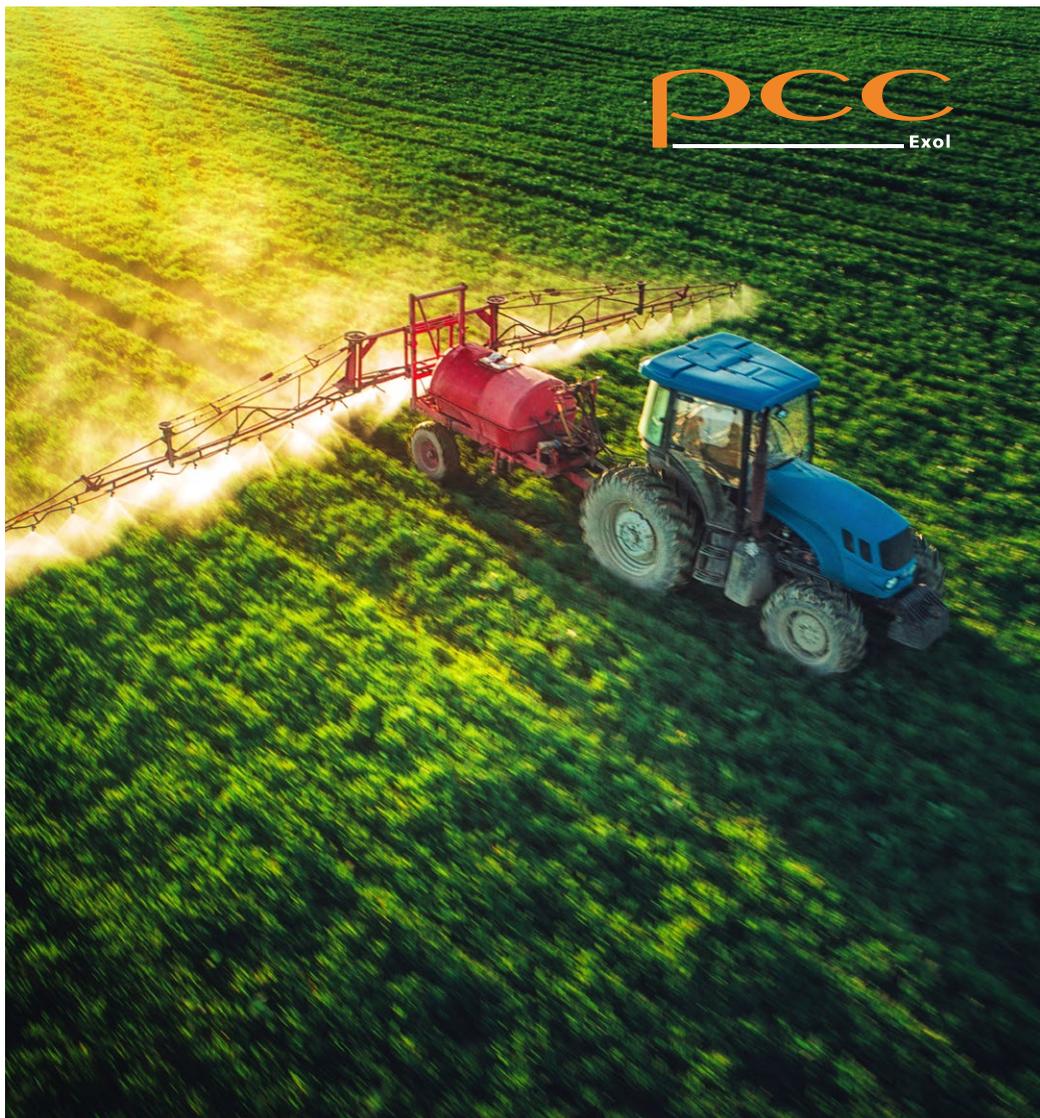


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Exol



AGROCHEMICALS FORMULATION

Formulation Guide

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AGROCHEMICALS FORMULATION

General information

The agrochemical industry focuses its efforts on developing active ingredients specifically designed to help farmers fight weeds, fungi, pests and other, destroying their crops. Such active co-formulants are not suitable for use in their raw state. Instead, they must be formulated with specialist additives, Co-formulants and adjuvants which improve active delivery and performance.

PCC EXOL products have many uses and applications across the broad spectrum of crop protection formulations and adjuvants.

Our focus is the development of additives, which enhance the performance of customers' formulations. The following table shows different product groups and their main applications by formulation type.



TEBUKONAZOL 250 g/l EC

Tebuconazole is a compound belonging to the class of triazoles, a systemic fungicide intended for preventive and emergency use on winter wheat, spring barley, winter barley, and winter oilseed rape.

Table 1. Composition of the Tebuconazole 250 g/l EC formulation

INGREDIENT	ROLE	CONTENT [%]	
Tebuconazole	Active substance	26	26
EXOemul A3	Emulsifier	9-13	0
EXOemul A3C	Emulsifier	0	9-13
N,N-dimethyldecanamide (C-10)	Solvent	up to 100	up to 100

EC formulations (emulsifiable concentrate) are concentrates that are used to prepare with water. Lipophilic active substance is dissolved in various types of oils or waxes. The formulation contains emulsifiers to prevent liquid separation. Once water is added, the homogeneous and milky-white emulsion is formed. Active substance content: 5-50%. Agents in EC formulations are generally more effective than those in SC formulations, but also much more toxic to aquatic organisms. They may cause irritation in contact with the skin. Cleaning the sprayer is much more difficult as these agents may cause corrosion.

EXOemul A3 and EXOemul A3C are mixtures of anionic and non-ionic surfactants with emulsifying properties. These are yellow and viscous liquids that are easily soluble in water. EXOemul A3 and EXOemul A3C are high performance emulsifiers which ensure stability of emulsions in EC and EW liquid pesticide formulations.

Table 2. Properties of the EXOemul A3 and EXOemul A3C emulsifiers.

PARAMETERS	EXOEMUL A3	EXOEMUL A3C
Appearance at (20 ± 25) °C	viscous, yellow liquid	yellow liquid which often becomes turbid
Hazen colour at 25°C	max. 500	max. 500
pH of 2% solution	5-8	6-9
Dry matter, % (m/m)	87-93	85-88
Solubility in water	very good	very good
Density at 20°C, g/ml	approx. 1.059	approx. 1.045
Solidification point, °C	approx. 8	approx. 1
Viscosity at 20°C, mPa·s	approx. 3000	approx. 2900
Flash point, °C	approx. 53	approx. 39

How to prepare the Tebuconazole 250 g/l EC formulation:



- 1 Weigh out the emulsifier and the solvent.
- 2 Mix using a stirrer until a homogeneous consistency is obtained.
- 3 Then add the active substance to the mixture and mix until the system is fully homogeneous.
- 4 This process is carried out at room temperature (20±2°C).

CLETHODIM 120 g/l EC

Clethodim is a selective, systemic herbicide. This herbicide is absorbed by the leaves and then distributed to the roots and runners of weeds, inhibiting their growth and development.

It is used to control the monocotyledonous weeds growing close to the following crops: sugar beet, winter oilseed rape, potatoes, strawberries, onions, and cabbage. It is a compound belonging to the class of cyclohexenediones. Susceptible weeds: barnyard grass, wild oat, common couch, self-seeding cereals.

Table 1. Composition of the CLETHODIM 120 g/l EC formulation

INGREDIENT	ROLE	CONTENT [%]
Clethodim	Active substance	11,6 - 13
EXOemul A3C	Emulsifier	9-11
Solvent naphta	Solvent	up to 100

How to prepare the CLETHODIM 120 g/l EC formulation:



1. Weigh out the required amount of the emulsifiers, the solvent and the active substance.
2. Mix until a homogeneous consistency is obtained (about 1 hour).
3. This process was carried out at room temperature (20±2°C).

EXOemul A3C is a mixture of anionic and non-ionic surfactants with emulsifying properties. The product is effective as an emulsifier and provides a stable emulsion. EXOemul A3C is effective as an emulsifier and ensures stability of emulsions in various pesticide formulations.

Table 2. Properties of the EXOemul A3C emulsifier.

PARAMETERS	EXOEMUL A3C
Appearance at (20 ÷ 25) °C	yellow liquid which often becomes turbid
Hazen colour at 25°C	max. 500
pH of 2% solution	6-9
Dry matter, % (m/m)	85-88
Solubility in water	very good
Density at 20°C, g/ml	approx. 1.045
Solidification point, °C	approx. 1
Viscosity at 20°C, mPa·s	approx. 2900
Flash point, °C	approx. 39



DELTAMETHRIN 25 g/l EC

Deltamethrin is an insecticide the group of pyrethroids. It is used to protect winter wheat, sprung barley, potatoes, winter oilseed rape and head cabbage.

Insects susceptible to deltamethrin: henbit, potato beetle, rapeseed flea beetle and cabbage leafminer, rapeseed strawberry, cabbage leafminer and rapeseed whitewash, cabbage aphid, cabbage leafminer and cabbage leafminer.

Table 1. Composition of Deltamethrin 25 g/l EC formulation

INGREDIENT	ROLE	CONTENT [%]
Deltamethrin	Active substance	2,5
ROKAcet R40	Emulsifier	2,5-3,0
EXOcal 60B	Emulsifier	2,5-3,0
Solvent naphta	Solvent	up to 100

ROKAcet R40 – a non-ionic surfactant belonging to the class of polyoxyethylene esters of fatty acids of castor oil.

EXOcal 60B – an anionic surfactant used in combination with non-ionic surfactants to form effective emulsifying systems for pesticide concentrate formulations.

How to prepare the Deltamethrin 25 g/l EC formulation:



1. Weigh the set amount of: emulsifiers, solvent and active substance and mix until a homogeneous consistency (approx. 1 hour).
2. This process was carried out at room temperature ($20 \pm 2^\circ \text{C}$).

METCONAZOLE 60 g/l EC

Metconazole is a compound belonging to the class of triazoles which is used as a fungicide on (among others): cereals, corn, rape, soybeans. It is effective against fungal diseases, including fusarium ear blight, Septoria tritici, blackleg disease of Brassica crops, noble rot.

Table 1. Composition of the Metconazole 60 g/l EC formulation

INGREDIENT	ROLE	CONTENT [%]
Techn. metconazole	Active substance	65
ROKAcet R40	Emulsifier	21 -30
EXOcal 70	Emulsifier	21 -30
Solvent naphta	Solvent	Up to 1
Cyclohexanone	Co-solvent	100

ROKAcet R40 – a non-ionic surfactant belonging to the class of polyoxyethylene esters of fatty acids of castor oil.

EXOcal 70 – an anionic surfactant used in combination with non-ionic surfactants to form effective emulsifying systems for pesticide concentrate formulations.

How to prepare the Metconazole 60 g/l EC formulation:



1. Weigh out the active substance and the solvents.
2. Mix using a stirrer until a homogeneous consistency is obtained.
3. Then add the emulsifier system to the mixture and mix until the product is fully homogeneous.
4. This process is carried out at room temperature ($20 \pm 2^\circ \text{C}$).

ABAMECTIN 1.8 g/l EC

Abamectin is a compound belonging to the class of avermectins – an insecticide and acaricide for use on fruit trees, vegetable plants and flowers. It is primarily used to control spider mites, leaf miners and Colorado potato beetle.

Table 1. Composition of the Abamectin 1.8 g/l EC formulation

INGREDIENT	ROLE	CONTENT [%]
Techn. abamectin	Active substance	1.8
Hydrocarbons, C10, aromatics	Solvent	76
Propyl lactate	Co-solvent	10
EXOemul ABO	Emulsifier system	12

EXOemul ABO is a mixture of anionic and non-ionic surfactants with emulsifying properties. It is a yellow and viscous liquid that is easily soluble in water.

Table 2. Properties of the EXOemul ABO emulsifier

PARAMETERS	EXOEMUL ABO
Appearance at (20 ± 25) °C	Clear, yellow liquid
Hazen colour at 25°C	max. 500
pH of 1% solution	5-8
Solubility in water	very good
Density at 20°C, g/ml	approx. 1.053
Solidification point, °C	approx. 5
Viscosity at 20°C, mPa·s	approx. 1200
Flash point, °C	approx. 50
Flash point, °C	approx. 39



How to prepare the Abamectin 1.8 g/l EC formulation:

1. Weigh out the active substance and the solvents.
2. Mix using a stirrer until a homogeneous consistency is obtained.
3. Then add the emulsifier to the mixture and mix until the emulsifier system is fully homogeneous.
4. This process must be carried out at room temperature (20±2°C).

GLYPHOSATE 360 g/l SL

Glyphosate – a compound belonging to the class of phosphonates, a non-selective herbicide which is effective against the broad spectrum of weeds. This active substance causes metabolic disorders by blocking the biosynthesis of aromatic amino acids by blocking the shikimic acid pathway in the growing parts of plants. It is effective against almost all kinds of plants and can be used prior to establishing a plantation, sprouting a cultivated plant or immediately before harvesting. It is also used on wastelands and orchards. It is used to control noxious weeds.

The SL formulation is a soluble concentrate. Mixed with water, it forms a true solution containing up to 50% of active substance. It is also easy and efficient to use. This formulation is often used in combination with an adjuvant to improve the properties of the working fluid.

Table 1. Composition of the Glyphosate 360 g/l SL

INGREDIENT	ROLE	CONTENT [%]
Monoisopropylamine	Alkali to neutralize glyphosate	11.27
Glyphosate	Active substance	32
Water	Solvent	44.03
ROKAmina K30B	Built in- adjuvant	10.2
Silicone antifoam	Anti-foaming agent	0.5
Propylene glycol	Antifreeze agent	2

How to prepare the Glyphosate 360 g/l SL formulation:



- Mix the reaction batch continuously using a magnetic stirrer. Dispense the required amount of demineralised water and monoisopropylamine. Mix them together.
- Then add the glyphosate gradually and carry out a neutralisation reaction at 55 °C.
- Dispense the required amount of betaine, propylene glycol and antifoam. Mix everything at 55 °C until the batch is thoroughly homogenised.
- Leave it to cool. Filter the mixture (if necessary) to remove any impurities from the technical glyphosate.

ROKAmina K30B – amphoteric surfactant that is used as wetting agent for herbicide components, recommended mainly for glyphosate-containing preparations.

Table 2. Properties of ROKAmina K30B

PARAMETERS	ROKAMINA K30B
Appearance at (20±25)°C	light yellow liquid
Hazen colour at (20±25)°C	max. 150
pH of 5% solution	6-8
Density at 25°C, g/ml	1.04
Active substance, %	29-33
Solubility in water	unlimited



ALPHA-CYPERMETHRIN 100 g/l EC

Alpha-cypermethrin is a pyrethroid insecticide which is widely used to control chewing and sucking insects such as butterfly caterpillars, beetles, and hymenopterans. It is primarily used on vegetables, cereals, beetroot, potatoes, and in horticulture.

Table 1. Composition of the Alpha-cypermethrin 100 g/l EC formulation

INGREDIENT	ROLE	CONTENT [%]
Alpha cypermethrin	Active substance	11
Solvent naphta	Solvent	73
ROKAcet R40	Emulsifier	8-10
EXOcal 70	Emulsifier	6-8

ROKAcet R40 – a non-ionic surfactant belonging to the class of polyoxyethylene esters of fatty acids of castor oil.

EXOcal 70 – an anionic surfactant used in combination with non-ionic surfactants to form effective emulsifying systems for pesticide concentrate formulations.

How to prepare the Alpha-cypermethrin 100 g/l EC formulation:



1. Weigh out the required amount of the solvent and the active substance.
2. Mix until a homogeneous consistency is obtained (about 1 hour).
3. Then weigh out the required amount of emulsifiers and mix again until a clear solution is obtained (about 0.5 h).
4. This process is carried out at room temperature (20±2°C).

METCONAZOLE 60 g/l SL

Metconazole is a compound belonging to the class of triazoles which is used as a fungicide on (among others): cereals, corn, rape, soybeans. It is effective against fungal diseases, including fusarium ear blight, Septoria tritici, blackleg disease of Brassica crops, noble rot.

Table 1. Composition of the Metconazole 60 g/l SL formulation

INGREDIENT	ROLE	PERCENTAGE [%]
Techn. metconazole	Active substance	6.3
ROKAnol NL6	Solubiliser	42
Pentanol	Solvent	22
Paraffinic hydrocarbons	Co-solvent	20
Water	Solvent	10

ROKAnol NL6 – a non-ionic surfactant used as a component of the washing and cleaning agents. The aqueous solutions of this product are resistant to acids, hard water and – partially – to alkali. The product can be mixed with the non-ionic, cationic, and anionic agents, both in anhydrous and aqueous solutions.

How to prepare the Metkonazol 60 g/l SL formulation:



1. Weigh out the active substance and the solvents.
2. Mix using a stirrer until a homogeneous consistency is obtained.
3. Then add the emulsifier to the mixture and mix until the emulsifier system is fully homogeneous.
4. This process is carried out at room temperature (20±2°C).



NICOSULFURON 40 g/l OD

Nicosulfuron is a systemic herbicide. It is mainly absorbed by the leaves and spreads quickly through the plant, inhibiting its growth and development. It is used to control the monocotyledonous and dicotyledonous weeds growing close to corn crops. It is a compound belonging to the class of sulfonylurea herbicides.

Susceptible weeds include cockspur grass, European field pansy, sinapis arvensis, chickweed, red deadnettle, white goosefoot, common couch, cleavers, black nightshade, amaranthus retroflexus, field pennycress, gallant soldier.

Intermediate susceptible weeds: creeping thistle, black bindweed, redshank.

OD formulations are oil suspensions. The active substance insoluble in oil is suspended in it. The formulation forms an emulsion with water. Adjuvants are often added. The active substance content is small – up to 20%.

Table 1. Composition of the NICOSULFURON 40 g/l OD formulation

INGREDIENT	ROLE	PERCENTAGE [%]
Nicosulfuron	Active substance	4.0
ROKAmer 2100	Dispersing agent	10.0
Hydrophobic fumed silica	Thickening agent	5.3
ROKAnol LP2024	Low foaming wetting agent	5.0
EXOcal 60EH	Emulsifier	5.0
ROKAcet R40	Emulsifier	12.0
Methyl esters of rapeseed	Continuous phase	up to 100

Surfactants used specifically in OD formulations:

ROKAcet R40 – a surfactant recommended as a dispersant in SC formulations and as an emulsifier in OD formulations.

ROKAmer 2100 – a copolymer of ethylene oxide and propylene oxide, recommended as a dispersing agent in OD formulations.

ROKAnol LP2024 – a surfactant which facilitates the penetration of the active substance into the aerial parts of the plant.

EXOcal 60EH – an anionic surfactant used in combination with non-ionic surfactants to form effective emulsifying systems for pesticide concentrate formulations.

How to prepare the Nicosulfuron 40 g/l OD formulation:



1. Mix the dispersant with the methyl esters of rapeseed.
2. Add an active substance to the mixture and disperse it using a high shear dissolver.
3. Wet grind the pre-mix in a mixer grinder until it is finely dispersed.
4. Then add the remaining ingredients (wetting agent, freezing point depressant, preservative, and thickeners) and mix them using a dissolver.



NICOSULFURON 40 g/l SC

Nicosulfuron is a systemic herbicide. It is mainly absorbed by the leaves and spreads quickly through the plant, inhibiting its growth and development. It is used to control the monocotyledonous and dicotyledonous weeds growing close to corn crops. It is a compound belonging to the class of sulfonylurea herbicides.

Susceptible weeds include cockspur grass, European field pansy, sinapis arvensis, chickweed, red deadnettle, white goosefoot, common couch, cleavers, black nightshade, amaranthus retroflexus, field pennycress, gallant soldier.

Intermediate susceptible weeds: creeping thistle, black bindweed, redshank.

The SC formulation is a liquid suspension concentrate which is diluted with water. Very complex type of formulation type containing very fine solid particles of active substance dispersed in water using various dispersants and wetting agents. Suspension concentrates often contain ingredients such as viscosity modifiers, adjuvants, defoamers and anti-freezing agents.

Table 1. Composition of the NICOSULFURON 40 g/l SC formulation

INGREDIENT	ROLE	PERCENTAGE [%]
Nicosulfuron	Active substance	4.11
ROKAcet R40	Emulsifier	6.00
EXOfos PB-139 neutra. NaOH	Dispersing agent	1.00
Xanthan gum	Thickening agent	0.35
ROKAmer G3500	Low foaming wetting agent	1.50
Propylene glycol	Antifreeze agent	5.00
EXOantifoam S100	Anti-foaming agent	0.50
Methylisothiazolinone	Preservative	0.50
Water	Continuous phase	81.04



MESOTRIONE 100 g/l SC

Mesotrione is a herbicide belonging to the class of triketones that is primarily used on corn crops against the following weeds: cockspur grass, European field pansy, chickweed, red deadnettle, white goosefoot, cleavers, black bindweed, anthemis arvensis, amaranthus retroflexus, shepherd's purse, field pennycress, gallant soldier, common fumitory. It is a foliar and soil acting herbicide which blocks the carotenoid biosynthesis process, leading to the degradation of chlorophyll and the bleaching of leaves.

Table 1. Composition of the Mesotrione 100 g/l SC formulation

INGREDIENT	ROLE	CONTENT [G/L]
Technical mesotrione	Active substance	100
ROKAcet R26	Dispersant	90-120
ROKAnol ID8	Wetting agent	20-40
n-octanol	Built-in adjuvant	40-50
Propylene glycol	Antifreeze agent	90
Xanthan gum	Thickening agent	4-5
Methylisothiazolinone	Bacteriostat	>1
Silicone emulsion	Anti-foaming agent	2
Water	Continuous phase	Up to 1

Surfactants specifically used in SC formulations:

ROKAcet R40 – a surfactant recommended as a dispersant in SC formulations and as an emulsifier in OD formulations.

EXOfos PB-139 neutra. NaOH – a surfactant recommended as a dispersant in the SC and OD formulations.

ROKAmer G3500 – a non-ionic anti-foaming surfactant which is recommended as a wetting agent (recommended concentration: above 10 g/l).

EXOantifoam S100 – a silicone anti-foaming emulsion. The product is designed for use in water systems – especially those containing surfactants – to prevent the formation of foam and effectively reduce its amount.

ROKAcet R26 – an ethoxylated castor oil which can also be used as an emulsifier, dispersant, solubiliser and a softening agent. The aqueous solutions of this product are resistant to acids, hard water and – partially – to alkali. The product can be mixed with the non-ionic, cationic, and anionic agents, both in anhydrous and aqueous solutions.

ROKAnol ID8 – the non-ionic surfactant belonging to the class of C9-C11 ethoxylated fatty alcohols, which is used as a wetting agent and emulsifier.

How to prepare the Nicosulfuron 40 g/l SC formulation:



1. Mix the dispersant with water.
2. Add an active substance to the mixture and disperse it using a high shear dissolver.
3. Wet grind the pre-mix in a mixer grinder until it is finely dispersed.
4. Then add the remaining ingredients (wetting agent, freezing point depressant, preservative, and thickeners) and mix them using a dissolver.

How to prepare the Mezotrion 100 g/l SC formulation:



1. Weigh out the formulation ingredients (except for the solution formed by a thickening agent) and homogenise them prior to grinding.
2. Mix until properly ground.
3. Prepare a solution from a thickening agent by introducing xanthan gum into the propylene glycol and then introduce some of the excess water.
4. After obtaining the thickener and grinding the product, combine the two ingredients until a homogeneous suspension is obtained.
5. This process must be carried out at room temperature (20±2°C).



TEBUCONAZOLE 250 g/l EW

Tebuconazole is a compound belonging to the class of triazoles, a systemic fungicide intended for preventive and emergency use on winter wheat, spring barley, winter barley, and winter oilseed rape.

Table 1. Composition of the Tebuconazole 250 g/l EW formulation

INGREDIENT	ROLE	CONTENT [%]	
Tebuconazole	Active substance	26	26
EXOemul A3	Emulsifier	9-13	0
EXOemul A3C	Emulsifier	0	9-13
Propylene glycol	Antifreeze agent	0-1	0-1
Water	Aqueous phase	up to 1	up to 1
N,N-dimethyldecanamide	Solvent	up to 100	up to 100

EW formulations are water-based emulsions. Liquid, heterogeneous formulations formed from the active substances dissolved in an organic solvent and emulsified in water.

EXOemul A3 and **EXOemul A3C** are mixtures of anionic and non-ionic surfactants with emulsifying properties. These are yellow and viscous liquids that are easily soluble in water. EXOemul A3 and EXOemul A3C are highly effective as emulsifiers and ensure the stability of emulsions in the EC and EW liquid pesticide formulations.

Table 2. Properties of the EXOemul A3 and EXOemul A3C emulsifiers.

PARAMETERS	EXOEMUL A3	EXOEMUL A3C
Appearance at (20 ± 25) °C	viscous, yellow liquid	yellow liquid which often becomes turbid
Hazen colour at 25°C	max. 500	max. 500
pH of 2% solution	5-8	6-9
Dry matter, % (m/m)	87-93	85-88
Solubility in water	very good	very good
Density at 20°C, g/ml	approx. 1.059	approx. 1.045
Solidification point, °C	approx. 8	approx. 1
Viscosity at 20°C, mPa·s	approx. 3000	approx. 2900
Flash point, °C	approx. 53	approx. 39

How to prepare the Tebuconazole 250 g/l EW formulation:



- 1 Weigh out the emulsifier and the solvent.
- 2 Mix using a stirrer until a homogeneous consistency is obtained.
- 3 Then add the active substance, the

propylene glycol and the water to the mixture and homogenise until a homogeneous consistency is obtained.
4. This process is carried out at room temperature (20±2°C).

Designed with
the thought
about you

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



PCC GROUP in numbers



80

COMPANIES



39

SITES



17

COUNTRIES



3200

EMPLOYEES

PCC EXOL SA

Sustainable technologies for new generations

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

The offered surfactants have a very broad range of application. Aside from the mass production for personal care products industry, cosmetics and detergents, the substances produced by PCC EXOL SA also include specialised products used in various industries.



Textiles and clothing Agrochemicals Tanning Paper processing Construction Oil extraction Metal processing Mining Paints, lacquers and glues

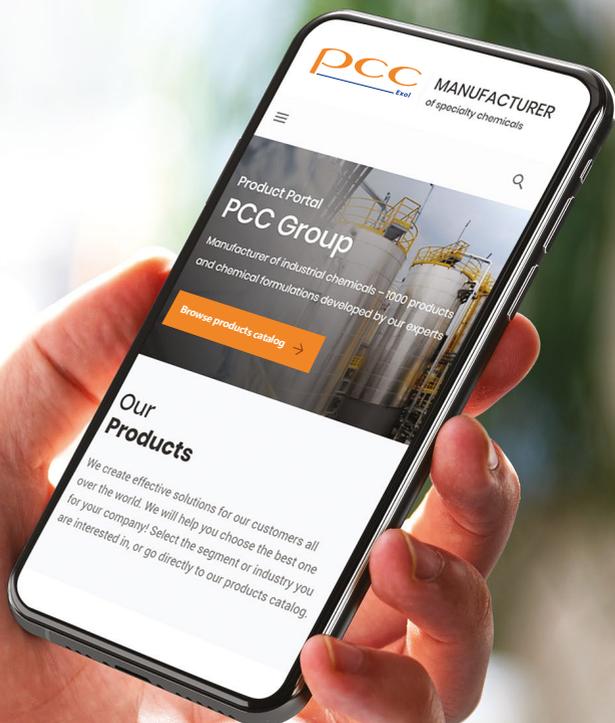
...and many others.

Their comprehensive portfolio is continuously extended by new, innovative products, so the company can meet even the strictest market requirements and adapt to individual needs of customers. This is possible due to the dynamic development of the research facilities, flexible production as well as the knowledge and experienced personnel. PCC EXOL SA have the key competence necessary for a worldwide production of surfactants. The ongoing projects will soon bring new opportunities for the company 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 suit individual customer demands.

The strategic investor in PCC EXOL SA is PCC SE, operating on international markets of chemical raw materials, transport, energy, coal, coke, petrol, plastics and metallurgy.

For more information, please contact: products@pcc.eu.

www.products.pcc.eu



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