PCC products for Lubricants & MWF

Application guide

Local. Global. Integrated.

Lubricants Business Unit

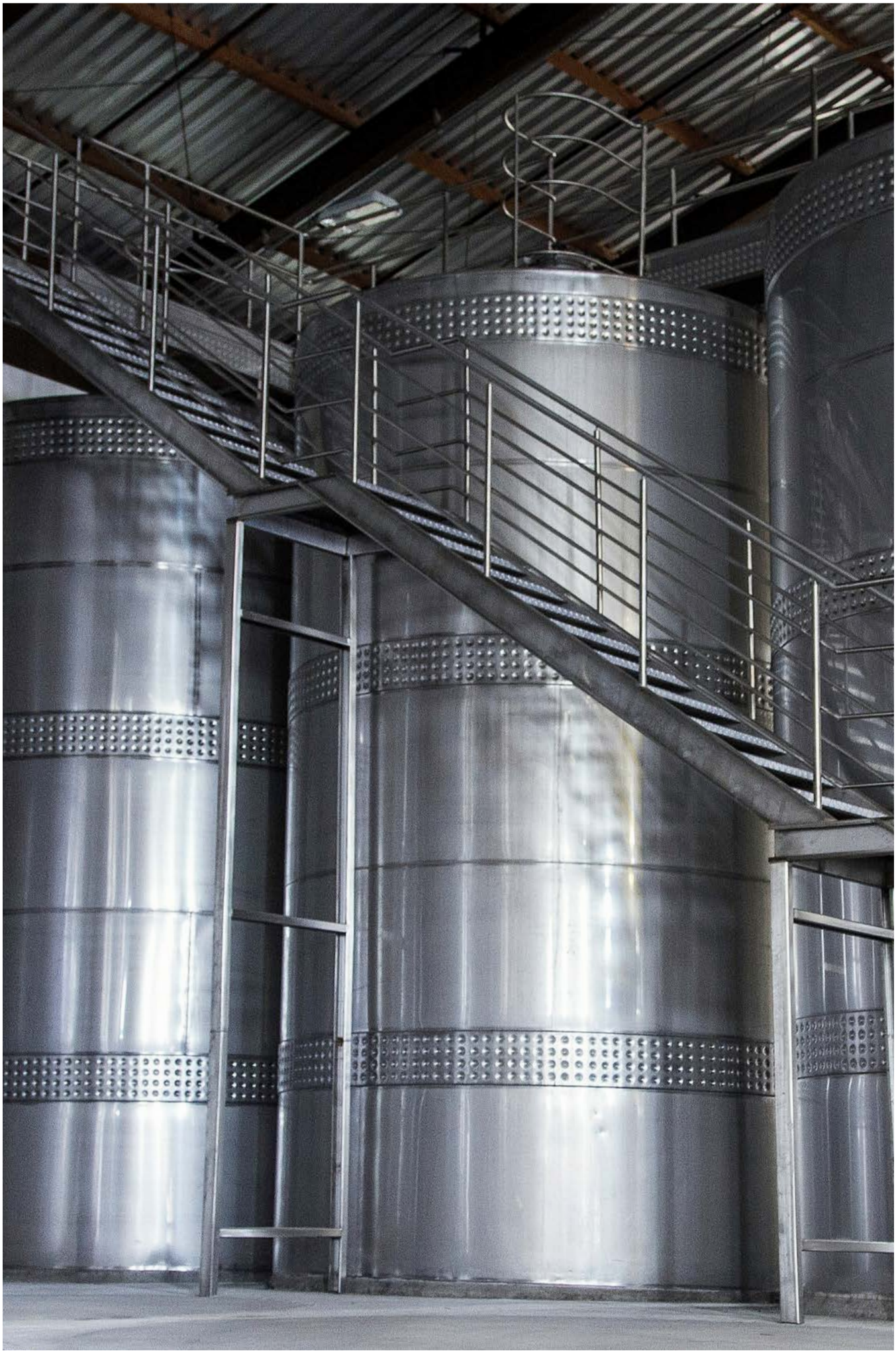
The Business Unit operating within the structures of PCC Rokita S.A., offers a wide range of products that are key raw materials for the formulation of lubricants and metal working fluids (MWF). The portfolio includes, among others: Group V synthetic base oils – polyalkylene glycols (PAGs), Functional additives: anti-wear (AW), extreme-pressure (EP), Raw materials for metal working fluids: emulsifiers, wetting additives, lubricating additives and anti-foaming agents.

Lubricants Business Unit has its own R&D and technical support department, which develops existing solutions, new products and provides full technical support to customers. Production is carried out in the production business units of the PCC Group, which ensures high quality and efficiency of processes. KL products are manufactured in highly advanced installations of polyols, flame retardants, ethoxylates and formulations.

KL products are dedicated mainly to blenders (formulators) of lubricants and metal working fluids, using PCC chemical components in the blending process to create final products. The products reach both the industrial and consumer markets, finding applications in the formulation of metal working fluids and industrial lubricants. KL offer focuses on two key areas: Lubricants, MWF (metal working fluids).

The products are dedicated mainly to professional formulators rather than end users. KL is the leader in Poland and one of the largest producers in Central and Eastern Europe in the chemical industry for lubricants and metal working fluids. It is the only one in Poland to offer: Group V synthetic base oils, anti-wear (AW) and extreme-pressure (EP) additives, surfactants.

Table of contents



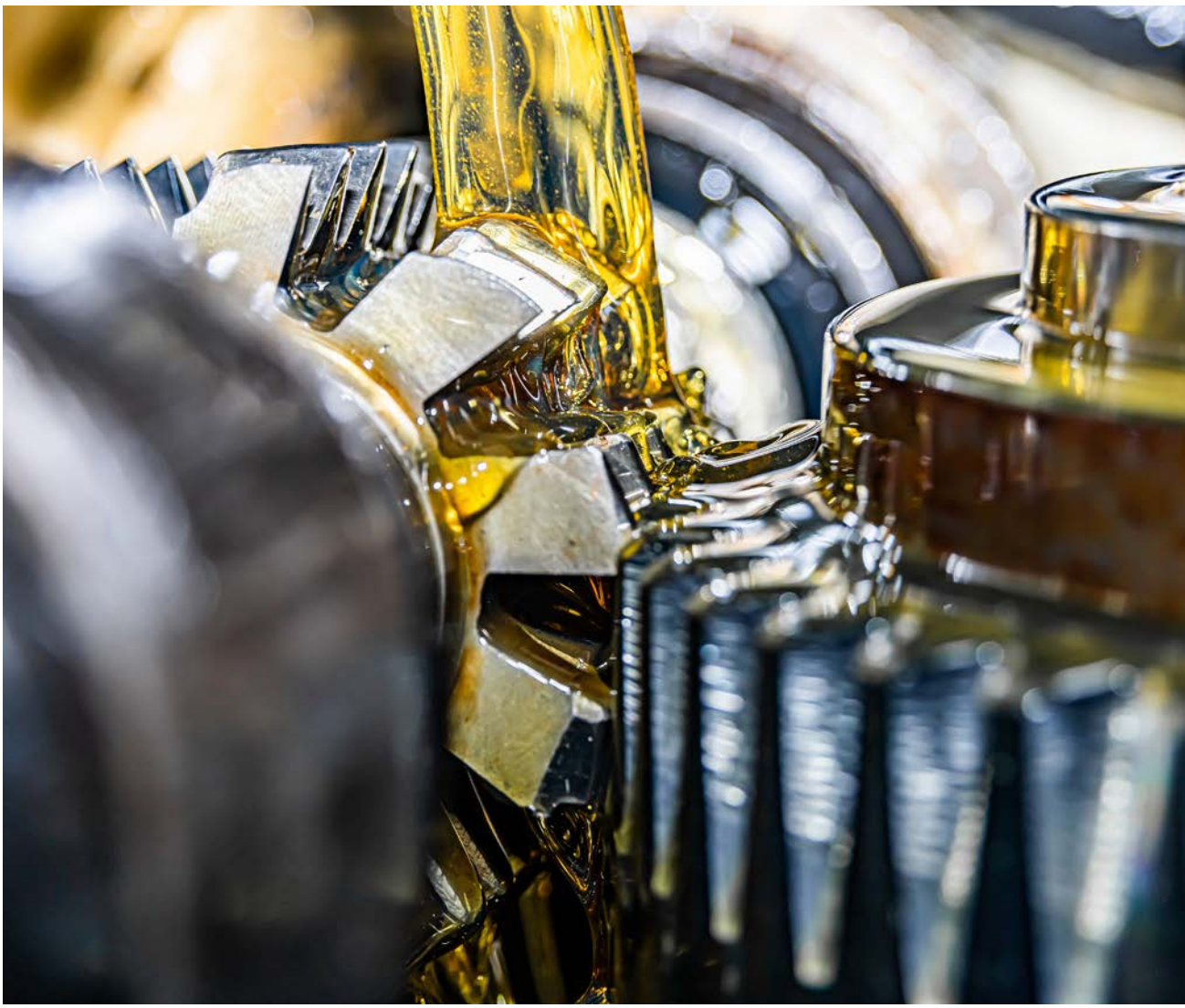
01 / Raw materials for Industrial lubricants

PCC Group offers raw materials for wide range of industrial lubricants. Our portfolio covers ingredients for formulation of:

- compressor lubricants,
- gear oils,
- hydraulic fluids,
- textile lubricants,
- heat transfer fluids,
- greases,
- EV fluids.

We recommend our products as base oils and additives for industrial lubricants formulation.
In our offer you could find:

- group V base oils - PAG,
- group V base oils - phosphate esters,
- anti-wear additives,
- extreme-pressure additives,
- specialised components for fire-resistant hydraulic fluids,
- specialised components for textile lubricants,
- products recommended as ingredients of EV fluids.



Raw materials for Compressor lubricants

Compressor is a mechanical device that increase the pressure of a gas by reducing its volume. Due to the type of compressed gas, compressors can be divided into air compressors and hydrocarbon gas compressors.

Air compressors transform atmospheric air into pressurized air which can be used as a power source for various systems in industry.

Hydrocarbon gas compressors are very important in petrochemical and gas industries because of playing a key role in the compression of various hydrocarbon gases, like methane, propane, butane and natural gas. It is very important element in many industrial processes, such as transportation, storage and processing of natural gas.

Choosing the right compressor oil is very important. This oil is exposed to high operational temperature of the compressed gas, and in the case of air compressors, to the presence of oxygen. The flash point of compressor oil should be 40 - 50°C higher than the highest temperature occurring in the system. Compressor oils are required to have high thermal stability and resistance to oxidation, as well as no tendency to formation of solid deposits.

PCC products covers:

- Base stocks for synthetic compressor lubricants
  – polyalkylene glycols
- AW additives – triaryl phosphate esters

Polyalkylene glycols products overview

Polyalkylene glycols base stocks show unique properties in comparison to other base stocks like petroleum derivatives, Group I – III (mineral oil) and also better results compared with Group IV derivatives, polyalphaolefins (PAOs).

Product name	EO/PO ratio	ISO VG range	MW range, [g/mol]	Kin. Viscosity at 40, [cSt]	Kin. Viscosity at 100, [cSt]	Viscosity Index range	Pour point range, [°C]	Flash point range, [°C]	Density at 20 Range, [g/cm³]
				ASTM D445	ASTM D445	ASTM D2270	ASTM D97	ASTM D92	DIN 51757
PAG base stocks for air compressor lubricants									
Rokolub® P-B Series	0:1	10 - 320	300 - 4600	9 - 363	2 - 63	110 - 220	<(-30) - <(-43)	160 - 230	0.96 - 1.00
PAG base stocks for gas compressor lubricants									
Rokolub® 50-B Series	1:1	10 - 1000	450 - 5500	9 - 1100	2 - 190	155 - 267	(-25) - (-61)	180 - 250	1.02 - 1.05
Ready-to-use lubricant for LDPE Hyper compressors									
Rokolub® 320F	–	–	–	255 - 287	46 - 48	235	<(-20)	>200	1.08

Application data for highlighted products

Product name	Kin. Viscosity at 40, [cSt]	Kin. Viscosity at 100, [cSt]	Viscosity Index	Pour point, [°C]	Flash point, [°C]	Foaming I sequence, [min/min]	Air release, [min]	TOST, [h]	RPVOT, [min]
	ASTM D445	ASTM D445	ASTM D2270	ASTM D97	ASTM D92	PN-ISO 6247	ASTM D3427	ASTM D943	ASTM D2272
PAG base stocks for air compressor lubricants									
Rokolub® P-B-46	41 - 51	8.2 - 10.2	180	<(-42)	>210	10/0	<0.5	59	140
Rokolub® P-B-100	90 - 110	16 - 23	200	<(-36)	>220	30/0	<0.5	36	160
PAG base stocks for gas compressor lubricants									
Rokolub® 50-B-150	135 - 168	25.5 - 33.0	230	<(-43)	>250	500/0	5	27	62
Ready-to-use lubricant for LDPE Hyper compressors									
Rokolub® 320F	255 - 287	46 - 48	235	<(-20)	>200	560/280	21	48	118

AW additives – Triaryl phosphate esters overview

Rokolub® AD Series prevents sliding surfaces from welding under severe conditions. These products provide protection against excessive tool wear from scoring or galling and ensure that lubricating film on the metal surface is deposited.

Product name	Chemical name	Appearance	Kin. Viscosity at 40 [cSt]	Acid number [mgKOH/g]	Water content [% w/w]	Phosphorus content Based on [% w/w] composition (GC-MS analysis)	Density Range at 20 [g/cm³]
			ISO 3104	In-house method	ISO 760		ISO 2811
Rokolub® AD Series	Phenol isopropylated phenyl phosphate	liquid	22 - 32	<0.1	<0.1	7.9 - 8.5	1.10 - 1.25
Rokolub® AD Series	tert-butylphenyl phenyl phosphate	liquid	32 - 90	<0.1	<0.1	7.5 - 8.3	1.11 - 1.16

Application data for highlighted products

Four-ball anti-wear performance for Rokolub® AD 246 ultra and Rokolub® AD 290 LTPP according to ASTM D4172 (method B: 1200 rpm, 1 h, 75°C, 40 kg)

Product name	Average scar diameter [mm]
Mineral base stock	0.91
Mineral base stock + 3% Rokolub® AD 246 ultra	0.52
Mineral base stock + 3% Rokolub® AD 290 LTPP	0.52
Poly-α-olefin base stock	0.81
Poly-α-olefin base stock + 3% Rokolub® AD 246 ultra	0.55
Poly-α-olefin base stock + 3% Rokolub® AD 290 LTPP	0.55

Raw materials for Industrial Gear lubricants

Correct selection of the gearbox is of prime importance for trouble-free operations of the machine. The most popular gear used in industry include: helical gears, bevel helical gears, planetary gears and worm gears.

Helical gears
Helical gears are a type of cylindrical gears with teeth that are cut at an angle to the gear's wheel. Due to their high load capacity, quiet and smooth operations are widely used in mechanical power transmission, industrial and power machinery.

Bevel helical gears
Bevel helical gears combine the features of bevel and helical gears. These are gears with bevel shape but teeth are cut at the angle as in helical gears. The design allows for smooth and quiet power transmission between intersecting shafts. They are commonly used when power needs to be transferred between two shafts that meet at an angle, typically at a 90°.

Planetary gears
In planetary gears several gears called planet gears mesh with a central gear. Planetary gears are compact and have high torque but can be harder to maintain or repair due to their complicated shape. They are used in a wide range applications including electric vehicles, wind turbines and industrial machinery. Due to high performance, synthetic oils are often used to planetary gears.

Worm gears
Worm gears are most common driver type used to transmit power from active to passive shaft. Worm gears are consisting of two main elements: worm (a screw-like shaft) and worm wheel. In this type of gear a shaft and a worm wheel are located perpendicular to each other. The worm slides against the teeth of worm wheel, resulting in more friction compared to other gears. Lubricants for worm gears are specialty formulated to handle the unique challenges such as: high slipping friction, heat generation and metal-to-metal contact. Lubricants to gears should provide superior thermal stability, oxidation resistance and efficiency.

PCC products covers:
- Base stocks for synthetic industrial gear oils – polyalkylene glycols
- AW additives – triaryl phosphate esters (see page 7)
- EP additives – acidic phosphate esters

Polyalkylene glycols products overview

The Rokolub® Series products exhibit excellent lubricity and provide anti-wear and extreme pressure performance, maintaining high viscosity index, low pour point and sludge deposit control.

Product name	EO/PO ratio	Water solub.	ISO VG range	MW range, [g/mol]	Kin. Viscosity at 40, [cSt]	Kin. Viscosity at 100, [cSt]	Viscosity Index range	Pour point range, [°C]	Flash point range, [°C]	Density at 20 range, [g/cm³]
					ASTM D445	ASTM D445	ASTM D2270	ASTM D97	ASTM D92	DIN 51757
PAG base stocks for industrial gear lubricants										
Rokolub® 50-B Series	1:1	yes	10 - 1000	450 - 5500	9 - 1100	2 - 190	155 - 267	(-25) - (-61)	180 - 250	1.02 - 1.05
Rokolub® 60-D Series	3:2	yes	68 - 1000	900 - 5600	61 - 1100	10 - 185	190 - 270	(-28) - (-38)	220 - 240	1.06 - 1.07
Rokolub® P-B Series	0:1	no	10 - 320	300 - 4600	9 - 363	2 - 63	100 - 220	(-30) - (-43)	160 - 230	0.96 - 1.00
Rokolub® PO-D Series	0:1	no	20 - 700	220 - 6000	23 - 925	2 - 140	0 - 250	(-29) - (-32)	200 - 230	1.01 - 1.02

Application data for highlighted products among PAGs

Product name	Kin. Viscosity at 40, [cSt]	Kin. Viscosity at 100, [cSt]	Viscosity Index	Pour point, [°C]	Flash point, [°C]	Last non-seizure load, [N]	Weld load, [N],	TOST, [h]	RPVOT, [min]
	ASTM D445	ASTM D445	ASTM D2270	ASTM D97	ASTM D92	ASTM D2783	ASTM D2783	ASTM D943	ASTM D2272
PAG base stocks for industrial gear lubricants									
Rokolub® 50-B-150	135 - 168	25.5 - 33.0	230	<(-43)	>250	784	1236	27	62
Rokolub® 60-D-220	198 - 242	34 - 44	230	<(-35)	>240	981	1236	19	34
Rokolub® 60-D-1000	900 - 1100	150 - 185	270	<(-26)	>220	981	1569	30	48
Rokolub® PO-D-460	420 - 500	55 - 75	220	<(-32)	>200	618	1236	114	36

EP additives – acidic phosphate esters for industrial gear lubricants

EXOfos® Series products are considered anionic phosphorus esters with an acidic pH. In our portfolio there are phosphorus esters of pure alcohols as well as alkoxylated/ethoxylated ones. These products exhibit very good EP properties in mineral oil solutions.

Product name	Chemical name	Acid value [mg KOH/g]	pH	Solidification point [°C]	Phosphorus content [%]	Weld load [N]	Density at 25, [g/cm³]
		in house	PN-EN 1262	PN-ISO 1392	in house	ASTM D2783	DIN 51757
EXOfos® PA-080S	2-Ethylhexyl Phosphate	250 - 250	2.0 - 3.0	<(-20)	11 - 12	1569	1.02
EXOfos® PB-184	PEG-4 oleyl phosphate	135 - 160	2.0 - 3.0	~ (-4)	4 - 5	1961	1.03
EXOfos® PB-264	PEG-4 lauryl phosphate	150 - 180	2.0 - 3.0	~ 2	6 - 7	1569	1.04
EXOfos® PA-1300	Isotridecyl Phosphate	135 - 155	2.5 - 3	< (-20)	8 - 9	1236	0.96
EXOfos® PA-810	Decyl octyl, phosphate	280 - 330	1.5 - 2.5	~ (-14)	<1	1569	1.0
EXOfos® PB-133	PEG-3 isotridecyl phosphate	140 - 160	1.5 - 3.0	< (-20)	5 - 6	1569	1.02
EXOfos® PB-1016M	mono-C10-16-alkyl ethers	100 - 125	1.0 - 3.0	< (-20)	–	2453	1.05

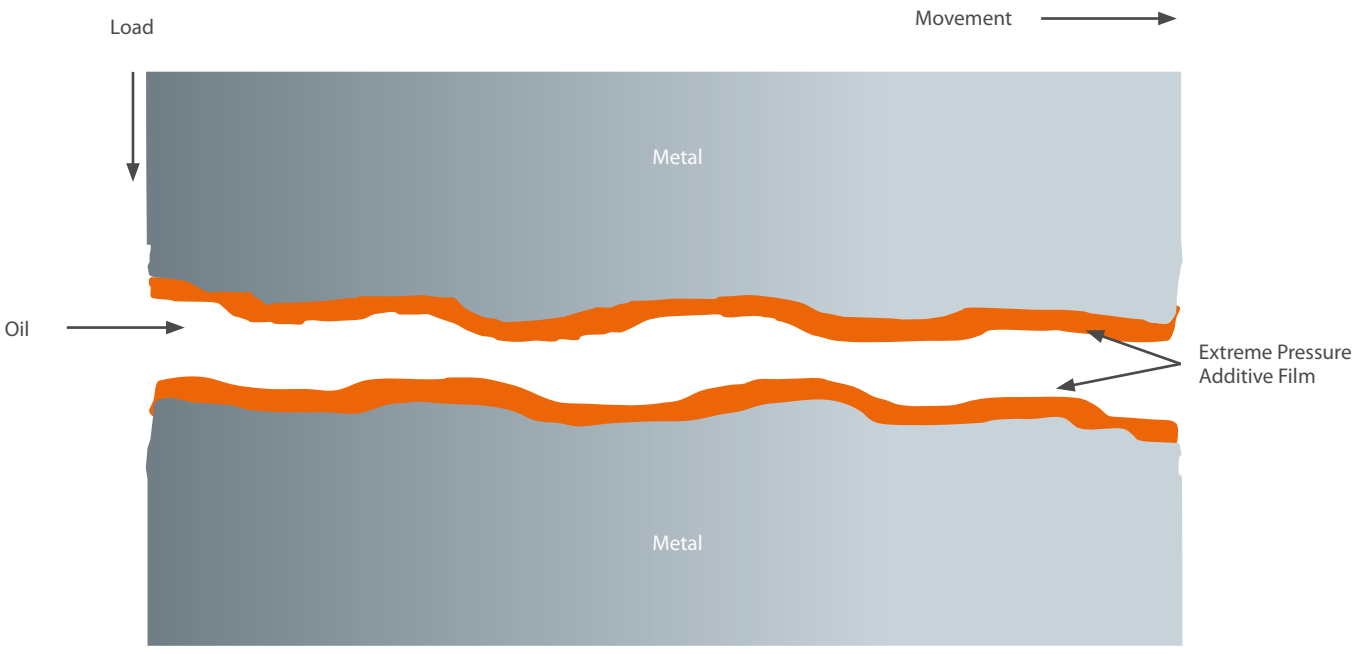


Figure 1. Scheme showing the formation of a protective film by EXOfos® Series products

Raw materials for Hydraulic lubricants

HFDU are non-aqueous products based on PAGs. Could be based on mineral oil soluble, water insoluble PAGs or water-soluble PAGs. All base stocks can be designed to be readily biodegradable, non--toxic and non-hazardous. Generally are non-hazardous when burned. Recommended operational temperature is from -20°C up to +70°C.

HFDR are non-aqueous products based on neutral phosphate esters. Generally they have environmental and health impact but could be designed to reduce those effects. Generally impossible to ignite and flame. Recommended operational temperature is from -20°C up to +70°C.

HFA-E are aqueous products based on over 95% of water, mineral oils, emulsifiers and additives. Can be designed to be readily biodegradable, non-toxic and non-hazardous. Generally simply impossible to ignite and flame. Recommended operational temperature is from +5°C up to +50°C.

HFC are aqueous products designed as water-polymer solutions. Usually contain about 40% of water. Generally they could have environmental and health impact but could be also designed to reduce those effects. Depends on ingredients could be hazardous when burned. Recommended operational temperature is from -20°C up to +50°C.

PCC products covers:

- Base stocks for HFDU type hydraulic oils – polyalkylene glycols
- Base stocks for HFDR type hydraulic oils – triaryl phosphate esters
- Emulsifiers for HFA-E type hydraulic oils – C16-C18 alcohol, alkoxylates
- EP & CI additives for HFA-E & HFC hydraulic oils
- AW additives for mineral & HFDU hydraulic oils – triaryl phosphate esters (page 7)

Polyalkylene glycols – base stocks for HFDU overview

PAGs keep hydrolytic stability, which can be seen as a major advantage of hydraulic fluids based on this solution. In many industrial applications, contamination with water cannot be completely avoided. When this appears, the PAG absorbs water partially and does not change the hydraulic efficiency.

Product name	EO/PO ratio	ISO VG range	MW range, [g/mol]	Kin. Viscosity at 40, [cSt]	Kin. Viscosity at 100, [cSt]	Viscosity Index range	Pour point range, [°C]	Flash point range, [°C]	Density at 20 range, [g/cm³]
				ASTM D445	ASTM D445	ASTM D2270	ASTM D97	ASTM D92	DIN 51757
Rokolub® P-B Series	0:1	10 - 320	300 - 4600	9 - 363	2 - 63	110 - 220	< (-30) - <(-43)	160 - 230	0.96 - 1.00
Rokolub® PO-D Series	0:1	20 - 700	220 - 6000	23 - 925	2 - 140	0 - 250	(-29) - (-32)	200 - 230	1.01 - 1.02
Rokolub® 50-B Series	1:1	10 - 1000	450 - 5500	9 - 1100	2 - 190	155 - 267	(-25) - (-61)	180 - 250	1.02 - 1.05

Triaryl phosphate esters – base stocks for HFDR overview

Rokolub® FR is a synthetic base oil Series intended for formulating non-aqueous fire-resistant hydraulic fluids (HFDR type), in accordance with ISO 6743- 4. Thanks to their unique properties, Rokolub® FR fluids are the best available option for applications with a high potential risk of fire. Furthermore, both perfect oxidation stability and appropriate thermal stability make Rokolub® FR Series preferable for high temperatures as well. Rokolub® FR's features enable the formulation of fire resistant fluids suitable for the power generation industry as well as many general industrial applications requiring outstanding fire resistance.

Product name	Chemical name	Appearance	ISO VG	Acid number, [mgKOH/g]	Water content, [%(w/w)]	Pour point, [°C]	Flash point, [°C]	Fire point, [°C]	Autoignition, [°C]	Density at 25 range, [g/cm³]
				In-house	ISO 760	ASTM D97	ASTM D92	ASTM D92	ASTM E659	DIN 51757
Rokolub® FR T Series	tert-butylphenyl phenyl phosphate	liquid	32 - 68	<0.1	<0.1	< (-15)	>240	>300	>500	1.13 - 1.16

Application data for highlighted products for HFDU & HFDR fluids

Product name	Kin. Viscosity at 40, [cSt]	Kin. Viscosity at 100, [cSt]	Viscosity Index	Pour point, [°C]	Flash point, [°C]	Fire point, [°C]	RPVOT, [min]	Foaming I sequence, [min/min]	Air release, [min]
	ASTM D445	ASTM D445	ASTM D2270	ASTM D97	ASTM D92	ASTM D92	ASTM D2272	PN-ISO 6247	ASTM D3427
PAG base stocks for HFDU lubricants									
Rokolub® P-B-46	41 - 51	8.2 - 10.2	180	<(-42)	>210	–	140	10/0	<0.5
Rokolub® 32	25 - 35	2.5 - 7.5	60	<(-40)	>200	–	54	0/0	<0.5
Rokolub® 50-B-46	41 - 55	8.5 - 13.5	210	<(-43)	>230	–	88	640/0	4
Triaryl phosphate esters base stocks for HFDR lubricants									
Rokolub® FR T-46 ultra	41.4 - 50.6	–	32	<(-15)	>230	>300	–	–	–

Emulsifiers for HFA-E type hydraulic fluids

HFA-E hydraulic fluids are O/W emulsion that have at least 95% of water content. High water content require usage of reliable and efficient emulsifiers. In our portfolio we have surfactants as well as emulsifier packages that can be applied in such a way.

Product name	Chemical name	Cloud point [°C]	pH	HLB	Emulsion stability	Foaming profile	Solidification point [°C]	Dynamic Viscosity at 25 [mPa·s]
		EN 1890	PN-EN 1262	in house	in house	ASTM D1173-07	PN-ISO 1392	in house
ROKAnol® LP66	C16 - 18 alkoxylated alcohols	44 - 46 E	5.0 - 7.0	11	>3 weeks	Low foaming	~4	160
ROKAnol® LP42	C16 - 18 alkoxylated alcohols	64 - 68 E	5.0 - 7.0	9	< 96 h	Low foaming	~6	60
EXOemul M3	Mixture of surfactants	66 - 68 E	5.0 - 7.0	–	>168 h	Moderate foaming	~ (-3)	50
EXOemul OM4	Mixture of surfactants	–	7.0 - 9.5	8.3	<96 h	Moderate foaming	<(-20)	40

EP&CI additives – acidic phosphate esters for HFA-E & HFC types hydraulic fluids

EXOfos® Series products are considered anionic phosphorus esters with an acidic pH. In our portfolio there are phosphorus esters of pure alcohols as well as alkoxylated/ethoxylated ones. These products exhibit very good EP properties in mineral oil solutions. In addition EXOfoses® neutralized with TEA shows outstanding corrosion inhibition performance, this products can be used in water based formulation as primary or secondary corrosion inhibitor.

Product name	Chemical name	Acid value [mg KOH/g]	pH	Solidification point [°C]	Phosphorus content [%]	Weld load [N]	Ferrous metal corrosion	Ferrous metal corrosion
		in house	PN-EN 1262	PN-ISO 1392	in house	ASTM D2783	PN-M-55789	DIN-51360
EXOfos® PA-080S	2-Ethylhexyl Phosphate	250 - 250	2.0 - 3.0	<(-20)	11 - 12	1569	H0	0/0
EXOfos® PB-184	PEG-4 oleyl phosphate	135 - 160	2.0 - 3.0	~ (-4)	4 - 5	1961	H0	0/0
EXOfos® PB-264	PEG-4 lauryl phosphate	150 - 180	2.0 - 3.0	~ 2	6 - 7	1569	H0	0/0
EXOfos® PA-1300	Isotridecyl Phosphate	135 - 155	2.5 - 3	<(-20)	8 - 9	1236	H0	0/0
EXOfos® PA-810	Decyl octyl, phosphate	280 - 330	1.5 - 2.5	~ (-14)	<1	1569	H0	–
EXOfos® PB-1016M	mono-C10-16-alkyl ethers	100 - 125	1.0 - 3.0	<(-20)	–	2453	–	0/0

Raw materials for textile lubricants

Among textile industry we could indicate many processes which need lubrication including:

- **Spinning** – the process of taking textile fibbers and filaments and making them into a yarn,
- **Knitting** – is a method for production of textile fabrics by interlacing yarn loops with loops of the same or other yarns,
- **Weaving** – the process of interlacing two sets of threads (warp and weft) at right angles to create fabric,
- **Finishing** – the process of applying treatments to fabrics after they have been woven or knitted, to enhance their appearance, texture, performance, or add specific functionalities.

Depending on the process the requirements for lubricants vary so they need to be formulated in different raw materials to ensure the required performance.

- **Spinning** – lubricants need to ensure excellent corrosion protection for bearings, opening rollers, spinnerets, spinning pumps, and spinning turbines,
- **Knitting** – lubricants need to be formulated as extremely thermal and oxidation stable to offer long service life with minimum maintenance requirements for guide bars, needles, sinkers and slide rails,
- **Weaving** – use of high performance lubricants to extend time between maintenance operations among chains, gears and gripper looms,
- **Finishing** – lubricants need to provide resistance to water, steam, acidic and alkaline solutions for compensators, rollers, rolling bearings and steamers.

PCC products covers:

- Lubricity boosters – polyalkylene glycols
- Wetting agents
- Antistatic agents
- EP & CI additives
- Additives for textile lubricants for fibres spinning, knitting, weaving and finishing

Product name	Chemical name	Cloud point [°C]	pH	HLB	Solidification point [°C]	Dynamic Viscosity at 25 [mPa·s]	Application
		EN 1890	PN-EN 1262	in house	PN-ISO 1392	in house	
Rokolub® 50-B-10	Butanol, propoxylated, ethoxylated	> 90	7.4	11.0	<(-31)	29	Lubricity and hygrospcopity booster
Rokolub® 50-B-20	Butanol, propoxylated, ethoxylated	77	–	12.0	<(-32)	55	Lubricity and hygrospcopity booster
POLIkol 200	PEG	> 90 A	4.6 - 7.4	–	< 0	11.7	Lubricity and hygrospcopity booster
POLIkol 400	PEG	–	4.6 - 7.4	–	5	–	Lubricity and hygrospcopity booster
ROKAnol® EH9LA	2-Ethylhexanol, alcoxylated	62 - 66	5.0 - 7.0	–	7	–	Lubricant & wetting agent
ROKAmid KAD	Cocamide DEA	~0	9.0 - 10.5	–	4	1105	Lubricant for polyester/ poliamide fiber & antistatic agent
ROKAmid RAD	Rapeseed DEA	~0	7.5 - 10.5	–	4	1057	Lubricant for polyester/ poliamide fiber & antistatic agent
ROKAcet O7	PEG-7 Oleate	–	5.5 - 8.5	10.6	0	84	Lubricant & antistatic agent
ROKAcet R11	PEG-11 Castor Oil	–	5.0 - 7.0	6.9	(-20)	578	Lubricant
ROKAcet R26	PEG-26 Castor Oil	–	7.5 - 9.5	11.0	0	590	Lubricant
Sulfosuccinate DOSS70GP	Sulfosuccinate sodium salt of di (2-Ethylhexyl)	<20	6.0 - 8.0	–	-	267	Antistatic & wetting agent
EXOfos® PB-184	PEG-4 oleyl phosphate	–	2.0 - 3.0	–	(-4)	1792	Extreme pressure & corrosion inhibitor
EXOfos® PB-264	PEG-4 lauryl phosphate	–	2.0 - 3.0	–	2	–	Extreme pressure & corrosion inhibitor
EXOfos® PB-267	PEG-7 lauryl phosphate	–	2.0 - 3.0	–	17	–	Extreme pressure & corrosion inhibitor

Raw materials for heat transfer fluids

Heat transfer fluid (HTF) is a gas or liquid that takes part in heat transfer by serving as an intermediary in cooling on one side of a process, transporting and storing thermal energy, and heating on another side of a process. Our offer is recommended for liquid heat transfer fluids operating in wide range of temperatures. PAGs because of low pour point, high flash point and high viscosity index could be used in application where temperature vary a lot (from -40°C up to 200°C). Neutral phosphate esters are designed for high temperature application (from 0°C up to 300°C).

PCC products covers:

- Base stocks for non-aqueous heat transfer fluids
- Base stocks for aqueous heat transfer fluids

Synthetic base oils for formulating non-aqueous heat transfer fluids

Product name	Chemical name	Appearance	ISO VG	Acid number, [mg KOH/g]	Water content, [%]	Pour point range, [°C]	Flash point range, [°C]	Fire point, [°C]	Autoignition, [°C]	Density range, [g/cm³]
				ASTM D7253	ASTM D4672	ASTM D97	ASTM D92	ASTM D92	ASTM E659	DIN 51757
Rokolub® P-B Series	butanol propoxylated	liquid	10 - 320	max. 0.1	max. 0.08	<(-30) - <(-43)	160 - 230	–	–	0.96 - 1.00
Rokolub® FR T Series	tert-butylphenyl phenyl phosphate	liquid	32 - 68	<0.1	<0.1	<(-15)	>240	>300	>500	1.13 - 1.16

Synthetic base oils for formulating of aqueous heat transfer fluids

Product name	Chemical name	Appearance	ISO VG	Acid number, [mg KOH/g]	Water content, [%]	Pour point range, [°C]	Flash point range, [°C]	Density range, [g/cm³]
				ASTM D7253	ASTM D4672	ASTM D97	ASTM D92	DIN 51757
Rokolub® 60-D Series	polypropylene polyethylene glycol	liquid	68 - 1000	max. 0.1	max.0.08	(-28) - (-38)	220 - 240	1.06 - 1.07
ROKAmer® Series	EO/PO block copolymers	liquid	–	0.01 - 0.05	max. 1	(-20) - 10	200 - 220	0.99 - 1.05
ROKAmer® R Series	Reversed EO/PO block copolymers	liquid	–	–	max.1	(-20) - 2	100 - 220	1.01 - 1.05
POLIkol 200	Polyoxyethylene glycol	liquid	–	–	max. 1	~0	182	1.12

Raw materials for turbine lubricants

Turbine oils are specialized lubricants designed for use in steam, gas and water turbines. These oils play a critical role in the protection, efficient operations and reliability of the turbine system by reducing friction, dissipating heat and protecting against wear and corrosion.

Base oils and additives are two main categories of raw materials used in turbine oils. The base oil makes up 90-99% of turbine oils and provides primary lubrication properties. The key properties that determine a base oil's suitability for turbine oil applications include viscosity, viscosity index, good demulsibility, high thermal stability and oxidation stability.

The additives constitute 1-10% of turbine oils. Additives are mixed into base oils to enhance the properties of the base oil or to impart some new properties. Common additives include corrosion inhibitors to protect metal surfaces against rust and corrosion, antioxidants to prevent oxidation, foam inhibitors which control foam in high-speed systems and anti-wear agents which reduce wear of metal surfaces.

PCC products covers:

- Base stocks for turbine lubricants – polyalkylene glycols
- Base stocks for turbine lubricants – Triaryl phosphate esters

PAGs base oils

Product	EO/PO ratio	ISO VG range	MW Range [g/mol] ASTM D2270	Kin. Viscosity at 40 [cSt] ASTM D445	Kin. Viscosity at 100 [cSt] ASTM D445	Viscosity Index range ASTM D2270	Pour point Range [°C] ASTM D97	Flash point Range [°C] ASTM D92	Density at 20 Range [g/cm³] DIN 51757
Rokolub® P-B Series	0:1	10-320	300-4600	9-363	2-63	110-220	<-30 -<-43	160-230	0.96-1.00

Triaryl phosphate esters base oils

Product	Chemical name	Appearance	ISO VG	Acid number, [mg KOH/g] in-house method	Water content, [%] ISO 760	Pour point range, [°C] ASTM D97	Flash point range, [°C] ASTM D92	Fire point, [°C] ASTM D92	Autoignition, [°C] ASTM D2155	Density at 25 Range [g/cm³]
Rokolub® FR T Series	tert-butylphenyl phenyl phosphate	liquid	32-68	<0.1	<0.1	-26-(-14)	>230	>300	>500	1.13-1.16

Application data for highlighted products

Product	Kin. Viscosity at 40, [cSt] ASTM D445	Kin. Viscosity at 100, [cSt] ASTM D445	Viscosity Index ASTM D2270	Pour point, [°C] ASTM D97	Flash point, [°C] ASTM D92	Fire point, [°C] ASTM D92	RPVOT, [min] ASTM D2272	Foaming I sequence, [min/min]	Air release, [min] ASTM D 3427-86
PAG base stocks for turbine lubricants:									
Rokolub® P-B 32	34	7.1	178	<(-44)	208	–	<84	40/0	<0.5
Rokolub® P-B 46	46	9.3	191	<(-42)	218	–	<152	10/0	<0.5
Triaryl phosphate esters base stocks for turbine lubricants:									
Rokolub® FR T-46 ultra	50.2	5.9	32	<(-15)	>240	>300	–	–	–

Raw materials for greases

Grease is a solid or semisolid lubricant formed as a dispersion of thickening agents in a liquid lubricant.

If you would like to formulate biodegradable grease, with excellent elastomer compatibility and thermal stability at elevated temperatures, PAGs are the best choice to consider as a base oil for formulating grease with required performance.

PCC products covers:

- Base stocks for greases – polyalkylene glycols
- Polyol thickeners
- EP additives for mineral and synthetic greases

Synthetic PAG base oils for biodegradable, environmentally acceptable greases

Product	EO/PO ratio	ISO VG range	MW Range [g/mol]	Kin. Viscosity at 40 [cSt]	Kin. Viscosity at 100 [cSt]	Viscosity Index range	Pour point Range [°C]	Flash point Range [°C]	Density at 20 Range [g/cm³] DIN 51757
Rokolub® P-B Series	0:1	10-320	300-4600	9-363	2-63	110-220	<(-30) -<(-43)	160-230	0.96-1.00
Rokolub® PO-D Series	0:1	20-700	220-6000	23-925	2-140	0-250	(-29) – (-32)	200-230	1.01-1.02

Application data for highlighted products

Product	Kin. Viscosity at 40, [cSt] ASTM D445	Kin. Viscosity at 100, [cSt] ASTM D445	Viscosity Index ASTM D2270	Pour point, [°C] ASTM D97	Flash point, [°C] ASTM D92	Fire point, [°C] ASTM D92	RPVOT, [min] ASTM D2272	Foaming I sequence, [min/min] PN-ISO 6247	Air release, [min] ASTM D3427
Rokolub® P-B-32	25-36	4.9-7.6	180	<(-43)	>210	84	40/0	<0.5	<0.5
Rokolub® P-B-46	41-51	8.2-10.2	180	<(-42)	>210	140	10/0	<0.5	<0.5
Rokolub® P-B-150	135-165	23-32	220	<(-36)	>230	194	0/0	<0.5	–
Rokolub® P-B-220	198-242	31-40	220	<(-30)	>230	151	0/0	1	<0.5
Rokolub® 32 (PO-D-32)	25-35	2.5-7.5	60	<(-40)	>200	54	0/0	<0.5	–
Rokolub® 150 (PO-D-150)	135-160	20-30	180	<(-34)	>200	34	0/0	<0.5	<0.5
Rokolub® PO-D-10000	9000-12000	1350-1500	370	(-9)	>200	–	0/0	24	–

EP additives – acidic phosphate esters for greases

EXOfos® Series products are considered anionic phosphorus esters with an acidic pH. In our portfolio there are phosphorus esters of pure alcohols as well as alkoxylated/ethoxylated ones. These products exhibit very good EP properties in mineral oil solutions.

Product	Chemical name	Acid value [mg KOH/g], in house	pH, PN-EN 1262	Solidification point [°C], PN-ISO 1392	Phosphorus content [%], in house	Weld load [N], ASTM D2783	Density at 25, [g/cm³], DIN 51757
EXOfos® PA-080S	2-Ethylhexyl Phosphate	250-250	2.0-3.0	<(-20)	11-12	1569	1.02
EXOfos® PB-184	PEG-4 oleyl phosphate	135-160	2.0-3.0	~ (-4)	4-5	1961	1.03
EXOfos® PB-264	PEG-4 lauryl phosphate	150-180	2.0-3.0	~ 2	6-7	1569	1.04
EXOfos® PA-1300	Isotridecyl Phosphate	135-155	2.5-3	<(-20)	8-9	1236	0.96
EXOfos® PA-810	Decyl octyl, phosphate	280-330	1.5-2.5	~ (-14)	<1	1569	1.0
EXOfos® PB-133	PEG-3 isotridecyl phosphate	140-160	1.5-3.0	<(-20)	5-6	1569	1.02
EXOfos® PB-1016M	mono-C10-16-alkyl ethers	100-125	1.0-3.0	<(-20)	–	2453	1.05

Raw materials for EV fluids

Cooling fluids

The main purpose of coolants in electric cars is to dissipate heat from the battery and electric motor, which means that the coolant must transfer heat as quickly as possible. In addition, due to the presence of high-voltage current in the system, it is also necessary for the electrical conductivity to be as low as possible (estimated values are around max. 100 µS/cm). Furthermore, resistance to oxidation and high temperatures is required. Standard coolants are mainly based on ethylene glycol, and the most popular formulation is an aqueous solution of ethylene glycol.

Transmission fluids

In the case of transmission fluids designed for electric cars, the requirements are much stricter than for classic combustion engine cars. Once again, the most important purpose of the fluid is to dissipate heat, which in an electric motor is generated mainly by two processes: high revs and heat loss on the motor coils. In addition, the high revs are also problematic – the lubricant used must be resistant to their effects (in an electric motor, revs can reach 20,000 RPM). Given the high stresses and torque in electric cars, another requirement is excellent AW and EP properties, as well as high performance of the functional fluid. Therefore, it is important that the tribological properties of such a fluid remain unchanged during engine operation. In addition to their use in electric motors, transmission fluids are also used in other EV systems. Due to this fact, it is important that the designed functional fluids cause as little corrosion of metals as possible, i.e., steel, aluminum, and especially copper, as well as degradation of polymers. Unlike coolants, the electrical conductivity of transmission fluids must be significantly lower – similar to that of insulators – and allow for effective dissipation of electrical charge. The estimated electrical conductivity values for this type of functional fluid should be in the range of 10-12 S/cm to 10-6 S/cm

Standard transmission fluids consist mainly of base oils with various additives such as viscosity modifiers, EP and AW additives, antioxidants etc.

Brake fluids

Brake fluids for electric cars, like other functional fluids for this type of car, have much more stringent requirements than those for combustion engine cars. Usually, during normal use of an electric car, the brakes are not subjected to significant wear and tear – cars of this class have the ability to perform so-called regenerative braking, where braking is performed by the electric motor itself. However, when the car's battery is fully charged, this is not possible, so it is necessary for the brake fluid to ensure maximum performance. Given the increased weight of such a car, there is an increased risk of vapor bubbles forming during braking, so it is important that the brake fluid has a high boiling point, i.e., a minimum of 180°C wet and a minimum of 260°C dry. The second result of using regenerative braking is reduced brake wear when the batteries are not fully charged. Due to this fact, it is required that brake fluids for electric cars have increased corrosion resistance. Another important parameter is low viscosity, especially at low temperatures - commercially available brake fluids reach a viscosity of 1450 cSt at -40°C and 5-10 cSt at 20°C; the minimum viscosity value at 100°C, i.e. approximately 1.5-1.7 cSt, is also important.

Reduced electrical conductivity is required as standard for this type of fluid - for most manufacturers, the limit value is 200 µS/cm. In addition, it is required that the brake fluid cause as little degradation of materials as possible, e.g. rubber. Typical brake fluid consists of raw materials with low viscosity and high boiling point. In addition some additives need to be added – mainly corrosion inhibitors and antioxidants.

In PCC Rokita portfolio we have three type of product groups dedicated for EV fluids:
PAGs – including Rokolub® P-B, 50-B, MOS series and Rokolub® B-10M
PPGs – including Rokolub® PO-D-20
PEGs – including POLIkol 200

These products can be divided according to the applications mentioned earlier:
Cooling fluids – Rokolub® 50-B series and POLIkol 200
Transmission fluids – Rokolub® MOS series
Brake fluids – Rokolub® P-B series, Rokolub® PO-D-20 and Rokolub® B-10M

Product	Electrical conductivity, [µS/cm]	ISO VG range	MW range, [g/mol]	Kin. Viscosity at 40, [cSt]	Kin. Viscosity at 100, [cSt]	Viscosity Index range	Pour point range, [oC]	Flash point range, [°C]	Density at 20 range, [g/cm^3]
	PB 07.44.00/01			ASTM D445	ASTM D445	ASTM D2270	ASTM D97	ASTM D92	DIN 51757
Rokolub® P-B series	<0.5	10 - 100	330 - 1400	13 - 96	3 - 18	109 - 220	<(-43) - <(-30)	>(160) - >(220)	0.96 - 0.99
Rokolub® MOS series	<0.5	22 - 220	600 - 2450	20 - 206	5 - 31	148 - 191	(-51) - <(-10)	>(200) - >(240)	0.93 - 0.97
Rokolub® 50-B series	<0.5	10 - 20	45 - 500	16 - 22	4 - 5	155 - 177	(-61) - <(-41)	>(180)	1.02
Rokolub® B-10M	<0.5	10	360	10	3	112	–	–	0.98
Rokolub® PO-D-20	<0.5	20	220	24	3.1	212	–	148	1.01
POLIkol 200	10	–	200	23	4	75	<(-32)	182	1.12

02 / Raw materials for metalworking fluids

PCC Group offers raw materials for wide range of metalworking fluids.
Our portfolio covers ingredients for formulation of:

- neat oils (straight oils),
- emulsifiable oils (soluble oils),
- semisynthetic fluids,
- synthetic fluids.

We recommend our products as additives for multiple metalworking fluid formulation.
In our offer you could find:

- emulsifiers,
- low foaming emulsifiers,
- boundary lubricity additives,
- wetting agents,
- extreme-pressure additives,
- corrosion inhibitors,
- coupling agents,
- anti-mist additives,
- alkalinity boosters.

Metalworking fluids types description

Neat oils

Sometimes referred to as straight oils, these type of fluids are based on mineral or vegetable oil and do not consist of any water and water based additives. They are mainly used in application that require more lubricity then heat reduction. Typical neat oil has such components as mineral/vegetable oil, extreme pressure additive, boundary lubricants, corrosion inhibitors and antioxidants. These type of fluids can be applied directly as a ready to use product.

Emulsifiable oils

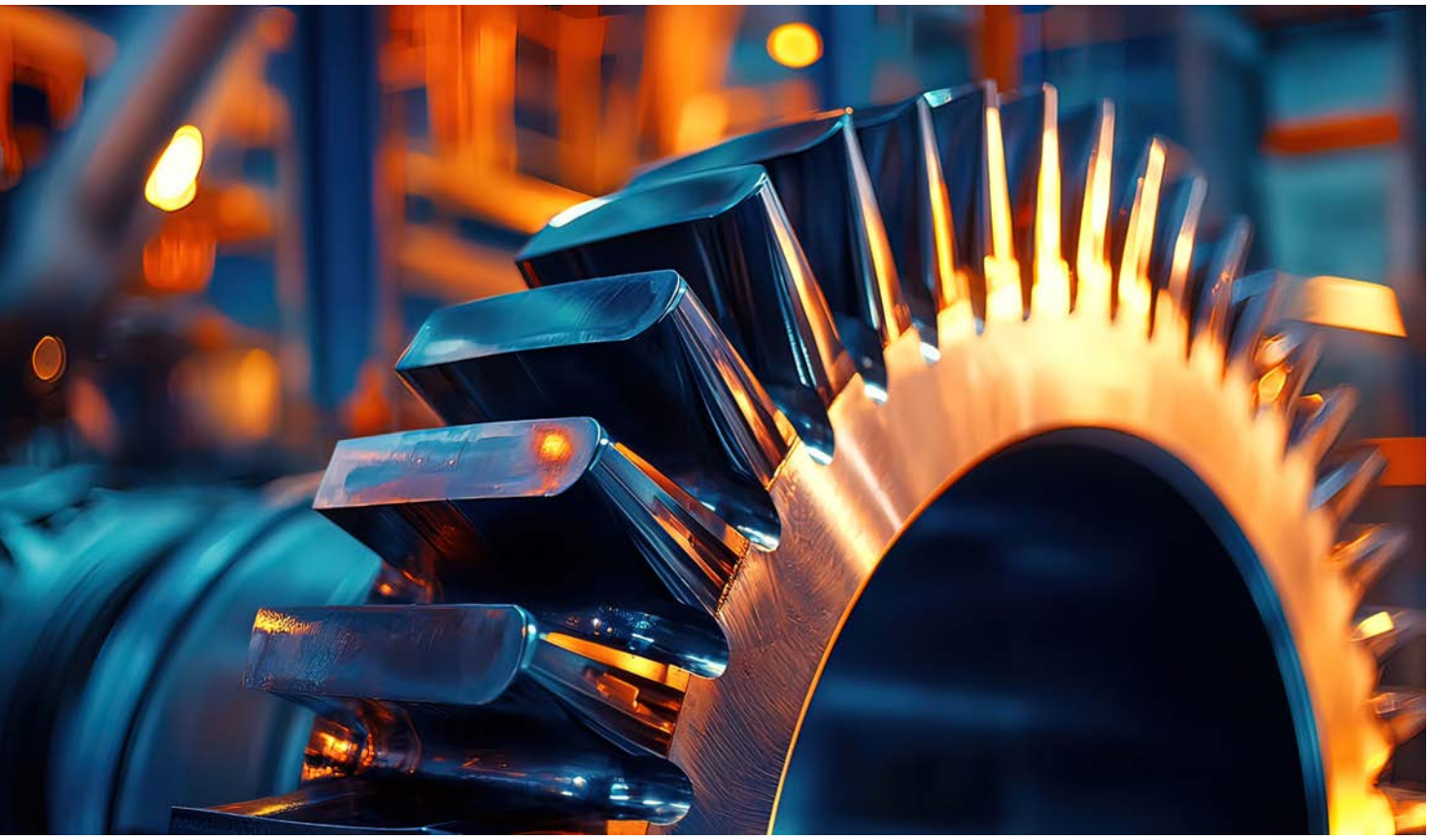
Due to the inability of neat oils to cover proper heat reduction this kind of fluid was developed. Soluble oil application is based on creating oil concentrate consisting of mineral oil – naphthenic of paraffinic, emulsifier and Series of additives. This concentrate is then diluted with water to desired concentration, creating milky macroemulsion. Due to the presence of water in the MWF some characteristics may occur such as corrosion, foaming or microbiological contamination, that is why variety of additives must be applied in the formulation including corrosion inhibitors, foam control agents and biocides.

Semisynthetic fluids

This type of fluid is a "connection" between soluble oils and fully synthetic fluids. Usually semisynthetic fluids are prepared using both water and mineral oil base stocks, in addition emulsifiers and additives that are soluble in these two mediums are being used. After the concentration is prepared it is diluted to given concentration using water. Again presence of this medium enforces usage of additives such as corrosion inhibitors, defoamers, anti--oxidants and others. Based on concentration of oil in the formulation we can diverse low-oil and high-oil types of semisynthetic fluids.

Synthetic fluids

Synthetic fluids are the only type of MWF that do not contain mineral oil in any form. In general they can be diverse into three different types: solution synthetic fluid, emulsified synthetic fluid and straight synthetic fluid. In the first kind of SF water is used and water soluble additives and it is then diluted with water to desired concentration. Emulsified synthetic fluid is based on base stock such as vegetable oils or synthetic ones and contains also additives known in previous examples: emulsifiers, corrosion inhibitors etc.; this concentrate is then diluted with water. The last type which is straight synthetic oil is similar to emulsified synthetic fluid but it doesn't contain any water and it's not diluted.



Raw materials for neat oils

Sometimes referred to as straight oils, these type of fluids are based on mineral or vegetable oil and do not consist of any water and water based additives. They are mainly used in application that require more lubricity then heat reduction. Typical neat oil has such components as mineral/vegetable oil, extreme pressure additive, boundary lubricants, corrosion inhibitors and antioxidants. These type of fluids can be applied directly as a ready to use product.

Example neat oil formulation	
Component	Percentage
Mineral oil	70 - 95
Boundary lubricity additives	**5 - 10**
Extreme-pressure agents	**0 - 20**
Antioxidant	0 - 0.5
Anti-mist	0 - 0.5

PCC products covers:

- Boundary lubricity additives
- Extreme-pressure additives (EP)

Boundary lubricity additives

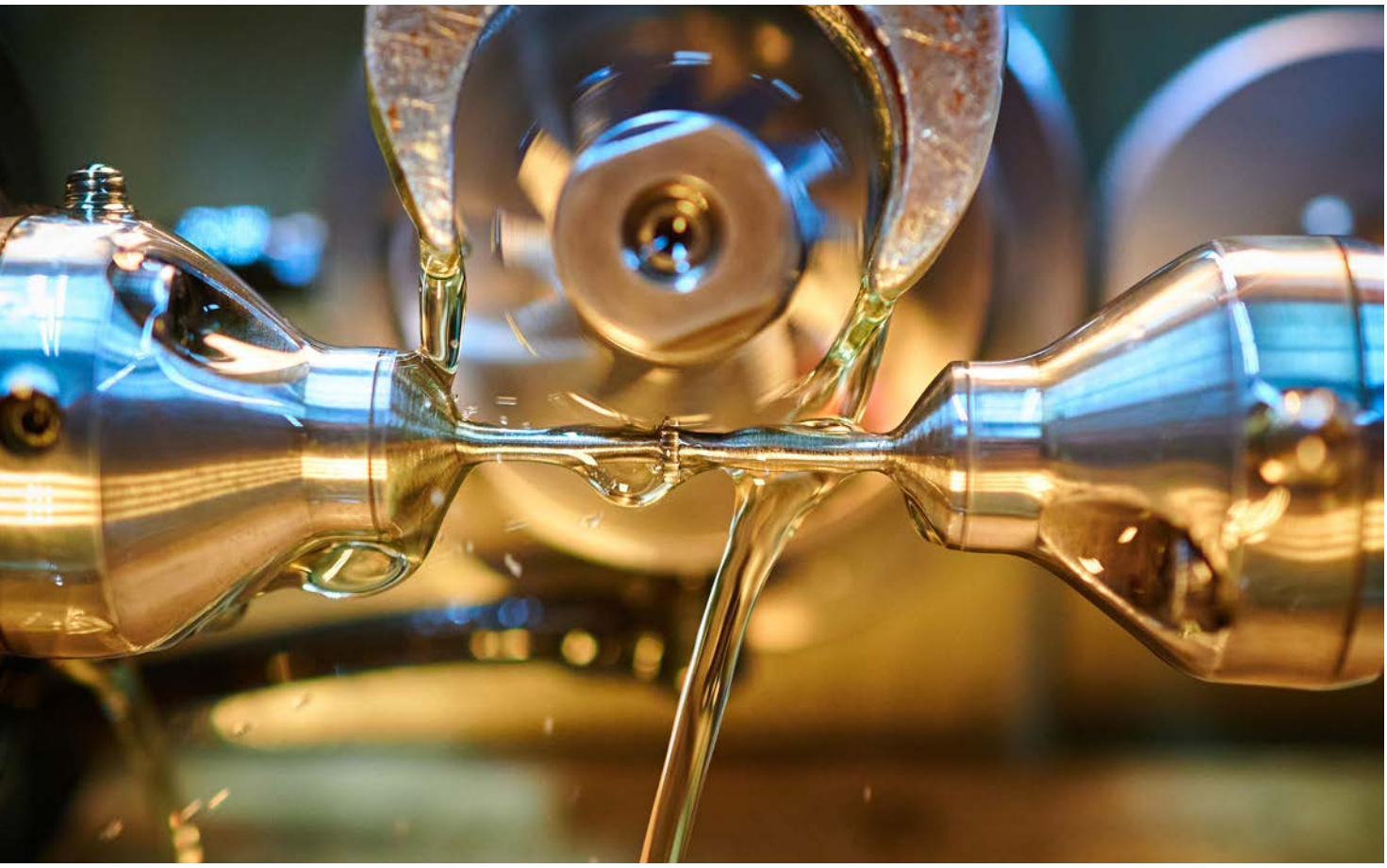
Boundary lubrication additives are compounds added to lubricants to increase their ability to reduce friction and wear under boundary lubrication conditions where surfaces are in direct contact. These additives form a protective layer on metal surfaces, reducing the effects of friction. Fatty acid ester derivatives provide excellent lubrication at low temperatures, so before EP additives become effective.

Product name	Chemical name	pH	HLB	Foaming profile	Solidification point [°C]
		PN-EN 1262	in house	ASTM D1173-07	PN-ISO 1392
ROKAcet R Series	Castor oil ethoxylates	5.0 - 9.5	7 - 13	Moderate foaming profile	0 - 50
ROKAcet O Series	Oleic acid ethoxylates	5.5 - 8.5	10 - 11	Low foaming profile	~ 0

EP additives – acidic phosphate esters for neat oils

EXOfos® Series products are considered anionic phosphorus esters with an acidic pH. In our portfolio there are phosphorus esters of pure alcohols as well as alkoxylated/ethoxylated ones. These products exhibit very good EP properties in mineral oil solutions.

Product name	Chemical name	Acid value [mg KOH/g]	pH	Solidification point [°C]	Phosphorus content [%]	Weld load [N]	Density at 25, [g/cm³]
		in house	PN-EN 1262	PN-ISO 1392	in house	ASTM D2783	DIN 51757
EXOfos® PA-080S	2-Ethylhexyl Phosphate	250 - 250	2.0 - 3.0	<-(20)	11 - 12	1569	1.02
EXOfos® PB-184	PEG-4 oleyl phosphate	135 - 160	~ (-4)	~ (-4)	4 - 5	1961	1.03
EXOfos® PB-264	PEG-4 lauryl phosphate	150 - 180	2.0 - 3.0	~ 2	6 - 7	1569	1.04
EXOfos® PA-1300	Isotridecyl Phosphate	135 - 155	2.5 - 3	<(-20)	8 - 9	1236	0.96
EXOfos® PA-810	Decyl octyl, phosphate	280 - 330	1.5 - 2.5	~ (-14)	<1	1569	1.0
EXOfos® PB-133	PEG-3 isotridecyl phosphate	140 - 160	1.5 - 3.0	<(-20)	5 - 6	1569	1.02
EXOfos® PB-1016M	mono-C10-16-alkyl ethers	100 - 125	1.0 - 3.0	<(-20)	–	2453	1.05



Raw materials for soluble oils

Due to the inability of neat oils to cover proper heat reduction this kind of fluid was developed. Soluble oil application is based on creating oil concentrate consisting of mineral oil – naphthenic of paraffinic, emulsifier and Series of additives. This concentrate is then diluted with water to desired concentration, creating milky macroemulsion. Due to the presence of water in the MWF some characteristics may occur such as corrosion, foaming or microbiological contamination, that's why variety of additives must be applied in the formulation including corrosion inhibitors, foam control agents and biocides.

Example soluble oil formulation	
Component	Percentage
Mineral oil (usually naphthenic oil)	60 - 85
Emulsifiers	**8 - 23**
Extreme-pressure additives	**0 - 20**
Corrosion inhibitors	**5 - 10**
Boundary lubricity additives	**0 - 5**
Coupling agent	**0 - 5**
Antioxidant	0 - 0.5
Anti-mist	0 - 0.5

PCC products covers:

- Emulsifiers
- Extreme-pressure additives (EP) & Corrosion inhibitors
- Boundary lubricity additives
- Coupling agents
- Anti-mist additives

Boundary lubricity additives

Boundary lubrication additives are compounds added to lubricants to increase their ability to reduce friction and wear under boundary lubrication conditions where surfaces are in direct contact. These additives form a protective layer on metal surfaces, reducing the effects of friction. Fatty acid ester derivatives provide excellent lubrication at low temperatures, so before EP additives become effective.

Product name	Chemical name	pH	HLB	Foaming profile	Solidification point [°C]
		PN-EN 1262	in house	ASTM D1173-07	PN-ISO 1392
ROKAcet R Series	Castor oil ethoxylates	5.0 - 9.5	7 - 13	Moderate foaming profile	0 - 50
ROKAcet O Series	Oleic acid ethoxylates	5.5 - 8.5	10 - 11	Low foaming profile	~ 0

Emulsifiers

Emulsifiers are additives used to help mix two substances that typically separate when they are combined. A very important parameter of emulsifier is hydrophilic-lipophilic balance. HLB value determines the degree of polarity of surfactants, and enables the right selection of an emulsifier. When the emulsifier has a low HLB value, it stabilizes the water-in-oil emulsion while higher HLB values indicate better water solubility and emulsifier stabilize an oil-in-water emulsion.

In our portfolio we have a lot of products with wide range of HLB value.

Product name	Chemical name	EO content range	Cloud point [°C]	pH	HLB	Solidification point [°C]
			EN 1890	PN-EN 1262	in house	PN-ISO 1392
ROKwin 80	1,4 - sorbitane monooleinate	n/a	–	–	4.3	–
ROKwinol Series	Sorbitan esters, ethoxylated	20 - 80	–	–	14.9 - 16.7	(-5) - 31
ROKAnol® O Series	Oleyl alcohol ethoxylated	3EO-100EO	37 - 41 E 70 - 75 C 87 - 92 B	5.0 - 8.5	7.1 - 18.8	(-4) - 48
ROKAnol® K Series	Alcohols, C16-C18 and C18 - unsatd, ethoxylated	3EO-7EO	49 - 72 D	5.5 - 8.5	7.0 - 10.8	15 - 20
ROKAnol® DB Series	Alcohols, C12 - C15, ethoxylated	3EO-7EO	55 - 81 D	4.6 - 7.4	7.8 - 12	10 - 20
ROKAnol® NL Series	Alcohols, C9-C11, ethoxylated	3EO-6EO	55 - 59 D 60 - 65 E 33 - 57 A	4.6 - 7.5	8.5 - 12.3	(-10) - 5
ROKAnol® IT Series	Alcohols, C13, ethoxylated	3EO-12EO	48 - 78 D 60 - 62 E 79 - 85 A	5.0 - 7.0	8 - 14.5	(-20) - 20
ROKAnol® ID Series	Isodecanol, ethoxylated	3EO-8EO	51 - 69 E 59 - 68 A	5.0 - 8.0	9.2 - 13.8	3 - 9
ROKAnol® TMP 3	Alcohols, C13-15, ethoxylated	3EO	44 - 46 E	5.0 - 8.0	7.2	5
ROKAnol® GA Series	Alcohol, C10, ethoxylated	3EO-9EO	33 - 70 E 54 - 70 A	5.0 - 7.0	9.0 - 14.5	(-10) - 20

Solution A – aqueous solution
Solution B – 50 g/L NaCl solution
Solution C – 100 g/L NaCl solution
Solution D – 45 g butyldiglycol/water solution
Solution E – 25 g butyldiglycol/water solution

Coupling agents

Coupling agents are additives used as an assistance in emulsification process, they do not exhibit emulsifying properties, but help the actual emulsifier to create more stable and tightened up emulsions.

In terms of chemistry these additives are usually based on propylene glycol or nonionic ethoxylates/propoxylates.

Product name	Chemical name	EO content	Cloud point [°C] EN 1890	pH PN-EN 1262	HLB in house	Solidification point [°C] PN-ISO 1392	Dynamic Viscosity at 25 [mPa·s] in house
POLIkol 200	Polyoxyethylene glycol	–	> 90 A	4.6 - 7.4	–	< 0	11.7
Rokolub® B-10M	butanol propoxylated ethoxylated	–	>90	5.5	–	<(-30)	17
Rokolub® 50-B-10	butanol propoxylated ethoxylated	–	>90	7.4	11	<(-31)	29
Rokolub® 50-B-20	butanol propoxylated ethoxylated	–	77	–	12	<(-32)	55
ROKAnol® LP 2024	Dodecanol + EO/PO	–	20 - 24 A	5.0 - 7.0	6.3	(-15)	–
ROKAnol® LP3135	C9 - 11 Alcohols + EO/PO	–	31 - 35 A	5.0 - 7.0	7.9	(-20)	–
ROKAnol® IT3	Alcohols C13 branched + EO	3	48 - 51 D	5.0 - 7.0	8	(-20)	–
ROKAnol® IT5	Alcohols C13 branched + EO	5	60 - 62 E	5.0 - 7.0	10.5	(-5)	–
ROKAnol® IT8	Alcohols C13 branched + EO	8	76 - 78 D	5.0 - 7.0	12.8	(-20)	–
ROKAnol® IT8W	Alcohols C13 branched + EO	8	75 - 79 D	5.0 - 7.0	12.8	8	–
ROKAnol® IT12	Alcohols C13 branched + EO	12	79 - 85 A	5.0 - 7.0	14.5	20	–

Solution A – aqueous solution
Solution B – 50 g/L NaCl solution
Solution C – 100 g/L NaCl solution
Solution D – 45 g butyldiglycol/water solution
Solution E – 25 g butyldiglycol/water solution

EP&CI additives – acidic phosphate esters for soluble oils

EXOfos® Series products are considered anionic phosphorus esters with an acidic pH. In our portfolio there are phosphorus esters of pure alcohols as well as alkoxylated/ethoxylated ones. These products exhibit very good EP properties in mineral oil solutions. In addition EXOfos®es neutralized with TEA shows outstanding corrosion inhibition performance, this products can be used in water based formulation as primary or secondary corrosion inhibitor.

Product name	Chemical name	Acid value [mg KOH/g]	pH	Solidification point [°C]	Phosphorus content [%]	Weld load [N]	Ferrous metal corrosion	Ferrous metal corrosion
		in house	PN-EN 1262	PN-ISO 1392	in house	ASTM D2783	PN-M-55789	DIN-51360
EXOfos® PA-080S	2-Ethylhexyl Phosphate	250 - 250	2.0 - 3.0	<(-20)	11 - 12	1569	H0	0/0
EXOfos® PB-184	PEG-4 oleyl phosphate	135 - 160	2.0 - 3.0	~ (-4)	4 - 5	1961	H0	0/0
EXOfos® PB-264	PEG-4 lauryl phosphate	150 - 180	2.0 - 3.0	~ 2	6 - 7	1569	H0	0/0
EXOfos® PA-1300	Isotridecyl Phosphate	135 - 155	2.5 - 3	<(-20)	8 - 9	1236	H0	0/0
EXOfos® PA-810	Decyl octyl, phosphate	280 - 330	1.5 - 2.5	~ (-14)	<1	1569	H0	–
EXOfos® PB-1016M	mono-C10-16-alkyl ethers	100 - 125	1.0 - 3.0	<(-20)	–	2453	–	0/0

Anti-mist additives

Anti-mist additives are substances added to metalworking fluids to reduce or eliminate mist formation, which can occur during machining processes. These additives typically work by modifying the surface tension or viscosity of the liquid, preventing it from breaking into small droplets that form mist.

Product name	Chemical name	pH	Solidification point [°C]	Dynamic Viscosity of the 50 per cent m/m solution in water [mPa·s]
		PN-EN 1262	PN-ISO 1392	in house
POLIkol 2000	Polyoxyethylene glycol	4.6 - 7.4	50	–
POLIkol 3000	Polyoxyethylene glycol	4.6 - 7.4	55	75 - 100
POLIkol 4000	Polyoxyethylene glycol	5.0 - 7.5	55	110 - 170
POLIkol l 6000	Polyoxyethylene glycol	4.6 - 7.4	52 - 58	200 - 270

Raw materials for semi-synthetic metalworking fluids

This type of fluid is a "connection" between soluble oils and fully synthetic fluids. Usually semisynthetic fluids are prepared using both water and mineral oil base stocks, in addition emulsifiers and additives that are soluble in these two mediums are being used. After the concentration is prepared it is diluted to given concentration using water. Again presence of this medium enforces usage of additives such as corrosion inhibitors, defoamers, anti-oxidants and others. Based on concentration of oil in the formulation we can diverse low-oil and high-oil types of semisynthetic fluids.

Example semi-synthetic MWF formulation	
Component	Percentage
Mineral oil (usually naphtenic oil)	5 - 50
Water	20 - 70
Emulsifiers (usually low foaming)	**10 - 25**
Corrosion inhibitors	**10 - 25**
Lubricity additives (Boundary & EP)	**2 - 15**
Reserve alkalinity boosters	**3 - 8**
Antimicrobial	2 - 8
Coupling agent	**1- 5**
Metal deactivators	0.1 - 1.0
Antioxidant	0 - 0.5
Anti-mist	**0 - 0.5**

PCC products covers:

- Emulsifiers (also low foaming)
- Extreme-pressure additives (EP) & Corrosion inhibitors (see page 32)
- Boundary lubricity additives (see page 29)
- Reserve alkalinity boosters
- Coupling agents (see page 31)
- Anti-mist additives (see page 32)

Emulsifiers

Emulsifiers are crucial for emulsifiable oils and semisynthetic fluids in creating micro and macroemulsions. One of the challenges is to create a product with low foaming profile, which is desired property in MWF.

For traditional emulsifiers see page 30.

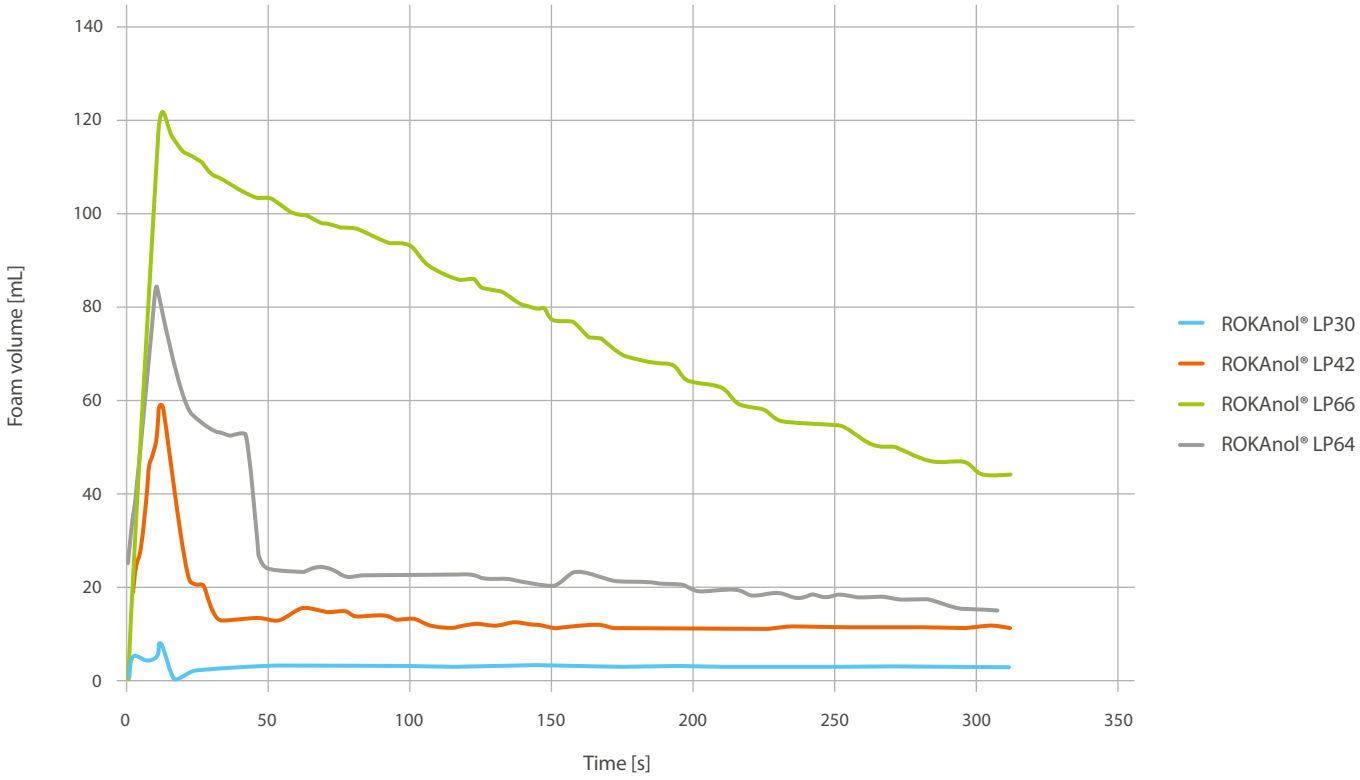
Low foaming emulsifiers

In our portfolio we have products based on alkoxylated C16 - C18 alcohols that exhibit excellent emulsifying properties. In addition they are low foaming and label free surfactants.

Product name	Chemical name	Cloud point [°C]	pH	HLB	Solidification point [°C]	Dynamic Viscosity at 25 [mPa·s]
		EN 1890	PN-EN 1262	in house	PN-ISO 1392	in house
ROKAnol® LP30	C16 - 18 alkoxylated alcohols	45 - 58 E	5 - 7	9	~ (-11)	110
ROKAnol® LP42	C16 - 18 alkoxylated alcohols	44 - 46 E	5 - 7	9	~6	60
ROKAnol® LP64	C16 - 18 alkoxylated alcohols	~ 55 E	5 - 7	11	~2	115
ROKAnol® LP66	C16 - 18 alkoxylated alcohols	64 - 68 E	5 - 7	11	~4	160

Solution A – aqueous solution
Solution B – 50 g/L NaCl solution
Solution C – 100 g/L NaCl solution
Solution D – 45 g butyldiglycol/water solution
Solution E – 25 g butyldiglycol/water solution

Foaming properties were measured using Kruss DFA100 foam analyzer. Previously prepared solution containing 0.1% of given product from the ROKAnol® LP Series and demineralized water was foamed by injecting 100 ml of gas with flow rate of 0.5 L/min. After that time the device started to measure the changes in foam volume in 5 minutes time. On the chart below you can see the results of the test.



From this chart can be seen that in all cases the foam created due to gas injection, quickly fades away in short time. In that test it's clearly visible how ROKAnol® LP30 is non foaming at all, very small amount of foam almost immediately disappears.

Same goes for ROKAnol® LP42 and despite quite large foam volume in ROKAnol® LP64 and LP66 cases, after 5 minutes time the foam is 4 times smaller (ROKAnol® LP64) and almost 3 times smaller (ROKAnol® LP66).

Reserve alkalinity boosters

This kind of additives are usually used in combination with corrosion inhibitors, they main purpose is to neutralize CI so they can be more functional in MWF environment. Additionally reverse alkalinity booster provide sufficient basicity to withstand acidic contaminations present in metalworking fluids environment. Main type of these products in terms of chemistry are alkanolamines.

Product name	Chemical name	pH	Solidification point [°C]
		PN-EN 1262	PN-ISO 1392
DEA	Diethanolamine	11*	~5
ROKAmid RAD	Oleamide DEA	7.5 - 10.5	~0
ROKAmid KAD	Cocoamide DEA	7.5 - 10.5	~0
ROKAmid MRZ4	Rapeseedamide MEA	9.2 - 10.0	~0

Raw materials for synthetic MWF

Synthetic fluids are the only type of MWF that do not contain mineral oil in any form. In general they can be diverse into three different types: solution synthetic fluid, emulsified synthetic fluid and straight synthetic fluid. In the first kind of SF water is used and water soluble additives and it is then diluted with water to desired concentration. Emulsified synthetic fluid is based on base stock such as vegetable oils or synthetic ones and contains also additives known in previous examples: emulsifiers, corrosion inhibitors etc.; this concentrate is then diluted with water. The last type which is straight synthetic oil is similar to emulsified synthetic fluid but it does not contain any water and it is not diluted.

Example synthetic MWF formulation	
Component	Percentage
Water	40 - 70
Boundary lubricity additives	**0 - 35**
Corrosion inhibitors	**15 - 30**
Extreme-pressure additives	**0 - 5**
Reserve alkalinity boosters	**10 - 20**
Antimicrobial	1 - 5
Coupling agent	**1 - 5**
Wetting agent	**0 - 1**
Metal deactivators	0.1 - 1.0
Antioxidant	0 - 0.5
Anti-mist	**0 - 0.5**

PCC products covers:

- Boundary lubricity additives
- Extreme-pressure additives (EP) & Corrosion inhibitors (see page 32)
- Reserve alkalinity boosters (see page 35)
- Coupling agents (see page 31)
- Wetting agents
- Anti-mist additives (see page 32)

Boundary lubricity additives for synthetic MWF

Boundary lubrication additives are compounds added to MWF to increase their ability to reduce friction and wear under boundary lubrication conditions where surfaces are in direct contact. These additives form a protective layer on metal surfaces, reducing the effects of friction.

Among synthetic MWF they are the only ingredients which provide lubricity. Taking into account need of fully solubility in water and great lubricity EO/PO random and block co-polymers are the best choice.

Product name	Chemical name	Cloud point [°C]	pH	Foaming profile	Solidification point [°C]	Dynamic Viscosity at 25°C [mPa·s]
		EN 1890	PN-EN 1262	ASTM D1173-07	PN-ISO 1392	in house
Rokolub® 60-D Series	polypropylene polyethylene glycol	67 - >90 [A]	–	Low foaming	<(-26) – <(-38)	165 - 2900
ROKAmer® Series	EO/PO block copolymers	16 - 60 [A] 18 - 69 [D]	4.6 - 8.0	Low foaming	(-20) - 10	230 - 1200
ROKAmer® R Series	Reversed EO/PO block copolymers	33 - 38 [A] 49 - 53 [E] 28 - 31 [D]	6.0 - 8.0	Low foaming	(-20) - 2	400 - 550
ROKAmer® ED Series	EO/PO block copolymers based on ethylenediamine	55 - 60 [E] 65 - 69 [D]	9.0 - 11.0	Low foaming	(-13) - 8	1100 - 1300

Solution A – aqueous solution
Solution B – 50 g/L NaCl solution
Solution C – 100 g/L NaCl solution
Solution D – 45 g butyldiglycol/water solution
Solution E – 25 g butyldiglycol/water solution

Wetting agents

Wetting agents, also known as surfactants, are ingredients that reduce the surface tension of a fluid, allowing it to spread and more effectively penetrate a surface

Product name	Chemical name	EO content range	Cloud point [°C]	pH	HLB	Solidification point [°C]
			EN 1890	PN-EN 1262	in house	PN-ISO 1392
ROKAnol® DB Series	Alcohols, C16-C18 and C18-unsatd, ethoxylated	3EO-7EO	49 - 72 D	5.5 - 8.5	7.0 - 10.8	15 - 20
ROKAnol® NL Series	Alcohols, C9-C11, ethoxylated	3EO-6EO	55 - 59 D 60 - 65 E 33 - 57 A	4.6 - 7.5	8.5 - 12.3	(-10) - 5
ROKAnol® IT Series	Alcohols, C13, ethoxylated	3EO-12EO	48 - 78 D 60 - 62 E 79 - 85 A	5.0 - 7.0	8 - 14.5	(-20) - 20
ROKAnol® ID Series	Isodecanol, ethoxylated	3EO-8EO	51 - 69 E 59 - 68 A	5.0 - 8.0	9.2 - 13.8	3 - 9
ROKAnol® TMP	Alcohols, C13-15, ethoxylated	3EO	44 - 46 E	5.0 - 8.0	7.2	5
ROKAnol® GA Series	Alcohol, C10, ethoxylated	3EO-9EO	33 - 70 E 54 - 70 A	5.0 - 7.0	9.0 - 14.5	(-10) - 20

Solution A – aqueous solution
Solution B – 50 g/L NaCl solution
Solution C – 100 g/L NaCl solution
Solution D – 45 g butyldiglycol/water solution
Solution E – 25 g butyldiglycol/water solution

Notes for guidance concerning the functional parameters and notation used in the catalogue

HLB (Hydrophilic-Lipophilic Balance)

The hydrophilic-hydrophobic balance is a parameter that determines the ratio of the content of the hydrophilic group and that of the hydrophobic group in a particle. The validity scope of the HLB number for non-ionic surface-active compounds is included within the range of 0 to 20 and is the measure of the share of the hydrophilic group in the particle.

$$HLB = 20 \cdot \frac{\text{molecular mass of hydrophilic part}}{\text{molecular mass of compound}}$$

On the other hand, for aqueous solution of ionic surface active agents, they acquire additional transformations increasing their degree of hydrophilicity, the value of the HLB number goes up to 40.

HLB for ester type compounds (ethoxylated fatty acids):

$$HLB = 20 \cdot \left(1 - \frac{L_Z}{L_K}\right)$$

L_Z saponification number of ethoxylated product, mgKOH/g

L_K acid number of acids subjected to ethoxylated product, mgKOH/g

On the basis of the HLB scale, the range of the utility fitness of surface-active agents can be determined.

Cloud point

Cloud point is an indicator determining the behavior of water or other organic solutions of non-ionic surfactants. Solutions of surfactants become cloudy during heating and revert to a clear solution at a certain temperature when cooled – this temperature is defined as 'cloud point'.

Depending on the temperature range at which the solution becomes cloudy, five determination methods are distinguished:

Method A – aqueous solution (10 – 90°C)

Method B – solution of NaCl 50g/l (>90°C)

Method C – solution of NaCl 100g/l (>90°C)

Method D – solution 45g of butyl diglycol/water (<10°C)

Method E – solution 25 g of butyl diglycol/water (<10°C)

HLB Number	EO content in product [%]	Product application
1 - 3	5 - 15	Anti-foaming agent
4 - 6	20 - 30	W/O emulsifier
7 - 11	35 - 55	Wetting agent
8 - 18	40 - 90	O/W emulsifier
10 - 15	50 - 75	Detergent
10 - 18	50 - 90	Solubilizer

PCC Group
Sienkiewicza 4
56-120 Brzeg Dolny, Poland
products@pcc.eu

Please visit our capital group business platform:
www.products.pcc.eu

September 2025