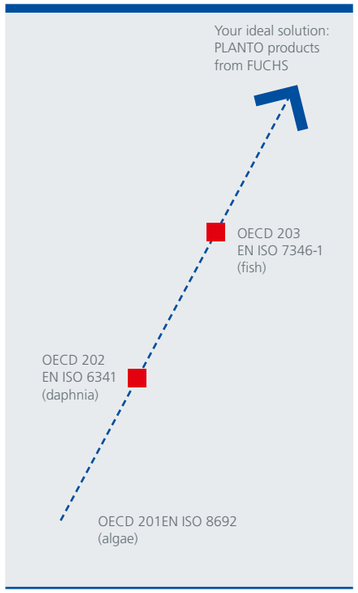
Test method	Procedure	Test criterion
301 B CO_2 evolution	A measured volume of the inoculated mineral medium, which contains a certain concentration of the test substance as the only nominal source of organic carbon, is aerated by the passage of carbon dioxide-free air at a controlled speed in the dark or in diffused light. The resulting CO_2 is trapped in sodium hydroxide and its content is determined by means of titration.	The amount of carbon dioxide derived from the test substance is given as a percentage of $ThCO_2$. The degree of biodegradability can also be calculated by also determining the DOC at the beginning and end of the test.
301 C MITI test	A stirred solution, or suspension, of the test substance in a mineral medium, inoculated with specially grown, unadapted micro-organisms, is incubated in a darkened, enclosed respirometer at 25 ±1 °C. The evolved carbon dioxide is absorbed by soda lime.	The oxygen uptake of a test substance is automatically measured over 28 days. Biodegradability is given as the percentage of the oxygen uptake of the ThOD.
301 F Manometric Respirometry	A measured volume of the inoculated mineral medium, which contains a known concentration of the test substance as the nominal sole source of organic carbon, is stirred in a closed flask and is observed at a constant temperature over 28 days.	The consumption of oxygen is determined either by measuring the quantity of oxygen required to maintain a constant gas volume in the respirometer flask, or from the change in volume or pressure in the apparatus.

The aquatic toxicity of lubricants
The lubricant must fulfill the requirements defined for the EEL regarding its main components or the requirements regarding every lubricant component that exists in a concentration of more than 0.10 percent by weight.

The aquatic toxicity must not be determined if the classification of the base oil or additive is already defined on the lubricant substance classification list, if a valid declaration of conformity can be presented, if the substance is so large that it cannot penetrate any biological membranes (molecular mass > 800 g/mol, molecule diameter > 1.5 nm), if the molecular weight fraction of a polymer is under 1,000 g/ mol and amounts to less than 1 % or due to the low water solubility of the substance (< 10 µg/l).

The OECD also defines three different test methods for testing the aquatic toxicity of lubricants: OECD 201, 202 and 203.

The concentration for acute aquatic toxicity to algae (OECD 201), daphnia (OECD 202) and fish (OECD 203) must be at least 100 mg/l for hydraulic fluids and gear oils. For all other lubricants, the concentration must be at least 1,000 mg/l according to the EEL. The EC50 value must be checked after 72 hours for algae or after 48 hours for daphnia, and the LC50 value must be checked after 96 hours for fish.



BRAPIDLY BIODEGRADABLE HYDRAULIC OILS

Mobile hydraulic applications demand environmentally friendly solutions

Hydraulic fluids make up approximately 13–14 % of total lubricant consumption in Germany. As such, hydraulic oils have a significant share of the lubricant market. Approximately 80–85 % of hydraulic fluids are pressure oils based on mineral oil. Fire resistant hydraulic fluids have a market share of 7 %, with rapidly biodegradable pressure fluids amounting to 5 %.

Environmentally friendly, rapidly biodegradable pressure fluids have been developed primarily with a high level of environmental compatibility in mind. These generally contain heavy metal-free, toxicologically harmless additives and additive systems and are used in both mobile and stationary systems. They are claiming a growing share of the market and are replacing mineral oil-based hydraulic fluids in numerous areas, in particular in the field of mobile hydraulic applications.

The minimum technical requirements of rapidly biodegradable pressure fluids are described in DIN ISO 15380.

Rapidly biodegradable pressure fluids according to DIN ISO 15380 are divided into the following product groups:

- HETG: Triglyceride (vegetable oils) – generally only used rarely
- HEES: Synthetic esters – largest and most important group (unsaturated, partially saturated and saturated)
- HEPG: Polyalkylene glycols – only used in low quantities
- HEPR: Polyalphaolefins and related hydrocarbons – fluids based on hydrocarbon products

Fluids are allocated in accordance with the main component in the base oil. DIN ISO 15380 contains requirements with regard to environmental compatibility as well as technical performance.

All PLANTO pressure fluids from FUCHS fulfill and surpass the requirements acc. to DIN ISO 15380.

Comparison of the physical characteristics of hydraulic oils

Designation/ typical measured values	MO Mineral oil	Polyalphaolefins	HEES Ester		HEPG Polyalkylene glycols	HETG Triglycerides
			saturated	part. saturated		
Product (example)	RENOLIN B 15 VG 46	RENOLIN UNISYN OL 46	PLANTOSYN 46 HVI	PLANTOHYD 46 S	RENOLIN PG 46	PLANTOHYD 40 N
Density at 15 °C [kg/m³]	875	843	905	921	1029	922
Viscosity index	105	146	150	186	203	211
Kin. viscosity –10 °C [mm²/s] 0 °C [mm²/s] 40 °C [mm²/s] 100 °C [mm²/s]	 1,591 593 46 6.9	 875 403 46 7.9	 814 440 46 8.2	 670 336 49 9.6	 866 282 46 9.7	 918 430 44 9.6
Flash point [°C]	210	260	280	304	240	306
Pour point [°C]	–24	<–60	–36	–42	–48	–36
Water-soluble	No	No	No	No	Yes	No
Biodegradability required by DIN ISO 15380 [%]	–	>60	>60	>60	>60	>60
Biodegradability of FUCHS products acc. to OECD 301 B/ C [%]	ca. 0–15	ca. 30	92*	74*	72.8*	ca. 80

* Test report available

Rapidly Biodegradable hydraulic oils – HEES-Test

HEES – ester-based, rapidly biodegradable pressure fluids
Ester oils are the most commonly used of all rapidly biodegradable pressure fluids with a share of approximately 80–90 %. Ester oils are generally synthetics made from alcohol and fatty acids.

The finished products created from these are known as "synthetically produced ester oils". If the acid chains are of natural origin, they can be given the designation "based on renewable raw materials".

All ester oils available on the market can hydrolyze when contaminated with water, i.e. ester products can be attacked in the event of exposure to water in the presence of oxygen at high temperatures.

Therefore, penetration of water in the system must be avoided when using ester oils. Hydrolysis is indicated by an increase of the acid number of the lubricant.

The more saturated the esters used, the less critically they react to water.

Advantages when using synthetic esters

- Biodegradable/minimum toxicity
- Reduction of CO_2
- Fuel saving/increased efficiency
- Long service life of lubricant
- Outstanding lubrication
- Very low coefficient of friction
- High performance
- Good oxidation and aging properties
- Partially excellent low-temperature properties
- Good viscosity-temperature properties (VI 120-180)
- High solubility
- Miscible with many base fluids such as mineral oil, HEPR, HEPG

Hydraulic fluids based on unsaturated, partly saturated and saturated synthetic esters
Esters are generally created through the reaction of an organic acid with a polyvalent alcohol under separation of water.

The combination of different types of organic acids and alcohols allows many variations of esters to be created for lubricants.

Greases and oils are produced through the esterification of alcohols and fatty acids. Fatty acids consist of a carboxyl group and of hydrocarbon chains of various lengths. The acid chains can be fully saturated (very high stability), partly saturated (good stability) and unsaturated. One speaks of saturated fatty acids when the fatty acids have no double bonds in their hydrocarbon chain.

If there are one or more double bonds in the hydrocarbon chain of the fatty acid, the fatty acid is partly saturated or unsaturated.

The number of double bonds in the hydrocarbon chain of the fatty acid determine the properties of the ester.

Double bonds are highly reactive and may be attacked by oxygen, which could end up in oil aging.

Fully saturated HEES ester oils are synthetic fluids which are resistant to high temperatures and which surpass the performance of mineral oils. They are therefore thermally stable and resistant to oxidation. Although HEES ester oils can also be partly saturated, they can still be classified as stable and, if the appropriate care is taken, used in the same manner as mineral oil. If a HEES ester oil only has double bonds, it is unsaturated.

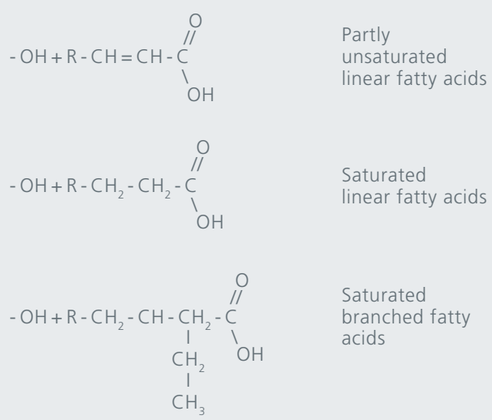
In order to test the aging stability of hydraulic oils, FUCHS applies the "Dry TOST" test according to DIN EN ISO 4263-1 (see following chapter). Unsaturated ester oils are usually tested with regard to their aging stability using the so-called Baader test. In the "Dry TOST" test, unsaturated ester oils display lower service lives.

The desired properties of the ester can be achieved by carefully selecting the raw materials.

The PLANTOSYN HVI range from FUCHS fulfills and surpasses the minimum requirements of HEES hydraulic oils according to DIN ISO 15380 and HVLP according to DIN 51524-3.

All PLANTO hydraulic fluids from FUCHS are produced on the basis of synthetic esters (saturated or partly saturated).

ALCOHOL



Rapidly biodegradable hydraulic oils – „Dry TOST“ test

Aging stability of PLANTO products – „Dry TOST“ test (DIN EN ISO 4263-1)

The “Dry TOST” test has been used for many years to test the aging stability of hydraulic oils. It is performed in a modified form without water.

360 ml of the lubricant is filled into a container. One catalyst each of steel and copper is immersed into this fluid. The test is carried out in the dark at a temperature of 95 °C. 3 l of oxygen per hour is added to the substance to be tested. A test duration of 1,000 hours is specified. Samples are removed at regular intervals and the neutralization number or change in kinematic viscosity of the lubricant is tested.

Oil aging generally becomes apparent through the increase in the neutralization number. The maximum permissible increase of the neutralization number is 2 mg KOH/g after 1,000 hours.

A further testing criterion is the change in kinematic viscosity of the lubricant at 40 °C. The maximum permissible change is ± 20 %.

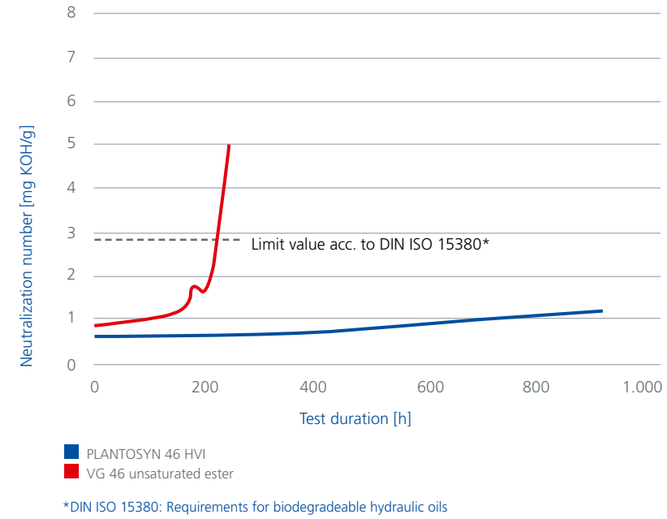
With the “Dry TOST” test FUCHS analyzes both the neutralization number and the change in kinematic viscosity of the lubricant in order to draw conclusions about its resistance to aging.

In the following diagrams, the “Dry TOST” test is carried out for a product based on unsaturated esters (VG 46) and the FUCHS hydraulic oil PLANTOSYN 46 HVI based on saturated esters.

The test criteria are the neutralization number and the change in kinematic viscosity at 40 °C. For both test criteria, the product (VG 46) based on unsaturated esters already exceeds the permitted limit values after approximately 200 hours. PLANTOSYN 46 HVI – based on saturated esters – on the other hand has a stable neutralization number up to a test duration of 3,000 hours. The limit value for the change in kinematic viscosity is actually exceeded after 3,500 hours.

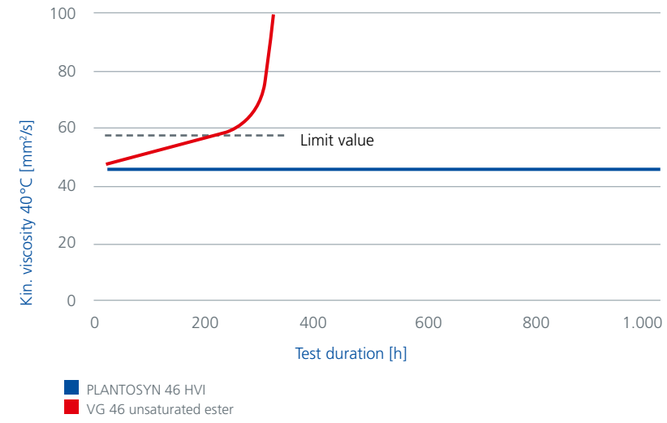
As such, the FUCHS product based on saturated esters has a far greater aging stability than the product based on unsaturated esters.

Aging stability of PLANTOSYN 46 HVI in “Dry TOST” test, DIN EN ISO 4263-1
PLANTOSYN 46 HVI vs. unsaturated ester oil: neutralization number



*DIN ISO 15380: Requirements for biodegradeable hydraulic oils

PLANTOSYN 46 HVI vs. unsaturated ester oil: kinematic viscosity



Rapidly biodegradable hydraulic oils – seals and elastomers

All hydraulic seals or elastomers used in the hydraulic system are fully or partially surrounded by the fluid medium during use. Interaction between the seal material and the hydraulic fluid is therefore unavoidable.

Physical influence

The hydraulic fluid can cause the seal material to swell or contract. This results in volume effects which change mechanical properties such as hardness, elasticity, tensile strength and stretching behavior. As a general rule, hydraulic oils should cause a slight increase in volume (small swelling).

Chemical influence

The temperature, oxygen, water and additives or aging products of the hydraulic fluid can also cause a negative change in the elastomer sealing material. In order to retain their flexibility, hydraulic oils generally should not harden the elastomers to a great degree.

Mechanical influence

The pressurization level or pressure pulsation through the medium can contribute to the mechanical load; furthermore, dynamically stressed seals wear due to the friction that occurs during the sliding movement. The tensile strength values should be influenced as little as possible in order to guarantee a long service life and prevent leakage.

Lubricant manufacturers analyze the behavior of hydraulic fluids and seal materials according to the standards DIN 51524, 53538 and 53505. These standards contain limit values for the change in volume or hardness of seal materials. Basic research and comparative tests of seal materials are carried out using reference liquids.

The mechanical wear of the seal is directly influenced by physical and chemical factors. Swelling leads to a softening of the material, higher friction and therefore also to higher wear and greater driving forces. Contraction can result in leakages.

The requirements of hydraulic fluids are therefore neutral behavior in contact with the seal materials and elastomers, protection of the seal from wear, removal of heat, minimization of friction and prevention of deposits at the sealing gap.

Testing of rapidly biodegradable hydraulic fluids based on vegetable oil, esters and polyglycol according to DIN ISO 15380 takes place over a longer time period in order to attain greater practical relevance.

The behavior of rapidly biodegradable hydraulic fluids in comparison to standard reference elastomers (SRE) after 1,000 hours at different test temperatures (80 or 100 °C) complies with CETOP R 81 H, ISO/DIS 6072. The seal materials in the test correspond to HNBR, FPM, NBR-1 and AU standards.

The tensile strength and elongation at break parameters have been added to the limit values for the change in hardness and volume. As such, the reduction in tensile strength and elongation at break must not exceed 30 % when testing with rapidly biodegradable hydraulic fluids (DIN ISO 15380, VDMA 24568).

Compatibility of elastomers with hydraulic fluids

	NBR	HNBR	AU	FPM (FKM)	EPDM mineral oil-free
	Suitable operating temperature range of elastomers (in °C)				
	–30 (–40)/+100	–20 (–30)/+140	–30/+80 (+100)	–20/+200**	–50/+150**
HL/HLP/HLPD Mineral oils	+	+	+	+	–
HETG	+	+	+	+	–
HEES	+*	+*	+*	+	–
HEPG	+*	+	–	+	+

*deployment must be tested for dynamically stressed seals
**max. air temperature

RAPIDLY BIODEGRADABLE GEAR OILS

Wind energy generators require the highest level of reliability and environmental friendliness

Although mineral oil-based gear oils continue to dominate, synthetic gear oils are becoming increasingly popular in the rapidly growing power transmission engineering market. The raised demands placed on gear oils by customers and gear manufacturers can often only be met with synthetic gear oils, as these offer greater performance characteristics.

In wind power in particular, synthetic gear oils are being used ever more frequently, as in many cases only these oils are capable of meeting the constantly growing technical performance requirements.

Synthetic gear oils withstand even the greatest loads and offer numerous advantages in comparison to mineral oilbased products:

- Service life two to three times longer
- Lower service costs
- Outstanding wear protection properties in gears and roller bearings
- Wider operating temperature range (multigrade characteristics)
- Lower disposal costs
- Better technical performance

The group of synthetic gear oils is divided into oils based on polyalphaolefins, polyalkylene glycols and synthetic esters.

The PLANTOGEAR S range from FUCHS is based on saturated esters and shows very low friction coefficients, a good load-carrying capacity and a high, naturally shear-stable viscosity index.

The polar structure of ester oils provides for good cleaning properties and dirt holding capacity. Furthermore, saturated esters display excellent thermal stability.

Products from the PLANTOGEAR S series can also be used to clean gearboxes which have been contaminated with deposits and sludge.

The oils of the PLANTOGEAR S series surpass the minimum requirements of CLP-E lubricating oils according to DIN 51517-3 together with DIN 51502, ISO 6743-6 and ISO 12925-1: CKC, CKD, CKE.

FUCHS offers the GEARMASTER ECO 320, an approved wind energy plant gear oil, specially for the wind power sector.

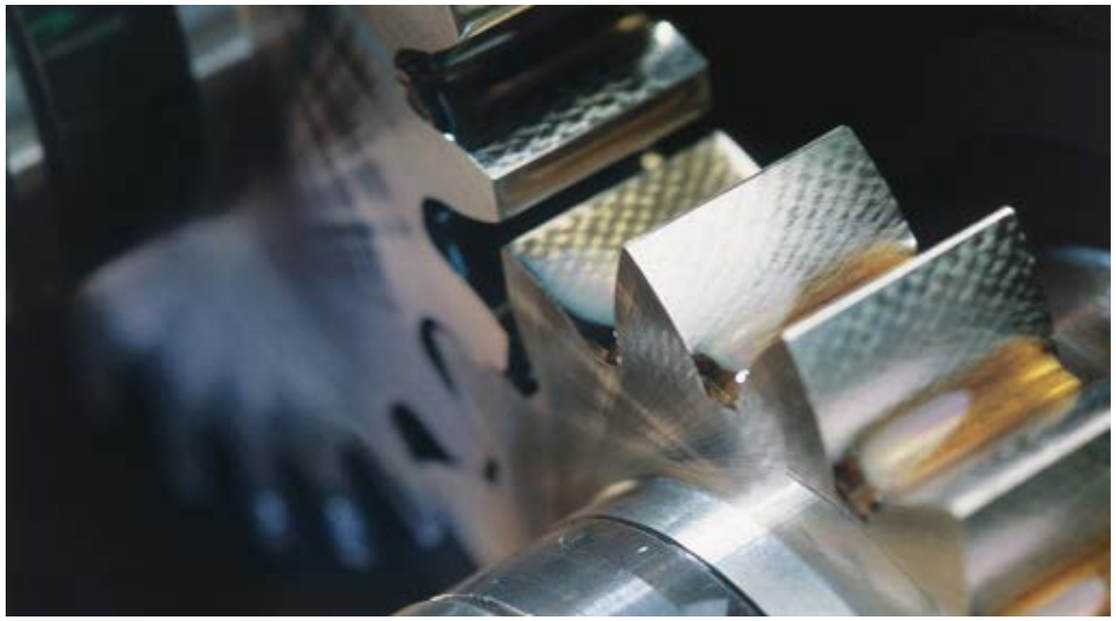
The PLANTOGEAR S range and GEARMASTER ECO 320 from FUCHS are rapidly biodegradable according to OECD 301. In addition, the PLANTOGEAR S range has also been awarded the EU Ecolabel.

Comparison of the physical characteristics of gear oils

Designation/typical measured values	MO Mineral oil	PAO Polyalphaolefins	POE Ester	PAG Polyalkylene glycols
Product (example)	RENOLIN CLP 220	RENOLIN UNISYN CLP 220	PLANTOGEAR 220 S	RENOLIN PG 220
Density at 15 °C [kg/m³]	896	854	938	1,075
Viscosity index	97	155	152	218
Kin. viscosity				
–10 °C [mm²/s]	21,140	6,300	6,666	6,800
0 °C [mm²/s]	5,010	2,700	2,773	1,571
20 °C [mm²/s]	853	656	663	527
40 °C [mm²/s]	221	220	220	220
60 °C [mm²/s]	79.3	93.1	92.4	108.0
100 °C [mm²/s]	18.9	26.7	26.2	36.8
Flash point [°C]	260	260	280	240
Pour point [°C]	–24	–42	–30	–33
Water-soluble	No	No	No	Yes
Biodegradability of FUCHS products acc. to OECD 301 B/ C [%]	ca. 0–10	ca. 15	90*	81.3*

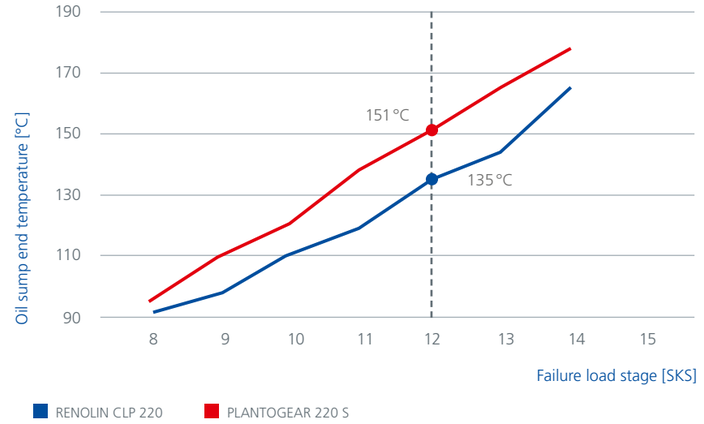
* Test report available

Rapidly biodegradable gear oils



PLANTOGEAR 220 S in FZG scuffing load carrying capacity test A/8,3/90 according to DIN ISO 14635-1

Comparison of oil sump temperatures of PLANTOGEAR 220 S based on synthetic esters and the mineral oil-based product RENOLIN CLP 220 under various load conditions.



FZG scuffing load carrying capacity test A/8,3/90 (DIN ISO 14635-1)
Many gear wheel damages can be influenced by lubricants. In order to test the scuffing load carrying capacity of gear oils, for many years FUCHS has used the FZG scuffing load carrying capacity test A/8,3/90 (gear geometry A, 8.3 m/s circumferential speed in the pitch circle, 90 °C starting oil temperature). ISO 14635-1 defines the test conditions for determining the scuffing load carrying capacity of lubricating oils at the FZG gear test rig.

The scuffing load carrying capacity is generally understood to be the greatest possible load a lubricant can be placed under in the specified conditions without scuffing occurring. The maximum scuffing load carrying capacity of the lubricant is described as the failure load stage. This is reached when the total of the gear damage is more than 20 mm.

To carry out the test, a test gear pair is immersed in the lubricant using the dip-feed lubrication method. The speed remains constant throughout the entire duration of the test. The test duration is 21,700 motor rotations. The load on the gear pair is increased in stages. The test begins at failure load stage 5. In the process, the oil temperature must be 90 °C ± 3 °C. Once the test duration has elapsed, the gears are removed and checked for fretting damage. If the total of the gear damage exceeds 20 mm, the test is ended. If no scuffing can be determined on the gear, the test is performed again at the higher failure load stage. This process is continued until scuffing of > 20 mm occurs or failure load stage 12 is reached.

In both bench tests and in practical application, the potential of synthetically-based gear oils to reduce oil sump temperatures by more than 10 °C is apparent. Based on failure load stage 8 at a Hertzian pressure of max. 1,233 N/mm² and an oil sump temperature of 90 °C, the failure load stages were continuously raised up to failure load stage 14 with a Hertzian pressure of approx. 2,138 N/mm². Under these conditions, an oil sump temperature 178 °C was reached for the mineral oil-based RENOLIN CLP 220 gear oil.

In comparison, when using PLANTOGEAR 220 S gear oil based on synthetic esters, the oil sump temperature could be reduced by 13 °C to 165 °C under the same operating conditions.

On average, the oil sump temperature of the PLANTOGEAR 220 S gear oil was 8 % lower than that of the RENOLIN CLP 220 gear oil during the entire duration of the test.

The PLANTOGEAR S range and GEARMASTER ECO 320 from FUCHS fulfill the minimum requirement according to DIN 51517-3, which specifies a failure load stage of at least 12.

RAPIDLY BIODEGRADABLE LUBRICANTS FOR THE MARINE SECTOR

Environmental protection agency stipulates environmentally compatible lubricants for all ships

In March 2013 the American Environmental Protection Agency (EPA) published the "Vessel General Permit" or VGP, which entered force in December of the same year. The new legislation stipulates that all ships must use environmentally compatible lubricants at all points where the lubricant comes into contact with water, unless this is technically infeasible.

This law applies to all ships greater than 79 feet in length which operate in the waters of the United States up to a distance of three miles from the coast or on lakes. Environmentally acceptable lubricants (EAL) must be biodegradable, may only have minimal toxicity and must not be bioaccumulative.

Biodegradable means

- 90 % w/w (mass percent) of the components of the lubricant (> 0.1 %) must be 60 % biodegradable in 28 days (according to OECD 301 B)
- Up to 5 % of the ingredients of the lubricant do not need to be biodegradable if they are not bioaccumulative
- The remaining components (> 0.1 %) should possess an inherent biodegradability of at least > 20 % and < 60 % (according to OECD 301 B)

Minimal toxicity means

- A substance that fulfills the requirements of OECD 201, 202 and 203
- The complete formula or individual components can be tested

Not bioaccumulative means

- Components that are not biodegradable must be determined in accordance with the defined standards (as per OECD 107 and 117)

Technically infeasible means

- No EAL or manufacturer specification for the equipment that is specified for a certain application
- Equipment that comes pre-lubricated (e. g. wire ropes) and have no available alternatives manufactured with EAL's
- Products meeting a manufacturer's specification are not available in a ship's port of destination
- The changeover and utilization of EAL can only be performed at the next dry dock

FUCHS PLANTO according to EU Ecolabel (also for VGP requirements)
In cooperation with LUKOIL Marine, FUCHS SCHMIERSTOFFE GMBH offers rapidly biodegradable hydraulic oils and industrial gear oils based on saturated, synthetic esters for applications in the marine sector. The products deliver outstanding performance and fulfill the technological and ecological requirements of VGP.

The biodegradable PLANTOSYN HVI and PLANTOGEAR S ranges from FUCHS have been awarded the EU Ecolabel and can therefore be used for all applications in the marine sector in accordance with VGP.

All products awarded the Blue Angel, the EU Ecolabel, the Nordic Swan or that comply with the Swedish Standards SS 155434 and 155470 and the OSPAR Guidelines can be marketed as "environmental acceptable lubricants" and can thus be used in accordance with the VGP.

RAPIDLY BIODEGRADABLE LUBRICANTS FOR THE AUTOMOTIVE INDUSTRY

Engine oils and special oils for every application

All manner of vehicles of different types and design are used on the road where fluids can enter the sewer network or the environment, on the field during harvest, in the forest when transporting wood or in mountainous regions when preparing pistes. Engine oils can enter the environment as a result of spillages or when filling.

With PLANTOMOT and PLANTO HYTRAC PLUS, FUCHS offers high-performance, rapidly biodegradable lubricants that guarantee excellent performance values.

Alongside rapidly biodegradable hydraulic and gear oils, FUCHS also offers a rapidly biodegradable engine oil and a special fluid (UTTO).

The super high-performance PLANTOMOT SAE 5W-40 engine oil is based on synthetic esters. The product is suitable for turbocharged and non-turbocharged diesel engines in passenger vehicles, buses, trucks, minibuses and industrial engines.

PLANTOMOT SAE 5W-40 is rapidly biodegradable (> 60 %) according to OECD 301 B and offers excellent engine performance as well as energy saving potential.

Moreover, PLANTOMOT SAE 5W-40 is compatible with biobased diesel fuels such as vegetable oil or RME. Further properties of PLANTOMOT SAE 5W-40 include outstanding cold starting behavior at very low temperatures, faster oiling of the engine and good supply of all mechanical parts, which in turn leads to lower wear.

Furthermore, the PLANTOMOT SAE 5W-40 engine oil reduces oil consumption, and its high level of oxidation stability enables oil change intervals to be increased. The powerful cleaning properties of PLANTOMOT SAE 5W-40 result in excellent engine cleanliness.

In addition, FUCHS offers a special fluid (UTTO) – PLANTO HYTRAC PLUS – for farming tractor gears/hydrostatic units with and without wet brakes. PLANTO HYTRAC PLUS is the environmentally friendly alternative to conventional hydraulic and gear oils based on mineral oil.

It is based on vegetable oil and is therefore rapidly biodegradable (OECD 301 B > 60 %). In the event of spillages or oil loss it remains in the upper layers of the earth to a large degree and is biologically degraded there. PLANTO HYTRAC PLUS is miscible and compatible with conventional hydraulic and gear oils with the same technology or specification.

It offers good flowability at low temperatures and ensures the fast supply of oil to all components. Furthermore, it displays excellent shear stability and thermal stability, as well as increasing oil change intervals and reducing deposits.

RAPIDLY BIODEGRADABLE LUBRICATING GREASES

100 % environmental compatiblility is essential for direct contact with water

Rapidly biodegradable, environmentally friendly lubricating greases based on rape seed oil or synthetic esters are recommended for all friction points to which conventional greases are normally applied, but in which a hazard to river water, groundwater, drinking water and ground cannot be ruled out when using conventional lubricating greases.

Rapidly biodegradable lubricating greases can also be used as total loss lubricants in drainage basins, agriculture, forests and hydroelectric power stations.

Simple greases based on rape seed oil can be replaced by fully synthetic ester-type greases here when particularly good UV and oxidation stability are required. Rapidly biodegradable lubricating greases should always be water-resistant, offer protection from corrosion, reduce wear, be sufficiently resistant to oxidation and be easy to pump in central lubricating systems.

For slow-rotating, highly stressed roller and plain bearings of all types, rapidly biodegradable lubricating greases with black solid lubricants and the corresponding dry running properties are used.

Rapidly biodegradable lubricating greases of the consistency class NLGI 2 are used for all roller and plain bearing applications, while rapidly biodegradable fluid greases are deployed for gears subjected to low to medium loads.

Biodegradability is tested according to OECD 301 B.
A lubricating grease is deemed to be biodegradable if it has decomposed by at least 50 % in this test.

In order to cut down on the variety of designations among rapidly biodegradable lubricating greases, a single definition for rapidly biodegradable lubricants has been established in Europe.

For this purpose, the following minimum requirements have been laid down for high-performance, rapidly biodegradable lubricating greases:

- The content of renewable raw materials according to ASTM D-6866 must be at least 25 %.
- Biodegradability according to OECD 301 B must be at least 50 %.
- The lubricating grease must not be designated as an environmentally harmful substance.

The PLANTOGEL range from FUCHS fulfills these requirements and the products can therefore be used as rapidly biodegradable lubricating greases.

Overview of PLANTO products

Brand name	Description	Density at 15 °C [g/ml]	Flash point n. Clev. [°C]	Kin. visc. at 40 °C [mm²/s]	Kin. visc. at 100 °C [mm²/s]	Cu-corr. at 100 °C	VI (viscosity index)	Pour point [°C]	Main application area
				Environmentally friendly industrial and hydraulic oils					
PLANTOHYD 32 N	Vegetable oil-based hydraulic oils with additives to increase oxidation and aging stability. Biodegradable (OECD 301) > 60 %. High wear protection (FZG stage 12). Surpass the minimum requirements of DIN 51524-3 HVLP. Exception: DIN 51587 "TOST" test. Miscible with conventional, mineral oil-based hydraulic oils. 32 N: HVLP 32, HETG 32 46 N: HVLP 46, HETG 46 Designation according to DIN ISO 15380: HETG.	922	274	31	7.4	–	213	–39	Universally usable in hydraulic systems from –27 °C to +70 °C (container temperature). The changeover guidelines according to DIN ISO 15380 must be observed.
PLANTOHYD 40 N*		922	306	44	9.6	–	211	–36	
PLANTOHYD 15 S*	Synthetic ester oils with additives to increase aging stability. Biodegradable (OECD 301) > 60 %. High wear protection (FZG stage 12). Surpass the minimum requirements of DIN ISO 15380 HEES. Miscible and compatible with conventional, mineral oilbased hydraulic oils. 32 S: HVLP 32, HEES 32 46 S: HVLP 46, HEES 46 68 S: HVLP 68, HEES 68 Designation according to DIN ISO 15380 "HEES". PLANTOHYD 15 S, 22 S and 46 S have been awarded the "Blauer Engel".	927	225	15	4	–	161	–51	Universally usable as a lubricating and hydraulic oil, especially in areas with strict environmental protection requirements/goals. Container temperature: –30 °C to +90 °C. Changeover guideline DIN ISO 15380 must be observed!
PLANTOHYD 22 S*		924	240	22	5.4	–	191	–36	
PLANTOHYD 32 S*		921	246	32	7.1	–	188	–51	
PLANTOHYD 46 S*		921	304	49	9.6	–	186	–42	
PLANTOHYD 68 S*		927	280	69	12.2	–	177	–48	
PLANTOHYD 22 S NWG*	Performance level equivalent to PLANTOHYD S. Fluid tested as "non-hazardous to water" according to current VwVwS.	905	195	23	5.5	–	191	–36	To be used in mobile or stationary applications where a hydraulic oil that is "non-hazardous to water" is required and where the old classification according to WGK 0 is not sufficient. Gears, bearings, actuators used at extremely low temperatures (e. g. polar regions). Hydraulic systems operated under similar temperatures can also be run with oils from the POLAR S range. The changeover guidelines according to DIN ISO 15380 must be observed.
PLANTOHYD 46 S NWG*		920	290	47	9.6	–	192	–39	
PLANTOLUBE POLAR 15 S	PLANTOLUBE POLAR S oils are environmentally friendly, rapidly biodegradable and have an extremely low pour point. Thanks to their very high VI, they can be used in a wide temperature range. POLAR-S oils offer outstanding protection against corrosion and wear and are highly agingresistant. Surpass the requirements of DIN 51 5242. Exception: "TOST test". Miscible and compatible with mineral oil. POLAR 15 S: HVLP 15, HEES 15 POLAR 22 S: HVLP 22, HEES 22 Designation according to DIN ISO 15380.	899	156	15	4.1	–	199	<–48	
PLANTOLUBE POLAR 22 S		908	166	22	5.7	–	200	<–51	
PLANTOSYN 32 HVI	Environmentally friendly hydraulic and circulating oils based on synthetic saturated esters. Rapidly biodegradable according to OECD 301 B > 60 %; high degree of wear protection, good seal and nonferrous metal compatibility, excellent oxidation stability. Fulfills the minimum requirements of HEES hydraulic oils according to DIN ISO 15380 and HVLP according to DIN 51524-3. Awarded the EU Ecolabel.	915	220	32	6.2	–	148	–46	Universally usable in all mobile and stationary hydraulic systems for which the use of a rapidly biodegradable HEES hydraulic oil according to DIN ISO 15380 is recommended (e. g. in agriculture and forestry). Can be used where unsaturated, synthetic esters have failed. Extended oil chain intervals possible. Container temperature from –30 °C to 100 °C. Observe DIN ISO 15380 when making changeovers. **Approvals:** MANNESMANN, REXROTH and SUNDSTRAND. **FUCHS recommendations:** BOSCH REXROTH AG, CAT BF-1, KRAMER ALLRAD, PALFINGER, SAUER DANFOS, TIMBERJACK, VALMET/ KOMATSU FOREST, PONSSE **Approvals:** FENDT, O&K
PLANTOSYN 46 HVI		905	280	46	8.2	–	150	–36	
PLANTOSYN 68 HVI		916	280	68	10.6	–	143	–27	
PLANTOSYN 3268	Environmentally friendly, high temperature-stable HVI multigrade hydraulic oil based on fully saturated, synthetic ester (HEES), surpasses DIN ISO 15380, rapidly biodegradable according to OECD 301 B > 60 %. Awarded the EU Ecolabel.	912	230	45.7	8.2	–	155	–	
PLANTOSYN 3268 ECO*	Environmentally friendly, universally usable HVI multigrade hydraulic oil based on synthetic esters (HEES), rapidly biodegradable according to OECD 301 B > 60 %.	921	304	48.8	9.6	–	186	–42	**Approvals:** Fendt KDM
				Slideway oils, machine oils					
PLANTOLUBE CGLP 68 S	Slideway oils based on synthetic esters with very good biodegradability, prevents stick-slip. Load-carrying capacity and wear protection are particularly outstanding.	928	304	69	12	–	177	–48	PLANTOLUBE CGLP 68/220 S are designed for use in combination with PLANTOCOOL and PLANTOCUT. For use in modern machine tools.
PLANTOLUBE CGLP 220 S		950	280	220	27	–	162	–48	
				Synthetically based compressor oils/circulating oils					
PLANTOLUBE SC 46 S	Fully synthetic, rapidly biodegradable compressor oil; high aging stability; good air release properties; low evaporation losses.	904	240	46	8	–	148	–45	Screw compressor oil based on saturated esters.

* The relevant products are qualified according to the EU Ecolabel.

Overview of PLANTO products

Brand name	Description	Density at 15 °C [g/ml]	Flash point n. Clev. [°C]	Kin. visc. at 40 °C [mm²/s]	Kin. visc. at 100 °C [mm²/s]	Cu-corr. at 100 °C	VI (viscosity index)	Pour point [°C]	Main application area
Synthetic circulating and gear oils									
PLANTOGEAR 100 S	Rapidly biodegradable high-performance gear oils on the basis of special, saturated esters. Extremely high thermal and aging stability, high viscosity index (shear-stable), good viscosity-temperature behavior, for low-temperature applications, excellent cleaning power due to polar ester structures, reduced friction, excellent wear protection, good FZG scuffing load carrying capacity, good protection against micropitting, outstanding FE8 performance, rapidly biodegradable and self-cleaning. The oils of the PLANTOGEAR S series of oils surpass the minimum requirements of CLP-E lubricating oils according to DIN 51517-3 together with DIN 51502, ISO 6743-6 and ISO 12925-1: CKC, CKD, CKE. The PLANTOGEAR S range has been awarded the EU Ecolabel.	924	280	100	13.7	–	138	–33	For highly-stressed spur, bevel, planetary and worm gears, above all in areas where leakages could present a hazard to soil and the ground or surface water. For both high and low application temperatures. High, shear-stable viscosity index. Can be used as a cleaning fluid.
PLANTOGEAR 150 S		926	280	150	19.1	–	145	–30	
PLANTOGEAR 220 S		938	280	220	26.2	–	152	–30	
PLANTOGEAR 320 S		943	280	320	35.1	–	155	–30	
PLANTOGEAR 460 S		951	280	460	48	–	163	–30	
PLANTOGEAR 680 S		958	280	680	66	–	170	–30	
GEARMASTER ECO 320 (for wind energy)		943	280	320	35.1	–	155	–33	
Adhesive oils, machine oils									
PLANTOTAC HV 220 N	High-quality adhesive oils based on vegetable oil, environmentally friendly and rapidly biodegradable. Adhesive oils from the PLANTOTAC HV range offer very good VT behavior and adhesive properties and excellent wear protection together with very high lubricating film strength. FZG test run A/3.3/90, failure load stage > 12. 220N: CG 220, 320N: CG 320, 460N: CG 460, 100S: CG 100 equivalent to PLANTOTAC HV-N only on the basis of aging-stable synthetic esters.	955	272	249	31.5	–	169	–36	Predominantly for so-called lubrication loss points, such as on non-oil-tight sealed bearings, saw frames, guide ways, joints, bolts, etc.
PLANTOTAC HV 320 N		958	264	381	42.4	–	166	–27	
PLANTOTAC HV 460 N		977	260	460	43.3	–	146	–30	
PLANTOTAC HV 100 S		924	300	100	17.5	–	193	–36	
Forming and mould release oils									
PLANTO SCHALUNGS-ÖL N*	Based on vegetable oil, rapidly biodegradable.	904	194	12.8	–	–	–	–18	Primarily used for steel shutterings in the concrete products and plastics industry. Flattening the cement surface. Special attention must be paid to compatibility with varnish and elastomers.
Chainsaw oil									
PLANTO TAC 68	Rapidly biodegradable, highly viscous and strongly adhesive chainsaw oil based on renewable raw materials. Awarded the EU Ecolabel.	924	–	55.32	11.83	–	–	–	PLANTO TAC 68 was developed specially for all lubricated saw chains which are used in the toughest conditions in environmentally sensitive areas such as protected water zones, forests, tree nurseries, etc. PLANTO TAC 68 can also be used in other areas in which an excellent chain lubricating oil is required.
Automotive									
PLANTOMOT SAE 5W-40	Super high-performance SAE class 5W-40 diesel engine oil. Rapidly biodegradable and particularly recommended for use with alternative diesel fuels.	918	244	76.8	14.2	–	193	–42	For use in machines and commercial vehicles, e. g. construction machines, buses, forestry and agricultural equipment or piste maintenance machinery as well as passenger vehicles. When using diesel or biodiesel, engines can be changed over to PLANTOMOT without flushing, regardless of their mileage. **FUCHS recommendations:** ACEA E3/B3, API CG-4, KUBOTA, SISU, ZETOR
PLANTO HYTRAC PLUS	Special fluid (UTTO) for farming tractor gears/hydrostatic units with and without wet brakes.	914	>200	–	10.3	–	211	–40	PLANTO HYTRAC PLUS is deployed in manual transmissions and gear/hydraulic systems with and without integrated oil bath brakes. In the event of spillages or oil loss PLANTO HYTRAC PLUS remains in the upper layers of the earth to a large degree and is biologically degraded there. **Specifications:** SAE 10W-30, SAE 80, API GL 4 **FUCHS recommendations:** Various tractor types

* The relevant products are qualified according to the EU Ecolabel.

Overview of PLANTO products

Brand name	Description	Density at 15 °C [g/ml]	Flash point n. Clev. [°C]	Kin. visc. at 40 °C [mm²/s]	Kin. visc. at 100 °C [mm²/s]	Cu-corr. at 100 °C	VI (viscosity index)	Pour point [°C]	Main application area
PLANTOGEL range: lubricating greases									
PLANTOGEL ECO 2 N (based on rape seed oil)	Calcium soap, light brown, also available in NLGI 1. Awarded the EU Ecolabel.	2	≥ 110	265–295	–20 to +70	1–90	0–0	36	Lubricating grease for lock gates, sewage plants, agriculture and forestry.
PLANTOGEL ECO 2 S (based on synthetic esters)	Lithium soap Awarded the EU Ecolabel.	2	≥ 170	265–295	–40 to +120	1–90	0–0	110	For lubricating roller and plain bearings, e. g. in water turbines, agriculture and forestry.

Overview of additional products

Brand name		Description	Density at 15 °C [g/ml]	Flash point n. Clev. [°C]	Kin. visc. at 40 °C [mm²/s]	Cu-corr. at 100 °C	Main application area
Ester-based cutting oils							
PLANTOCUT SR-range	7 SR Plus 10 22 40	Synthetic esters based on virgin raw materials, low hazard to water, rapidly biodegradable – low evaporation and low oil mist. Available in ISO VG 7, 10, 22 and 40 versions, PLANTOCUT 7 SR Plus and 10 SR are H3O4-free.	0.87 0.86 0.98 0.92	198 206 215 216	7 10 22 40	1 1 1 1	Suitable for all materials – therefore particularly suitable for all processes using a defined cutting edge and for grinding.
PLANTOCUT 18 S-CS		Synthetic esters based on virgin raw materials, low evaporation and low oil mist.	0.93	200	18	4	For heavy machining, used for processing magnetic malleable iron.
UNIFLUID-range	10 32	Low oil mist, copper-inactive universal product for metal-working and hydraulics based on synthetic esters, fully saturated; non-hazardous to water. Available in ISO VG 10 (H3O4-free) and ISO VG 32 versions.	0.87 0.96	220 256	9.8 32	1 1	Multifunctional oil for use in the field of metalworking and hydraulics for the same viscosity; only with A10 VSO 71 DR axial-piston pump from BOSCH REXROTH; universally usable for aluminum, cast iron and medium-strength steels. Product can also be used for honing and grinding.
Ester-based minimum quantity lubrication							
PLANTO MIKRO-range	10 SR UNI	Synthetic esters based on virgin raw materials, low hazard to water, rapidly biodegradable – low evaporation and low oil mist.	0.86 0.88	206 200	10 15	1 1	Universal for all materials, suitable for one and two-channel spray systems.
Metalforming lubricants, not water-miscible							
PLANTOFORM BSO 1002 PLANTOFORM MBO 2797		Synthetic, easily biodegradable ester.	0.865 0.921	130 300	5.4/20°C 49	1 1	Cold extrusion of small parts made of non-ferrous metals, in particular copper and aluminum, also some applications with stainless steel.

Checklist for switching hydraulic systems over to environmentally friendly hydraulic fluids

In case of questions to the range of products or to the changeover, please send the checklist to the responsible FUCHS-application engineer!

Adress

Location

Company

Date

Application

Transport, construction, municipal vehicles

Agriculture and forestry

Energy

Marine

Others

Recently used hydraulic fluid/type

Hydraulic oils	HLP ISO VG	HLP-D ISO VG	HVI-Oil ISO VG	Others
Gear oils	API GL	SAE	Type	
Engine oils	API/ACEA	SAE	Type	
Other specifications			Type	
Machine will be filled with			Date	

Hydraulic tanc

with coating or paint finish	inside ☐		galvanized inside ☐		Stainless steel inside untreated (black) ☐	
Tanc temperature display	yes ☐		no ☐			
Tanc temperature under operating conditions	from	°C	to	°C		
Tanc capacity (manufacturer information)	ca.	litres				
Total content of the hydraulic system	ca.	litres				
Operating pressure	from	bar	to	bar		
Volume flow	min.	litre/min.	max.	litre/min.		

Tube materials

Manufacturer			
Type/Description			
Elastomer material			
Proved compatibility	yes ☐	no ☐	

Pump

Manufacturer			
Type/Description			

Filter elements

Manufacturer			
Material			

Are there any other machines or equipment with environmental acceptable hydraulic oils in use?

Based on Polyglycols (HEPG) ☐	Based on rape seed oil (HETG) ☐	Saturated synth. Ester (HEES) ☐	Partly saturated synth. Ester (HEES) ☐	Others (e. g. HEPR – Polyalphaolefins) ☐

For your notes

The information contained in this product information is based on the experience and know-how of FUCHS SCHMIERSTOFFE GMBH in the development and manufacturing of lubricants and represents the current state-of-the-art. The performance of our products can be influenced by a series of factors, especially the specific use, the method of application, the operational environment, component pre-treatment, possible external contamination, etc. For this reason, universally-valid statements about the function of our products are not possible. The information given in this product information represents general, non-binding guidelines. No warranty expressed or implied is given concerning the properties of the product or its suitability for any given application.

We therefore recommend that you consult a FUCHS SCHMIERSTOFFE GMBH application engineer to discuss application conditions and the performance criteria of the products before the product is used. It is the responsibility of the user to test the functional suitability of the product and to use it with the corresponding care. Our products undergo continuous improvement. We therefore retain the right to change our product program, the products, and their manufacturing processes as well as all details of our product information sheets at any time and without warning, unless otherwise provided in customer-specific agreements. With the publication of this product information, all previous editions cease to be valid.

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