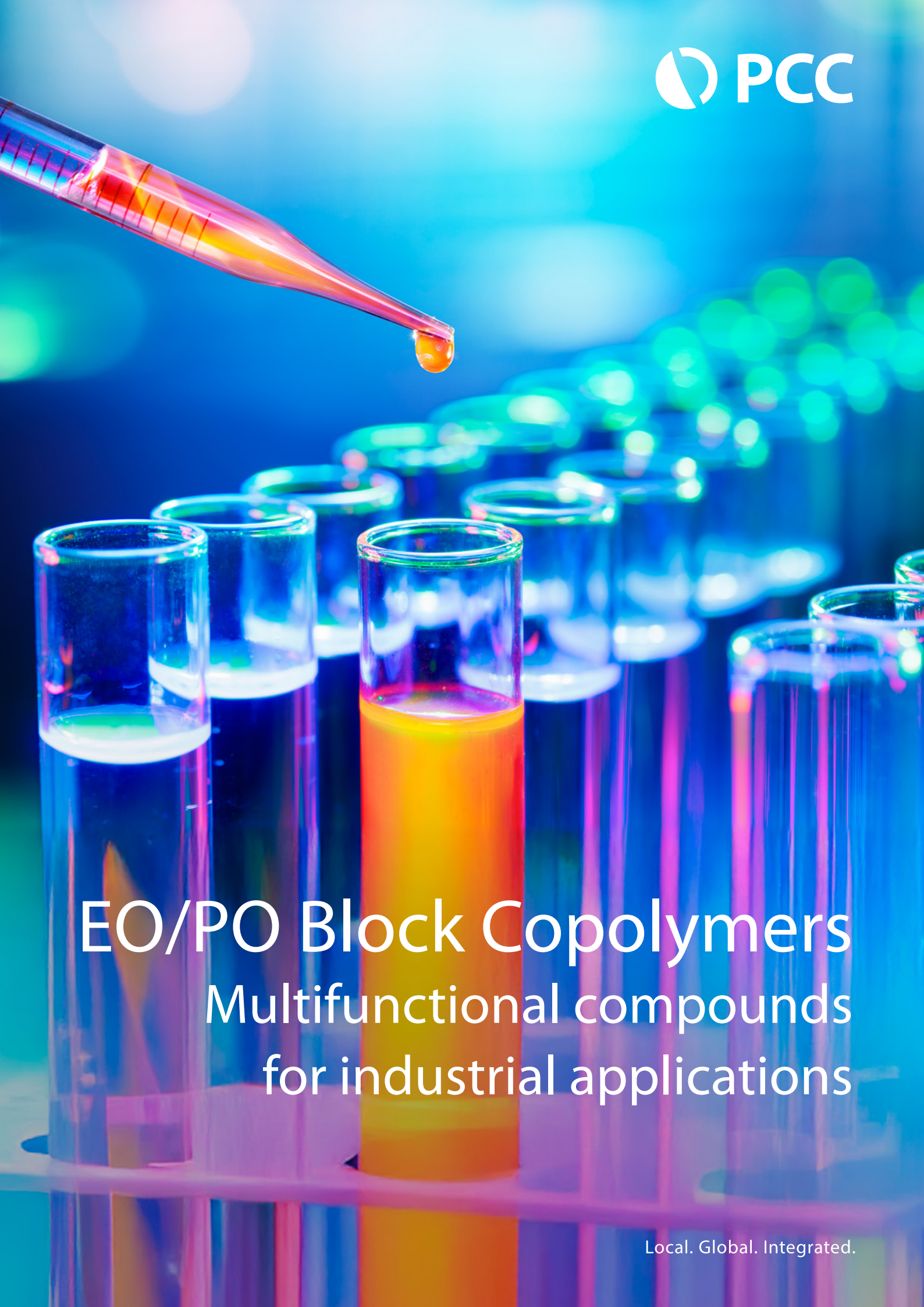

EO/PO Block Copolymers

Multifunctional compounds for industrial applications

Local. Global. Integrated.


Operating in 17 countries, in 39 different locations, PCC SE currently employs over 3 300 people.

About Us

PCC Exol SA is a major player in the European surfactants market. In the eastern and central-eastern part of the continent, it is the undisputed leader in its industry. Most of the production facilities and the company's headquarters are located in Brzeg Dolny, Poland. Here we develop, test and manufacture a wide range of anionic, non-ionic and amphoteric surfactants and speciality industrial formulations.

New products are continuously added to the portfolio in response to market trends and individual customer requirements. The surfactants produced at the plants have a very wide range of industrial applications. They are used as wetting agents, emulsifiers, auxiliaries in paper, metallurgy and many other industries, as well as in household chemicals, personal care products and textiles.

PCC EXOL pays special attention to the issue of sustainable development, which is one of the key elements of the company's strategy. In order to strengthen its competitive position in the surfactants market, the company is committed to promoting responsible production and consumption throughout the value chain. The concept of sustainable development is therefore a key aspect of all the company's management and operational processes.

PCC ROKITA SA
PCC PCG
OXYALKYLATES
IRPC

Polyols

- Polyether polyols
- Polyester polyols
- Prepolymers
- Polyurethane Systems

PCC
ROKITA SA

Chlorine

- Chlorine
- MCAA
- Other Chlorine Downstream Product

PCC
ROKITA SA

Phosphorus

- Phosphorus derivatives
- Naphthalene derivatives
- Polycarboxyethers (PCE)

PCC EXOL SA
PCC CHEMax. INC
PCC PCG OXYALKYLATES

Surfactants

- Anionic surfactants
- Cationic surfactants
- Nonionic surfactants
- Amphoteric surfactants (betaines)
- Chemical formulation

PCC
SYNTEZA

Alkylphenols

- Nonylphenol
- Dodecylphenol
- Tristyrylphenol

PCC CONSUMER PRODUCTS SA

Consumer Products

- Household & industrial Cleaners, Detergents and Personal Care Products

PCC
ROKITA SA

Energy

- Renewable Energy
- Conventional Energy

PCC
INTERMODAL SA

Logistics

- Intermodal transport
- Road Haulage
- Rail Transport

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BAKKISILICON HF.

Silicon

- Microsillica
- Silicon Metal

PCC
SE

Holding & Projects

- Portfolio Management
- Project Development

EO/PO block copolymers

Chemical description

Block copolymers are multipurpose products used in a variety of applications, including detergents and industrial and institutional (I&I) applications, where antifoaming, dispersing, and wetting properties play important roles. They can be used in rinse aids, hard surface cleaners (also CIP), metal cleaners and also as a laundry aids. Due to their unique structure block copolymers have good emulsifying properties. Hence, they can be used in agriculture, paints and coatings and other applications.

Chemical structure of ROKAmer series:

$$HO(CH_2CH_2O)_{m1}[CH(CH_3)CH_2O]_n(CH_2CH_2O)_{m2}H$$

m1 + m2 – average number of ethylene oxide units
n – average number of propylene oxide units

ROKAmer R2150, R2600, R2800 and R3100 are representative of block copolymer where the central polyethylene oxide block is flanked by two polypropylene oxide blocks and it is shown by the following formula:

Chemical structure of ROKAmer series R:

$$H(CH_2CH(CH_3)O)_{n1}[CH_2CH_2O]_m(CH_2CH(CH_3)O)_{n2}H$$

n1 + n2 – average number of propylene oxide units
m – average number of ethylene oxide units

Applications

- Automatic dishwashing detergents and rinse aids
- Paints and coatings
- Textile industry
- Laundry detergents
- Water treatment
- Hard surface cleaners
- Fermentation processes
- Agriculture
- Metal cleaning
- Pulp and paper

Basic information – ROKAmer Series & ROKAmer R Series

Basic physical and chemical properties	ROKAmer 1000	ROKAmer 1010	ROKAmer 1010/50	ROKAmer 1900	ROKAmer 2000	ROKAmer 2100	ROKAmer 2330	ROKAmer 2400
Appearance at 20 – 25°C	clear liquid	wax with a white to pale yellow colour	viscous liquid, colourless to pale yellow	clear liquid	clear or slightly turbid liquid	clear or turbid liquid	viscous liquid	liquid
Concentration [%]	approx. 99	approx. 99	approx. 50	approx. 99	approx. 99	approx. 99	approx. 99	approx. 99
Colour [Hazen scale]	approx. 10 (at 40°C)	approx. 40 (at 70°C)	max. 20 (at 40°C)	max. 50 (at 50 – 55°C)	max. 50 (at 40°C)	max. 125 (at 40°C)	max. 125 (at 40°C)	max. 100 (at 40°C)
Cloud point A [°C]	approx. 37	above 90	above 90	approx. 57	23 – 27	17 – 20 (10% solution)	21 – 26 (10% solution)	34 – 38
Cloud point B [°C]	approx. 24	approx. 88	approx. 88	approx. 47	approx. 13	approx. 14	approx. 18	approx. 21
Cloud point C [°C]	approx. 14	approx. 72	approx. 72	approx. 44	below 10	below 10	below 10	approx. 12
Cloud point D [°C]	approx. 48	approx. 94	approx. 94	approx. 79	approx. 40	approx. 44	approx. 59	approx. 65
Cloud point E [°C]	39 – 43	approx. 92	approx. 92	approx. 76	max. 40	approx. 38	approx. 56	approx. 61
Average molar mass [g/mol]	approx. 1000	approx. 8800	approx. 8800	approx. 1000	approx. 1800	approx. 2000	approx. 2200	approx. 2400
Water content [%]	max. 1	max. 1	49 – 51	max. 0.5	max. 1	max. 1	max. 1	max. 0.5
Solidification point [°C]	below -20	49 – 52	max. -5	approx. 1	below -20	below 0	below 10	approx. 4
pH in deionized water, at 20°C	5 – 7 (1% solution)	4.6 – 7.4 (2% solution)	7.0 – 9.0 (pH of product)	5 – 7 (1% solution)	4.6 – 7.4 (1% solution)	4.6 – 7.4 (10% solution)	4.6 – 7.4 (10% solution)	5.0 – 7.0 (10% solution)
Density [g/cm3]	approx. 1.02 (at 25°C)	approx. 1.05 (at 70°C)	approx. 1.04 (at 50°C)	approx. 1.04 (at 25°C)	approx. 1.01 (at 20°C)	1.01 – 1.03 (at 25°C)	approx. 1.03 (at 25°C)	approx. 1.04 (at 25°C)
Viscosity [cP]	approx. 170 (at 25°C)	approx. 1100 (at 55°C)	approx. 400 (at 25°C)	approx. 400 (at 25°C)	approx. 400 (at 25°C)	approx. 500 (at 25°C)	approx. 500 (at 25°C)	approx. 500 (at 25°C)
Surface tension at 25°C [mN/m]	45	40	36	43	39	40	37	42

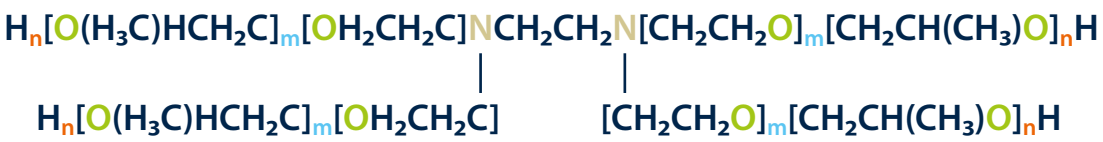
ROKAmer 2600	ROKAmer 2950	ROKAmer 3100	ROKAmer 3800	ROKAmer 6500	ROKAmer 6500W	ROKAmer R2150	ROKAmer R2650	ROKAmer R2800	ROKAmer R3100
clear or turbid liquid	viscous liquid or semi-liquid paste	liquid	liquid	wax	liquid	liquid	clear liquid	clear liquid	clear liquid
approx. 99	approx. 99	approx. 99	approx. 99	approx. 99	approx. 20	approx. 99	approx. 99	approx. 99	approx. 99
max. 50 (at 40°C)	approx. 30 (at 40°C)	max. 50 (at 50°C)	max. 100 (at 40°C)	max. 3 (iodine scale at 70°C)	max. 2 (iodine scale at 40°C)	max. 100 (at 15 – 20°C)	max. 100 (at 20 – 25°C)	approx. 20 (at 40°C)	max. 1 (Gardner scale at. 25°C)
16 – 20	54 – 60 (10% solution)	59 – 61	16 – 20	insoluble	insoluble	33 – 38	approx. 52	approx. 22	approx. 43
below 10	approx. 38	approx. 46	below 10	insoluble	insoluble	approx. 22	approx. 39	approx. 11	approx. 26
below 10	approx. 27	approx. 34	below 10	insoluble	insoluble	approx. 10	approx. 30	below 10	insoluble
approx. 39	approx. 68	approx. 71	approx. 53	approx. 84	approx. 84	approx. 42	approx. 55	28 – 31	approx. 44
33 – 37	approx. 65	approx. 70	46 – 52	approx. 87	approx. 87	approx. 38	49 – 53	approx. 25	30 – 32
approx. 2600	approx. 2900	approx. 3000	approx. 4000	approx. 6500	approx. 6500	approx. 2200	approx. 2700	approx. 2800	approx. 3100
max. 1	max. 1	max. 0.3	max. 0.5	max. 0.5	81 – 83	max. 0.4	max. 0.5	max. 0.5	max. 0.2
below -20	below 15	approx. 13	below -20	approx. 48	approx. -4	below -20	approx. 2	below -20	approx. 20
4.6 – 7.4 (1% solution)	4.6 – 7.4 (10% solution)	5.5 – 8.0 (5% solution)	5 – 8 (5% solution)	5 – 8 (5% solution)	5.5 – 7.5 (5% solution)	6 – 8 (2.5% solution)	6 – 8 (2.5% solution)	4 – 7 (1% solution)	5.0 – 7.5 (2.5% solution)
approx. 1.02 (at 25°C)	approx. 1.04 (at 25°C)	approx. 1.04 (at 25°C)	approx. 1.02 (at 25°C)	approx. 1.04 (at 25°C)	approx. 1.02 (at 25°C)	approx. 1.03 (at 25°C)	approx. 1.05 (at 25°C)	approx. 1.01 (at 25°C)	approx. 1.02 (at 20°C
approx. 700 (at 25°C)	approx. 1200 (at. 25°C)	approx. 300 (at. 25°C)	approx. 1150 (at 20°C)	approx. 560 (at 60°C)	approx. 10 (at. 25°C)	approx. 400 (at 25°C)	approx. 500 (at 25°C)	approx. 550 (at 20°C)	approx. 600 (at 20°C)
36	41	42	33	35	35	44	46	40	38

EO/PO block copolymers based on ethylenediamine

Chemical description

Block copolymers on ethylenediamine are non-ionic surfactants belonging to the group of block copolymers of ethylene oxide and propylene oxide, based on alkoxylated ethylenediamine. They are high polymers with a specific tetra-functional structure i.e., they have four hydrophilic groups. This feature distinguishes the ROKAmer ED group from other non-ionic surfactants and determines their properties. ROKAmer ED44 and ROKAmer ED57 are products with low- and anti-foaming properties.

Chemical structure of ROKAmer series ED:



4n – average number of propylene oxide units
4m – average number of ethylene oxide units

Applications

Refining industry

Crude oil extraction

Processing of process waters

Basic information – ROKAmer ED Series

Basic physical and chemical properties	ROKAmer ED44	ROKAmer ED57
Appearance at 20 – 25°C	liquid	liquid
Concentration [%]	approx. 99	approx. 99
Colour [Hazen scale]	approx. 1 (at 40°C)	approx. 1 (at 60°C)
Cloud point A [°C]	approx. 25	approx. 46
Cloud point B [°C]	approx. 17	approx. 33
Cloud point C [°C]	below 10	approx. 21
Cloud point D [°C]	approx. 61	65 – 69
Cloud point E [°C]	55 – 60	approx. 63
Average molar mass [g/mol]	5800	4900
Water content [%]	max. 0.4	max. 0.4
Solidification point [°C]	approx. -13	approx. -8
pH in deionized water, at 20°C	9 – 11 (2.5% solution)	9 – 11 (2.5% solution)
Density [g/cm3]	approx. 1.03	approx. 1.04
Viscosity [cP]	approx. 1100	approx. 1300
Surface tension at 25°C [mN/m]	33	35

EO/PO block copolymers based on glycerin

Chemical description

Block copolymers on glycerin are a nonionic surfactants belonging to the group of block copolymers of ethylene oxide and propylene oxide (EO / PO) with the use of glycerin as a starter.

There are polymers with a specific, three-functional structure, which means that it has three hydrophilic groups. This feature is characteristic of the ROKAmer G series compared to other nonionic surfactants and determines their properties.

Chemical structure of ROKAmer series G:

$$\begin{array}{l} CH_2O[CH_2CH(CH_3)O]_n(CH_2CH_2O)_mH \\ | \\ CHO[CH_2CH(CH_3)O]_n(CH_2CH_2O)_mH \\ | \\ CH_2O[CH_2CH(CH_3)O]_n(CH_2CH_2O)_mH \end{array}$$

3n – average number of propylene oxide units
3m – average number of ethylene oxide units

Applications

- Paper industry
- Food industry
- Sugar and fermentation industry
- Industrial cleaning and washing
- Oil field

Basic information – ROKAmer G Series

Basic physical and chemical properties	ROKAmer G3400	ROKAmer G3500	ROKAmer G3800	ROKAmer G4300	ROKAmer G5000E
Appearance at 20 – 25°C	liquid	clear liquid	clear liquid	clear liquid	clear liquid
Concentration [%]	approx. 99	approx. 99	approx. 99	approx. 99	approx. 99
Colour [Hazen scale]	max. 3 (Gardner at 25°)	approx. 10 (Hazen at 25°C)	approx. 20 (Hazen at 40°C)	max. 50 (Hazen at 25°C)	max. 50 (Hazen at 20-25°)
Cloud point A [°C]	approx. 26	36-42	approx. 18	approx. 17	insoluble
Cloud point B [°C]	below 10	approx. 18	below 10	insoluble	insoluble
Cloud point C [°C]	insoluble	approx. 14	below 10	insoluble	insoluble
Cloud point D [°C]	30 – 32	approx. 44	25 – 28	33 – 37	approx. 48
Cloud point E [°C]	approx. 28	approx. 40	approx. 24	approx. 30	approx. 46
Average molar mass [g/mol]	approx. 3400	approx. 3500	approx. 3800	approx. 4300	approx. 4850
Water content [%]	max. 0.2	max. 0.5	max. 0.5	max. 0.3	max. 0.1
Solidification point [°C]	below -20	below -15	below -20	below -20	below -20
pH in deionized water, at 20°C	5.0 – 7.0 (10% solution)	5 – 7 (1% solution)	5 – 7 (1% solution)	5 – 7 (1% solution)	approx. 6 (ethanol solution)
Density [g/cm3]	approx. 1.02 (at 25°C)	approx. 1.04 (at 25°C)	approx. 1.02 (at 25°C)	approx. 1.02 (at 25°C)	approx. 1.02 (at 25°C)
Viscosity [cP]	approx. 850 (at 25°C)	approx. 870 (at 20°C)	approx. 870 (at 20°C)	approx. 900 (at 20°C)	700 – 1000 (at 25°C)
Surface tension at 25°C [mN/m]	36	42	37	36	33

Polyoxypropylene glycols

Chemical description

Polyoxypropylene glycols are polymers with a bifunctional structure, which are caused by the presence of two hydrophilic groups in the molecule. This attribute allows the group of ROKAmers PP to be exposed among other non-ionic surfactants and determines their properties.

Chemical structure of ROKAmer PP Series:

$$HO[CH(CH_3)CH_2O]_nH$$

n = average number of propylene oxide units

Applications

- Paper industry
- Food industry
- Printing industry
- Production of lubricants
- Textile industry
- Water treatment
- Chemical intermediates

Basic information – ROKAmer PP Series

Basic physical and chemical properties	ROKAmer PP450	ROKAmer PP1000	ROKAmer PP2000	ROKAmer PP4000
Appearance at 20 – 25°C	homogenousclear liquid	homogenous clear liquid	clear liquid	liquid
Concentration [%]	approx. 99	approx. 99	approx. 99	approx. 99
Colour [Hazen scale]	max. 50	max. 50	max. 50	max. 100
Cloud point A [°C]	approx. 89	approx. 33	12 – 19	below 10
Cloud point B [°C]	approx. 58	approx. 21	approx. 10	-
Cloud point C [°C]	approx. 39	approx. 10	below 10	-
Cloud point D [°C]	approx. 66	approx. 38	approx. 23	below 10
Cloud point E [°C]	approx. 59	approx. 31	12 – 19	below 10
Average molar mass [g/mol]	approx. 450	approx. 1000	approx. 2000	approx. 4000
Water content [%]	max. 0.2	max. 0.5	max. 0.5	max. 0.5
Solidification point [°C]	below -20	below -20	below -20	below -20
pH in deionized water, at 20°C	approx. 5.5 (10% solution)	approx. 5.5 (1% solution)	approx. 6.0 (1% solution)	5.5 – 7.0 (1% solution)
Density [g/cm3]	approx. 1.01 (at 25°C)	approx. 1.00 (at 25°C)	approx. 1.04 (at 25°C)	approx. 1.02 (at 20°C)
Viscosity [cP]	60 – 80 (at 25°C)	130 – 170 (at 25°C)	approx. 400 (at 20°C)	700 – 1000 (at 25°C)
Surface tension at 25°C [mN/m]	50	44	38	40

Solubility

The solubility of ROKAmer series in **warm water** and other solvents has been shown in the table below.

Product	Conc. [%]	Demineralized water	Methanol	Isopropanol	Ethylene glycol	Hexane	Xylene	Mineral oil
ROKAmer 1000	10	●	●	●	●	●	●	●
ROKAmer 1010	10	●	●	●	●	●	●	●
ROKAmer 1010/50	10	●	●	●	●	●	●	●
ROKAmer 1900	10	●	●	●	●	●	●	●
ROKAmer 2000	10	●	●	●	●	●	●	●
ROKAmer 2100	10	●	●	●	●	●	●	●
ROKAmer 2330	10	●	●	●	●	●	●	●
ROKAmer 2400	10	●	●	●	●	●	●	●
ROKAmer 2600	10	●	●	●	●	●	●	●
ROKAmer 2950	10	●	●	●	●	●	●	●
ROKAmer 3100	10	●	●	●	●	●	●	●
ROKAmer 3800	10	●	●	●	●	●	●	●
ROKAmer 6500	10	●	●	●	●	●	●	●
ROKAmer 6500W	10	●	●	●	●	●	●	●
ROKAmer R2150	10	●	●	●	●	●	●	●
ROKAmer R2650	10	●	●	●	●	●	●	●
ROKAmer R2800	10	●	●	●	●	●	●	●
ROKAmer R3100	10	●	●	●	●	●	●	●
ROKAmer ED44	10	●	●	●	●	●	●	●
ROKAmer ED57	10	●	●	●	●	●	●	●
ROKAmer G3400	10	●	●	●	●	●	●	●
ROKAmer G3500	10	●	●	●	●	●	●	●
ROKAmer G3800	10	●	●	●	●	●	●	●
ROKAmer G4300	10	●	●	●	●	●	●	●
ROKAmer G5000E	10	●	●	●	●	●	●	●
ROKAmer PP450	10	●	●	●	●	●	●	●
ROKAmer PP1000	10	●	●	●	●	●	●	●
ROKAmer PP2000	10	●	●	●	●	●	●	●
ROKAmer PP4000	10	●	●	●	●	●	●	●

● soluble ● insoluble ● partially soluble

Wetting capability

Surfactants reduce the surface tension of liquids in which they are dissolved. Thanks to them, any liquid (usually water) has greater wetting capability, which increases its ability to get as close as possible to the solid. This is very important for many surfactant applications, especially in cleaning processes.

The capability of wetting cotton fabric was determined in accordance to **PN-EN 1772:2001** Standard.

Wetting time [s]	Description
<20	excellent
20-50	good
50-100	moderate
100-300	low
>300	poor

Product	1 g/L	2 g/L	5 g/L	10 g/L
ROKAmer 1000	poor	poor	poor	poor
ROKAmer 1010	poor	poor	poor	poor
ROKAmer 1010/50	poor	poor	poor	poor
ROKAmer 1900	poor	poor	poor	poor
ROKAmer 2000	poor	low	moderate	excellent
ROKAmer 2100	poor	poor	moderate	excellent
ROKAmer 2330	poor	poor	low	moderate
ROKAmer 2400	poor	poor	low	good
ROKAmer 2600	moderate	good	excellent	excellent
ROKAmer 2950	poor	poor	poor	moderate
ROKAmer 3100	poor	poor	poor	moderate
ROKAmer 3800	poor	poor	low	poor
ROKAmer 6500	poor	low	good	excellent
ROKAmer 6500W	poor	poor	low	moderate
ROKAmer R2150	poor	poor	poor	low
ROKAmer R2650	poor	poor	poor	poor
ROKAmer R2800	poor	low	moderate	excellent
ROKAmer R3100	poor	low	good	excellent
ROKAmer ED44	moderate	moderate	excellent	excellent
ROKAmer ED57	poor	low	moderate	good
ROKAmer G3400	poor	low	moderate	good
ROKAmer G3500	poor	poor	poor	poor
ROKAmer G3800	moderate	moderate	excellent	excellent
ROKAmer G4300	good	good	good	excellent
ROKAmer G5000E	moderate	good	excellent	excellent
ROKAmer PP450	poor	poor	poor	poor
ROKAmer PP1000	poor	poor	poor	poor
ROKAmer PP2000	poor	low	moderate	excellent
ROKAmer PP4000	poor	poor	poor	low

Foaming capability

Determination of the foaming capability was preformed according to **ASTM D1173** (the Ross-Miles method) for solution with a concentration of 1.0 g/L in deionised water at a temperature of 25ºC. Products from Rokamer series display no foaming capability or very poor foaming. Products with polyethylene glycol content below 30% exhibits also antifoaming properties and can be used as defoaming agents.

Foam volume [ml]	Description
70-170	moderate
<70	low
<25	poor
<10	none

Product	Foam volume [mL]		
	60 s	180 s	300 s
ROKAmer 1000	none	none	none
ROKAmer 1010	low	low	low
ROKAmer 1010/50	low	poor	poor
ROKAmer 1900	poor	poor	none
ROKAmer 2000	none	none	none
ROKAmer 2100	low	none	none
ROKAmer 2330	none	none	none
ROKAmer 2400	none	none	none
ROKAmer 2600	none	none	none
ROKAmer 2950	low	low	low
ROKAmer 3100	poor	none	none
ROKAmer 3800	none	none	none
ROKAmer 6500	moderate	moderate	moderate
ROKAmer 6500/W	low	low	low
ROKAmer R2150	none	none	none
ROKAmer R2650	none	none	none
ROKAmer R2800	none	none	none
ROKAmer R3100	none	none	none
ROKAmer ED44	low	low	poor
ROKAmer ED57	low	low	poor
ROKAmer G3400	none	none	none
ROKAmer G3500	none	none	none
ROKAmer G3800	none	none	none
ROKAmer G4300	none	none	none
ROKAmer G5000E	none	none	none
ROKAmer PP450	none	none	none
ROKAmer PP1000	none	none	none
ROKAmer PP2000	none	none	none
ROKAmer PP4000	none	none	none

EO/PO Block Copolymers – multifunctional surfactants for various industrial application

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