EXOfos® PB-1016M

OXIRANE, 2-METHYL-, POLYMER WITH OXIRANE, MONO-C10-16-ALKYL ETHERS, PHOSPHATES

KEY BENEFITS

- Good temperature resistance
- Compatible with wide range of base oils
- Compatible with other additive
- Ashless
- Lubrication
- Corrosion control
- Excellent extreme-pressure (EP) properties
- Emulsifier
- Low- foaming
- Biodegradable
- Not eco-toxic

GENERAL INFO & USES

EXOfos® PB-1016M is used in preparations for metalworking.
This product has: emulsifying, lubricating, low-foaming and anti-corrosion properties.

KEY APPLICATIONS

- gear oils
- metalworking fluids
- high-temperature lubricants
- greases hydraulic fluids

PACKAGING

Packaging with required UN sign. Polyethylene drums with a capacity of 200 liters, IBC containers and other packaging as agreed with the customer.

STORAGE & SHELF LIFE

Store in a tightly closed container in a room protected against atmospheric conditions, at a temperature of up to 40°C. Protect against humidity and high insolation. Guaranteed period of stability: 12 months from the date of manufacture.

TRANSPORTATION

Limitations resulting from ADR, RID, IMDG, ICAO/IATA regulations apply UN 3265 Corrosive liquid, acidic, organic, N.O.S. (Contains organic phosphate esters), Transport hazard class:8; Packing group: III; Covered means of transport recommende.

PHYSICAL-CHEMICAL PROPERTIES

Parameter	Method	EXOfos PB-1016M
CAS	–	68649-29-6
Chemical name	–	Oxirane, 2-methyl-, polymer with oxirane, mono-C10-16-alkyl ethers, phosphates
Appearance at 20-25[°C]	visual method	clear liquid
Color (Gardner)	PN-EN ISO 4630	2
AV to the first inflection point [mg KOH/g]	in-house method	50-60
AV to the second inflection point [mg KOH/g]	in-house method	105-125
pH value	PN-EN 1262, 1% in water	1-3
Solidification point [°C]	PN-ISO 1392	<-20
Density at 25°C [g/cm³]	PN-EN ISO 3675:2004	~1.05
Viscosity at 25°C [cP]	Brookfield method	~ 1200
P-content [%]	in-house method	~3
Water content [%]	PN-ISO 760:2001, direct method	<1

APPLICATION PROPERTIES

Solubility of EXOfos PB-1016M (PN-EN 13955: 25°C, 5%[w/w])

	Solvent							
Product name	Demineralized water	Methanol	Ethyl ether	Acetone	Paraffinic base oil	Naphtenic base oil	Rapeseed oil	Rapeseed oil methyl esters (RME)
EXOfos PA-1016M	◐	●	●	●	●	●	●	●

● soluble
● insoluble
◐ partially soluble

ALKALI AND ACID RESISTANCE

The analysis of this stability for low foaming surfactants has been performed in accordance with the PN-EN 14712:2005 standard.

- ○ macroscopic phase separation
- ● clear, homogeneous solution
- ● homogeneous, opalescent solution

Alkali and acid resistance (Sulphuric acid); concentration of 1%; temperature 20°C

conc g/l / solution	1	5	10	20	40	70	80	140	180	190
NaOH	●	●	●	●	●	●	●	●	●	○
HCl	●	●	●	●	●	●	●	●	–	–

FOAMING CAPABILITY

Determination of the foaming capability was preformed according to ATSM-1573 (the Ross-Miles method) for solution with a concentration of 1.0 g/l in deionised and hard water at a temperature of 25°C.

Product name	Demineralized water	Hard water
EXOfos PB-1016M	Poor	Poor

Foam value [ml]	Description
100-200	Moderate
70-100	Low
20-70	Poor
0-20	None

FOAM STABILITY

A solution of 1% EXOfos PB-1016M was prepared by dissolving it in demineralised or hard water with a hardness of 17 dH, using a Kruss DFA100 foam analyser, the solution obtained was foamed by injecting 150 ml of air at a rate of 0.5 l/min. The measurement was carried out at 20±2°C for 10 minutes.

Foam stability parameters for 1% solution EXOfos PB-1016M in deminarelized water and hard water.

Measurement name	$t_{FLS\ 75\%}$ [s]	$t_{FLS\ 50\%}$ [s]	$t_{FLS\ 25\%}$ [s]
Demi water	28	45	100
Hard water	33	59	124

Legend:

$t_{FLS\ 75\%}$ [s] - 25% drainage time: time at which the FLS has reduced to 75 % of its initial value
$t_{FLS\ 50\%}$ [s] - 50% drainage time: time at which the FLS has reduced to 50 % of its initial value
$t_{FLS\ 25\%}$ [s] - 75% drainage time: time at which the FLS has reduced to 25 % of its initial value

WETTING CAPABILITY

The capability of wetting cotton fabric was determined according to EN 1772:2001.
Wetting time (time in seconds necessary for wetting the textile material) was measured at EXOfos PB-1016M solution with a concentration of 0.5, and 2.0 g/l in deionized water at a temperature of 25°C.

Concentration	Demineralized water
0.5	Low
2.0	Good

Legend:

Time (s)	Description
<20	Excellent
20-50	Good
50-100	Moderate
100-300	Low
>300	Poor

Extreme-Pressure (EP)

Four-ball extreme-pressure (EP) tests in Rapeseed oil methyl esters (RME) or Rapeseed oil acording to ASTM D2783 (1760 rpm, 10 s).

Sample	Last nonseizure load [kg]	Weld point [kg]
Paraffinic base oil	392	981
Naphthenic base oil	392	981
Rapeseed oil methyl esters (RME)	392	981
Rapeseed oil	785	1 236
Paraffinic base oil + 3% EXOfos PB-1016M	1 236	2 453
Naphtenic base oil + 3% EXOfos PB-1016M	1 236	1 962
Rapeseed oil + 3% EXOfos PB-1016M	981	2 452
RME + 3% EXOfos PB-1016M	981	2 452

Four-ball anti-wear performance for EXOfos PB-1016M according to ASTM D4172 (method B: 1200 rpm, 1 h, 75°C, 40 kg)

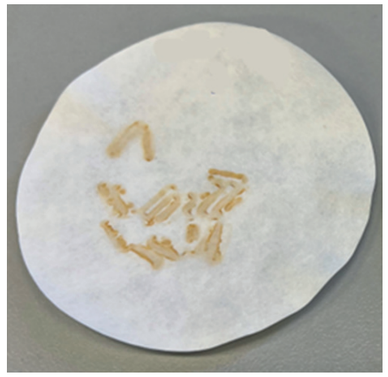
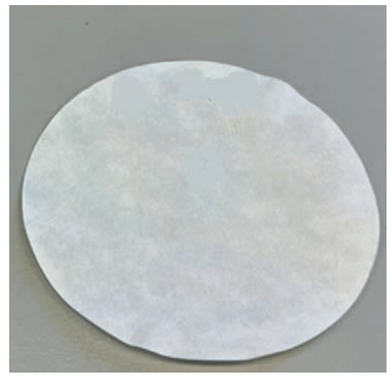
Sample	Avarage scar diameter [mm]
Paraffinic base oil (ISO VG 22)	0.91 ± 0.03
Naphtenic base oil	0.80 ± 0.03
Rapeseed oil methyl esters (RME)	0.76 ± 0.03
Rapeseed oil	0.73 ± 0.03
Paraffinic base oil + 0.5% EXOfos PB-1016M	0.65 ± 0.03
Naphtenic base oil + 3% EXOfos PB-1016M	0.58 ± 0.03
Rapeseed oil + 3% EXOfos PB-1016M	0.45 ± 0.03
RME + 3% EXOfos PB-1016M	0.48 ± 0.03

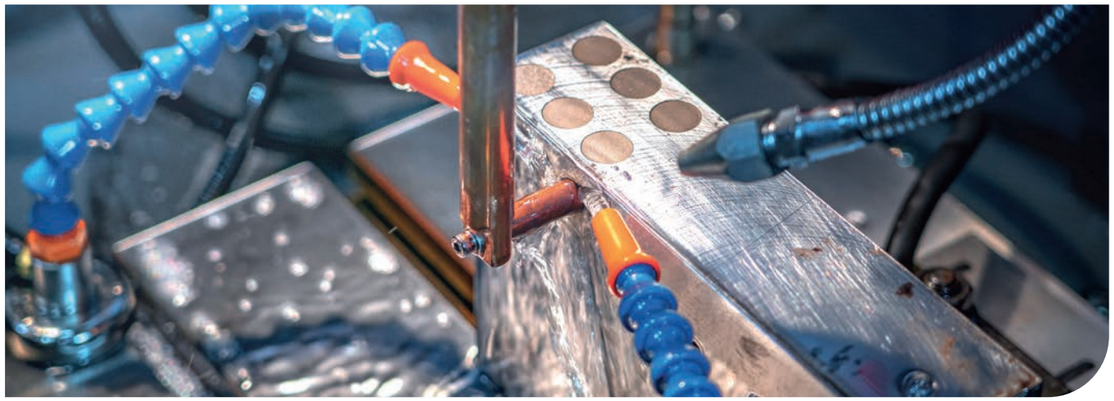
CORROSION INHIBITION

Chip/filter paper method (DIN-51360)

Test method description: cast iron chips are placed on filter paper and wetted with analysed solution. The corroded area is evaluated after 2 h.
Tests performed for products neutralized by triethanolamine to pH value 7-8 in demineralized water. In table below the minium concentrations of EXOfos PB-1016M needed to obtain 0 result (any signs of corrosion) are demonstrated.

Sample	Result
Water demi	3/3
1% EXOfos PB-1016M/TEA in water demi	0/0

Water demi	1% EXOfos PB-1016M/TEA in water demi
3/3	0/0
	



Result of Chip/filter paper method

Result	Description of the result	Degree of surface colouring
0	Lack of corrosion	None
1	Slight corrosion	A maximum of 3 tracks, none of which exceeds 1 mm in size
2	Weak corrosion	Surface stained by less than 1% but more marks or more than with result 1
3	Medium corrosion	More than 1%, but less than 5% of the surface colour
4	Strong corrosion	More than 5% surface staining

Copper corrosion according to ASTM D130-18

Method for evaluating the effect of lubricants on the copper surface. Copper plate placed in the sample for analysis, temperature 50°C, duration 3 hours. Evaluation of changes in the appearance of the plate according to the standard.

Hard water 20 d	1% EXOfos PB-1016M/TEA in water 20 d
3a/3a	1a/1a

EXAMPLE OF SEMISYNTHETIC FORMULA

Preparation:

Naphthenic oil, emulsifier, corrosion inhibitor, triethanolamine, butyldiglycol (BDG) and demineralised water were weighed, then the sample was stirred until homogeneous about 1 hour.

Ingredient	Semisynthetic fluid
Naphthenic base oil	15.0
EXOfos PB-1016M	2.0
EXOemul OM2* or EXOemul OM4*	13-23
EXOhib PC400	6.8
TEA	5.4
BDG	7.8
Deminarelized water	to 100
Apperance after preparation	clear solution
Stability after 2 weeks 20-25°C	clear solution
Stability after 2 weeks 40°C	clear solution
Stability after 4 cycle storage in: -5°C (24h), 25°C (24h), 40°C (24h)	clear solution

* emulsifier package dedicated to mineral oil

PCC EXOL SA
Sustainable technologies for new generations

PCC EXOL SA combines innovative technologies with experience in designing, producing and selling surfactants and chemical formulations

PCC EXOL SA is a company that combines cutting-edge technologies with rich experience in production of surfactants (surface active agents). The company is located in Brzeg Dolny (Poland), where anionic, nonionic and amphoteric surfactant production plants have been launched. Due to the flexible production processes, the company offers a wide spectrum of surfactants and industrial formulations, which are often suited for the individual customers operating in plenty of various industry sectors. As one of the leading surfactant manufacturers, PCC EXOL SA carries out new investment projects and implements innovative technologies based on the global sustainability trends.

PCC EXOL SA portfolio includes surfactants with a broad range of applications. Besides of the mass production for personal care and detregents industry, the substances produced by PCC EXOL SA also include specialized products used in various branches, such as textile, agrochemical, metal cleaning, oil drilling, building & construction, paints & coatings, paper industry, extraction & drilling, and many others.
The company comprehensive portfolio is continuously enriched with new innovative products, which meet even the strictest market requirements and adapt to the individual needs of customers. This is possible due to the dynamic development of the research facilities, flexible production, knowledge as well as experienced personnel.

PCC EXOL SA has the key competence necessary for a worldwide production of surfactants. The ongoing projects will soon bring the new opportunities for the company's further development and expansion into new markets. The company offers not only a wide portfolio and professional servicing but most of all flexible production and comprehensive system solutions that meet individual customer demands. The strategic PCC EXOL SA investor is PCC SE, operating on international markets of the chemical raw materials, transport, energy, coal, coke, petrol, plastics and metallurgy. PCC SE includes 80 companies operating in 39 different locations in 17 countries.

In accordance with our environmental concerns, this publication from the PCC Group was printed on Cocoon Silk - an ecological double-sided-coated matt paper. This paper is made of 100% waste paper via environment-friendly technology. The FSC® Certificate confirms that the raw materials used during the paper production process come from well-managed forests or other certified and controlled sources.

TEXT PAGES	
Brand	Cocoon Silk
Grammage	150
Number of pages	12

COVER PAGES	
Brand	Cocoon Silk
Grammage	250
Number of pages	4

PUBLICATION	
Size (cm)	21 x 29.7
Quantity	250

By using Cocoon Silk rather than non-recycled paper, the environmental impact was reduced by:

20	kg of landfill
2	kg CO_2 and greenhouse gases
27	km travel in the average European car
783	litres of water
43	kWh of energy
32	kg of wood

Carbon footprint data evaluated by Labelia Conseil in accordance with the Bilan Carbone® methodology. Calculations are based on a comparison between recycled paper used versus a virgin fibre paper - according to the latest European BREF data (virgin fibre paper) available.

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