Raw materials for dispersions and resins

Introduction

Emulsion polymerization is a process used to manufacture polymer dispersions also called latexes for a wide variety of formulations including water-based paints, coatings for wood, nonwoven, adhesives, sealants, rubbers. All of these applications are often called CASE (Coatings, Adhesives, Sealants, Elastomers).

A big advantage of water-based products over solvent-borne is the reduction of environmental impact due to the much lower level of VOC (volatile organic compounds) contained in formulations. Another significant advantage is easy to use and often not classified as hazardous labeling.

There are many process variations in emulsion polymerization. In the batch process, the reaction is initiated when all portions of reagents are present in the reactor. In the semi-continuous process - some reagents are added to the reactor at the beginning of the process and the remaining ingredients are dosed in controlled portions. Another process is the emulsion polymerization with pre-emulsion where monomers, water and surfactants are mixed together to form an emulsion which is dosed during the synthesis. Seeded emulsion polymerization is a process where a dispersed small amount of suspended fine particles of latex (seeds) is added to the reactor followed by feeding monomers, surfactants and initiators; the polymerization process starts in swelled latex particles. The seeds in latex suspension may be also prepared in situ as a first step of the emulsion polymerization.

 For more information please contact: products@pcc.eu

The role of surfactants in emulsion polymerization

Anionic and nonionic surfactants are commonly used in emulsion polymerization as emulsifiers and latex stabilizers. Typical concentration of surfactants is in the range from a few tenth to 5%. Anionic surfactants may be used as a single emulsifier or often in combination with nonionic surfactants. Nonionic formulations are rarely used alone, mainly due to the tendency of forming solutions with greater particle sizes. Even if a nonionic surfactant consists of a primary emulsifier, a small amount of anionic surfactant is often used to ensure lower particle size. A proper combination of nonionic and anionic emulsifiers is very important to provide good performance of the polymer dispersion. Anionic surfactants control particle size, ensuring a good polymerization rate and electrostatic stability, whereas nonionic surfactants improve mechanical and electrolytic stability, ensuring also the resistance to freeze-thaw cycles.

Surfactants plays many roles in the emulsion polymerization process and are essential for manufacturing latex. Surfactants reduce the interfacial tension between insoluble monomers and water, and form small monomer droplets in an aqueous matrix. Surfactants have a tendency to form micelles which play an essential role during the nucleation step of emulsion polymerization, as they create space where the polymerization occurs. As the reaction progresses the dimensions the micelles increase rapidly and when the limit values are achieved, they break and form polymer particles. Each polymer particle is covered with surfactants to prevent their agglomeration. Using a mixture of anionic and nonionic surfactants is very common in emulsion polymerization as it helps to stabilize the formulation for specific applications and ensures polymer dispersion stability during transport and storage. There are various types of latex stabilization using anionic and nonionic surfactants.

Various types of latex stabilization using anionic and nonionic surfactants.

Anionic surfactants are absorbed into polymer particles and surround them with electric charges. The electrostatic layer forms an energy barrier for other particles preventing their agglomeration. Anionic surfactants have the ability to stabilize small particles of a dispersion by electrostatic repulsion thus they are often used during the nucleation process. The main disadvantage of anionic surfactants is their high sensitivity to the presence of electrolytes.

Nonionic surfactants ensure latex stabilization by adsorption on polymer particles, covering them by long polyethylene glycol chains, forming a steric barrier between other polymer particles. The steric forces are not as strong as electrostatic ones, resulting in increased dimensions of particles. However, steric stabilization is far less sensitive to electrolytes and freezing.

PCC EXOL performance surfactants

Anionic emulsifiers

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PRODUCT CHARACTERISTICS					PRODUCT GROUP						
PRODUCT NAME	DESCRIPTION	CAS	APPEARANCE	ACTIVE SUBSTANCE CONTENT	Vinyl acetate & copolymers	Styrene Acrylics	Acrylics	Styrene butadiene rubber	Polyvinyl chloride	APE - free	Post-polymerization stability
ABSNa 25	Sodium Dodecylbenzenesulfonate	68411-30-3	liquid	24-26	●	●	●	●	○	●	
ABSNa 30	Sodium Dodecylbenzenesulfonate	68411-30-3	liquid	28-32	●	●	●	●	○	●	
ABSNA 50	Sodium Dodecylbenzenesulfonate	68411-30-3	paste	48-52	●	●	●	●	○	●	
ABSNA 60	Sodium Dodecylbenzenesulfonate	68411-30-3	paste	59-61	●	●	●	●	○	●	
ROSULfan A	Ammonium Lauryl Sulfate	90583-11-2	liquid	26-28	●	●	●	○	●	●	
ROSULfan A33	Ammonium Lauryl Sulfate	90583-11-2	viscous liquid	32-34	●	●	●	○	●	●	
ROSULfan L	Sodium Lauryl Sulfate	85586-07-8	liquid	27.5-30	●	●	●	○	●	●	
ROSULfan L15 CM	Sodium Lauryl Sulfate	85586-07-8	liquid	14.5-15.5	●	●	●	○	●	●	
ROSULfan LP	Sodium Lauryl Sulfate	85586-07-8	powder	min. 91	●	●	●	○	●	●	
SULFOROKAnol® IT2030	Sodium Trideceth Sulfate (20EO)	150413-26-6	liquid	28-30	●	●	●		○	●	●
SULFOROKAnol® L227/1	Sodium Laureth Sulfate (2EO)	68891-38-3	liquid	26.5-28	●	●	●		●	●	
SULFOROKAnol® A325/1	Ammonium Laureth Sulfate (3EO)	32612-48-9	viscous liquid	24-26	●	●	●		●	●	
SULFOROKAnol® L327/1	Sodium Laureth Sulfate (3EO)	68891-38-3	liquid	27-29	●	●	●		●	●	
SULFOROKAnol® L430/1	Sodium Laureth Sulfate (4EO)	68891-38-3	liquid	30-32	●	●	●		●	●	

PRODUCT CHARACTERISTICS					PRODUCT GROUP						
PRODUCT NAME	DESCRIPTION	CAS	APPEARANCE	ACTIVE SUBSTANCE CONTENT	Vinyl acetate & copolymers	Styrene Acrylics	Acrylics	Styrene butadiene rubber	Polyvinyl chloride	APE - free	Post-polymerization stability
SULFOROKAnol® L725/1	Sodium Laureth Sulfate (7EO)	68891-38-3	liquid	24-26	●	●	●		o	●	
SULFOROKAnol® L1230/1	Sodium Laureth Sulfate (12EO)	68891-38-3	liquid	29-31	●	●	●		o	●	o
SULFOROKAnol® L3030/1	Sodium Laureth Sulfate (30EO)	68891-38-3	liquid	32-34	●	●	●			●	o
SULFOROKAnol® UD727	Alcohols C11 Ethoxylated (7EO) Sulfate, sodium salt	219756-63-5	liquid	26-28	●	●	●			●	
SULFOROKAnol® TSP95	Alkylarylphenol Ethoxylated Sulfate, Ammonium Salt	119432-41-6	viscous liquid	min. 91	●	●	●	o		●	o
SULFOROKAfenol® N2030	Sodium Nonylphenol Ethoxylated Sulfate	9014-90-8	liquid	31-33	●	●	●	o			o
Sulfosuccinate D5	Mono-alkyl Sulfosuccinate, disodium salt	68630-97-7	liquid	29-32	●	●	●		o	●	
Sulfosuccinate L3/40	Disodium Laureth Sulfosuccinate	68815-56-5	liquid	min. 38	●	●	●	o		●	
Sulfosuccinate DOSS 70GP	Di (2ethylhexyl)sulfosuccinic acid, sodium salt	577-11-7	liquid	min. 70	●	●	●	o	●	●	
ROKAdis 600	Tridecyl Ether Phosphate	73038-25-2	liquid	min. 99	●	●	●			●	
ROKAdis 600A/25	Tridecyl Ether Phosphate, ammonium salt	69029-43-2	liquid	24-26	●	●	●			●	
ROKAdis 900	Tridecyl Ether Phosphate	73038-25-2	liquid	min. 99	●	●	●			●	
ROKAdis 900A/25	Tridecyl Ether Phosphate, ammonium salt	69029-43-2	liquid	24-26	●	●	●			●	
ROKAdis 900K/25	Tridecyl Ether Phosphate, potasium salt	68186-36-7	liquid	24-26	●	●	●			●	
EXOfos PT-E	Tristyrylphenol Ethoxylated Phosphate	90093-37-1	viscous liquid	min. 91	●	●	●	o		●	o
EXOfos PT-25K	Tristyrylphenol Ethoxylated Phosphate, potassium salt	163436-84-8	liquid	99	●	●	●	o		●	o
EXOsoft PC35	Potassium Cocoate	61789-30-8	liquid	34-35		o	o	o		●	
EXOemul BIT24	Potassium Oleate	143-18-0	liquid	25-28		o	o	o		●	
Rodys K	Naphthalenesulfonic acid, polymer with formaldehyde, sodium salt	9084-06-4	liquid	25-32				●		●	
Rodys R	Naphthalenesulfonic acid, polymer with formaldehyde, sodium salt	9084-06-4	liquid	37-39				●		●	
Rodys P	Naphthalenesulfonic acid, polymer with formaldehyde, potassium salt	9069-79-8	liquid	44-46				●		●	

● highly recommended o recommended

Nonionic emulsifiers

PCC Exol manufactures a broad range of nonionic products for emulsion polymerization. The product portfolio includes both commodity and special emulsifiers as well as latex additives. Our product range covers ethoxylates and alkoxylates of nonylphenol, fatty alcohols, acids and vegetable oils, fatty amines and amides, block copolymers of ethylene oxide and propylene oxide.
We manufacture our products based on alcohols derived from both - petrochemical and natural sources with an extensive range of carbon chains distribution ranging from C9-C18. With an appropriate method of conducting the reaction with ethylene oxide, it is possible to obtain a range of products with various ethoxylation degrees. Products based on other oleochemical feedstocks are available upon request.

PRODUCT CHARACTERISTICS						PRODUCT GROUP							
PRODUCT NAME	DESCRIPTION	CAS	APPEARANCE	HLB	ACTIVE SUBSTANCE CONTENT	Vinyl acetate & copolymers	Styrene Acrylics	Acrylics	Styrene butadiene rubber	Polyvinyl chloride	APE - free	Low foam	Post-polymerization stability
ROKAnol® EH18/80	2-ethylhexanol (18 EO)	26468-86-0	liquid	17.2	78 - 82	•	•	•			•		o
ROKAnol® IT10	Alcohols, C13, branched (10EO)	69011-36-5	liquid	13.8	min. 99.5	•	•	•	o	o	•		
ROKAnol® IT15/40	Alcohols, C13, branched (15EO)	69011-36-5	liquid	14.7	39-41	•	•	•	o	o	•		o
ROKAnol® IT20	Alcohols, C13, branched (20EO)	69011-36-5	wax	16.3	min. 99	•	•	•	o	o	•		o
ROKAnol® IT20/80	Alcohols, C13, branched (20EO)	69011-36-5	liquid	16.3	78-82	•	•	•	o	o	•		o
ROKAnol® IT28/70	Alcohols, C13, branched (28EO)	69011-36-5	liquid	17.2	68-72	•	•	•	o	o	•		o
ROKAnol® IT40/70	Alcohols, C13, branched (40EO)	69011-36-5	liquid	18.0	68-72	•	•	•	o	o	•		o
ROKAnol® IT100/35	Alcohols, C13, branched (100EO)	69011-36-5	liquid	19.1	34.0-36.0	•	•	•	o	o	•		o
ROKAnol® K18	Alcohols, C16-18 unsaturated (18EO)	9005-04-3	paste/wax	15.8	min. 99.0	•	•	•	o	o	•		o
ROKAnol® L10/80	Alcohols, C12-14 (10EO)	68439-50-9	liquid	13.8	77-81	•	•	•	o	o	•		o
ROKAnol® L12S/80	Alcohols, C12-14 (2EO)	68439-50-9	liquid	14.8	78-82	•	•	•	o	o	•		o
ROKAnol® L30/65	Alcohols, C12-14 (30EO)	68439-50-9	viscous liquid	18.0	64-66	•	•	•	o	o	•		o
ROKAnol® O18	Alcohols, C16-18 unsaturated (18EO)	9004-98-2	paste	15.6	min. 99.0	•	•	•	o	o	•		o
ROKAnol® O20	Alcohols, C16-18 unsaturated (20EO)	9004-98-2	paste	16.3	min. 99.0	•	•	•	o	o	•		o
ROKAnol® O20/20	Alcohols, C16-18 unsaturated (20EO)	9004-98-2	liquid	16.3	19-21	•	•	•	o	o	•		o

PRODUCT CHARACTERISTICS						PRODUCT GROUP							
PRODUCT NAME	DESCRIPTION	CAS	APPEARANCE	HLB	ACTIVE SUBSTANCE CONTENT	Vinyl acetate & copolymers	Styrene Acrylics	Acrylics	Styrene butadiene rubber	Polyvinyl chloride	APE - free	Low foam	Post-polymerization stability
ROKAnol® O23/70	Alcohols, C16-18 unsaturated (23EO)	9004-98-2	liquid	16.7	68-71	●	●	●			●		o
ROKAnol® SAE7	Alcohols, C12-14 secondary (7EO)	9004-98-2	liquid	12.9	min. 99.0	o	o	o	o	o	●		
ROKAnol SAE40W/70	Alcohols, C11-C15 secondary (40 EO)	68131-40-8	liquid	18.0	68.5-71.5	●	●	●	o	o	●		o
ROKAnol® T18	Alcohols, C16-18 (18EO)	68439-49-6	wax	15.8	min. 99.0	●	●	●	o	o	●		o
ROKAnol® T25 flakes	Alcohols, C16-18 (25EO)	68439-49-6	flakes	16.0	min. 99	●	●	●			●		o
ROKAnol® T25/25	Alcohols, C16-18 (25EO)	68439-49-6	liquid	16.0	24-26	●	●	●	o	o	●		o
ROKAnol® UDL28/70	Alcohols, C11, branched and linear (28EO)	127036-24-2	liquid	17.2	69-71	●	●	●	o	o	●		o
ROKAnol® UDL40/70	Alcohols, C11, branched and linear (40EO)	127036-24-2	liquid	18.2	69-71	●	●	●	o	o	●		o
EXOemul® EP287	Alcohols, C9-16 (28EO)	97043-91-9	liquid	–	68-72	●	●	●	o	o	●		o
ROKAnol® TSP16	Tristyrylphenol (16EO)	99734-09-5	viscous liquid	13.0	min. 99	●	●	●	o		●		o
ROKAnol® TSP20	Tristyrylphenol (20EO)	99734-09-5	liquid/paste	14.0	min. 99.5	●	●	●	o		●		o
ROKAnol® TSP25/80	Tristyrylphenol (25EO)	99734-09-5	liquid	14.9	79-81	●	●	●	o		●		o
ROKAnol® TSP40/20	Tristyrylphenol (40EO)	99734-09-5	liquid	16.4	19-21	●	●	●	o		●		o
ROKAcet R26	Castor Oil (26EO)	61791-12-6	liquid	11.0	min. 99.0	●	●	●	o	o	●		
ROKAcet R40	Castor Oil (40EO)	61791-12-6	paste	13.0	min. 99.0	●	●	●	o	o	●		
ROKAfenol N8LA	Nonylphenol (EO/PO)	37251-69-7	liquid	12.0	min. 99.0	●	●	●	o	o			
ROKAfenol N40*	Nonylphenol +40 EO	127087-87-0	wax	17.8	min. 99	●	●	●	o				
ROKAfenol D22	Dodecylphenol (22EO)	9014-92-0	wax	16.4	min. 99	●	●	●	o				o
ROKAmer 1010	PEG/PPG Copolymer	9003-11-6	wax	16.6	min. 99.0	o	o	o			●	●	
ROKAmer 1010/50	PEG/PPG Copolymer	9003-11-6	viscous liquid	16.6	>50	o	o	o			●	●	

● highly recommended   o recommended

* Available only outside of EU

Defoamers

ROKAmers and EXOantifoam series

Surfactants, especially anionic ones, have a strong tendency to create and stabilize foam during and after the emulsion polymerization process. Defoamers are commonly used in the process to avoid foam formation. Depending on the nature of the emulsifiers, viscosity, and final application of the polymeric dispersion, PCC Exol offers defoaming agents based on PEG/PPG copolymers and silicone emulsions.

PRODUCT CHARACTERISTICS						PRODUCT GROUP					
PRODUCT NAME	DESCRIPTION	CAS	APPEARANCE	HLB	ACTIVE SUBSTANCE CONTENT	Vinyl acetate & copolymers	Styrene Acrylics	Acrylics	Styrene butadiene rubber	Polyvinyl chloride	APE - free
ROKAmer 2330	PEG/PPG Copolymer	9003-11-6	clear or turbid liquid	4.9	min 99.0	o	o	o	o	o	•
ROKAmer 2600	PEG/PPG Copolymer	9003-11-6	clear or turbid liquid	5.6	min 99.0	o	o	o	o	o	•
ROKAmer 2950	PEG/PPG Copolymer	9003-11-6	clear or turbid liquid	8.1	min 99.0	o	o	o	o	o	•
EXOantifoam S100	Silicone emulsion	–	white emulsion	–	–	o	o	o	o	o	•

Antioxidants / thermal stabilisers

Rostabil series - short-life thermal stabilizers efficaciously provide protection against yellowing phenomenon. Considered as effective secondary stabilizers exhibit synergistic effect in conjunction with primary antioxidants. Rostabil stabilizers might be used either during synthesis or processing of various resins.

<table>
<tr><th>PRODUCT NAME</th><th>CHEMICAL NAME</th><th>CAS</th><th>PARAMETERS</th><th>APPLICATIONS</th><th>FEATURES</th></tr>
<tr><td>Rostabil TNF</td><td>Tris(nonylphenyl) phosphite</td><td>26523-78-4</td><td>Appearance: slightly colored
Colour [Hazen units]: max. 150
Acid value [mg KOH/g]: max. 0.3
Density at 25°C [g/cm³]: 0.975
Refractive index at 25°C: 1.530
Free nonylphenol [% (w/w)]: max. 4</td><td>Rostabil series comprises-secondary antioxidants based on organophosphites. Mainly, they are employed as effective thermal and processing stabilisers.</td><td rowspan="3">• Stabilisation during processing and curing cycles
• Excellent protection against degradation
• No yellowing effect
• Impart color stability during processing, fabrication and end use</td></tr>
<tr><td>Rostabil TPP</td><td>Triphenyl phosphite</td><td>101-02-0</td><td>Appearance: clear liquid
Colour [Hazen units]: max. 50
Acid value [mg KOH/g]: max. 0.5
Density at 25°C [g/cm³]: 1.183
Refractive index at 25°C: 1.588
Free phenol [% (w/w)]: max. 1</td><td>Thanks to good inhibitation of polymer degradation they ensure color control during processing and curing cycles.</td></tr>
<tr><td>Rostabil TDP</td><td>Triisodecyl phosphite</td><td>25448-25-3</td><td>Appearance: clear liquid
Colour [Hazen units]: max. 50
Acid value [mg KOH/g]: max. 0.1
Density at 25°C [g/cm³]: 0.887
Refractive index at 25°C: 1.4547
Total phenol [% (w/w)]: max. 1</td><td>Synergistic effect can be achieved with hindered phenol stabilisers (primary antioxidants). They are recommended to powder coatings.</td></tr>
</table>

Polyols for the production of PU Resins

The PCC Group offers polyols used in the production of polyurethanes, used as coating materials in formulations of paints and printing inks. The offer includes polypropylene glycols (PPG) with a molecular weight ranging from 450 to 18.000 g/mol.

PRODUCT NAME	DESCRIPTION	CAS	ACTIVE	MOLECULAR WEIGHT (g/mol)	APPEARANCE
POLIKOL 600	Polyoxoethylene glycol	25322-68-3	min. 99.5	600	liquid
POLIKOL 1500	Polyoxoethylene glycol	25322-68-3	min. 99.0	1500	wax
Rokopol® D450	Polyoxopropylene glycol	25322-69-4	min. 99.0	450	liquid
Rokopol® D1002	Polyoxopropylene glycol	25322-69-4	min. 99.94	1000	liquid
Rokopol® D2002	Polyoxopropylene glycol	25322-69-4	min. 99.94	2000	liquid
Rokopol® LDB Delta 4000	Polyoxopropylene glycol	25322-69-4	min. 99.95	4000	liquid
Rokopol® LDB Delta 8000 V2	Polyoxopropylene glycol	25322-69-4	min. 99.95	8000	liquid
Rokopol® LDB Delta VC 12000	Polyoxopropylene glycol	25322-69-4	min. 99.95	12000	liquid
Rokopol® LDB Delta VC 18000	Polyoxopropylene glycol	25322-69-4	min. 99.95	18000	liquid

Flame retardands

Roflam 6 acts as an internal flame retardant. The product contains reactive hydroxyl group, allowing for easy incorporation with various polurea and polyurethane resins, including PU dispersions recommended for waterborne transparent varnishes. Among other liquid flame retardants Roflam 6 stands out for its higher phosphorus content, directly enhancing its performance.

PRODUCT NAME	DESCRIPTION	CAS	ACTIVE SUBSTANCE CONTENT	VISCOSITY AT 25°C [mPa·s]:	DENSITY AT 20°C [g/cm^3]	PHOSPHORUS CONTENT	HYDROXYL NUMBER, mg KOH/g
Roflam 6	N,N-bis(2-hydroxyethyl) aminomethane phosphonic acid diethyl ester	2781-11-5	min. 99.5	100 – 300	1.16 – 1.17	12.2%	400 – 460

Starting formulation for intumescent PU dispersion

Component	grams	% pphm
Polyetherpolyol (OH No. = 110)	150	21.1
Polyesterpolyol (OH No. = 110)	50	7.0
DMPA	35	4.9
Roflam 6	150	21.1
IPDI	325	45.8
Acetone (optional)	165	
Triethylamine	22.4	
Water	1225	
Ethylene diamine	16	

Procedure

1. Mix Roflam 6, polyetherpolyol and polyesterpolyol at 70ºC
2. Add DMPA and mix until homogenous appearance
3. Add IPDI at 80ºC and check NCO content after 2 hour (add acetone if viscosity rises too high). The target content of NCO should be around 4.5%.
4. Cool down to 60ºC and add triethylamine for neutralization
5. Cool down to 50ºC and add reaction mixture slowly under vigorous stirring to water. Keep the temperature 23ºC during the process.
6. Add ethylene diamine quickly after dispersion step under vigorous stirring to avoid hot spots
7. If acetone used: remove the solvent during the distillation.

PCC Exol products in applications

Acrylic dispersion - evaluation of selected anionic surfactants

The influence of selected anionic surfactants on particle size, chemical stability and water resistance was investigated in the series of acrylic dispersions. The samples of dispersion were prepared according to following recepie:

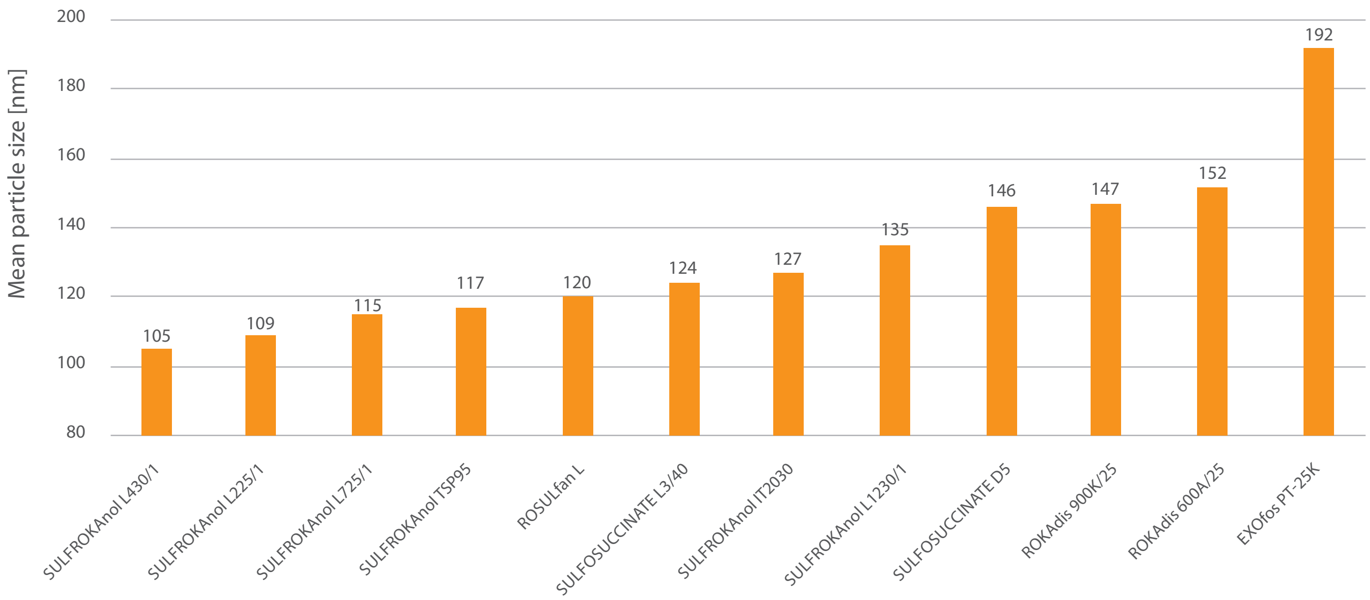
Component	grams	% pphm
REACTOR CHARGE		
Water	242.30	
SULFOROKAnol L430/1	3.17	0.20
$FeSO_4*7H_2O$	0.03	
PREEMULSION		
Water	152.00	
SULFOROKAnol L430/1	**28.50**	
Sodium acetate	4.00	**1.80**
Methyl methacrylate	247.00	52.00
2-Ethylhexyl acrylate	218.50	46.00
Acrylic acid	9.50	2.00
Water to clean	13.34	
INITIATOR SOLUTION I		
Ammonium persulfate	2.38	0.50
Water	33.25	
INITIATOR SOLUTION II		
Sodium bisulfite	1.58	0.33
Water	33.25	
pH ADJUSTMENT		
Ammonia solution Solution (15%)	10.20	
BIOCIDE		
CIT/MIT 3:1	1.00	
TOTAL WEIGHT	1000	

Procedure

1. Add the REACTOR CHARGE to the reaction flask and heat up to 72°C.
2. Prepare PREEMULSION and solution of INITIATOR I and INITIATOR II.
3. Start metering the PREEMULSION and the INITIATOR I and II over 3 hours, keeping the temperature in range of 72 – 74 °C.
4. After the addition hold the temperature at 72–74°C for 60 min.
5. Cool below 50°C, adjust pH with ammonia solution and add the biocide.
6. After cooling down to ambient temperature discharge and filter obtained dispersion, and collect coagulum from the filter.

Influence on particle size

Mean particle size was determined by DLS method. The results are shown in the following graph:



Influence on chemical stability.

2-3 droplets of analyzed dispersion were added to $CaCl_2$ solution. Stability of the dispersion was rated as “excellent” when no observed coagulum was formed.

	ROSULfan L	SULFOROKAnol L225/1	SULFOROKAnol L430/1	SULFOROKANOL L725/1	SULFOROKAnol L1230/1	SULFOROKANOL IT2030	SULFOROKAnol TSP95
2.5% $CaCl_2$	o	o	●	●	●	●	●
5% $CaCl_2$	o	o	●	●	●	●	●
10% $CaCl_2$	o	o	o	o	●	●	●
15% $CaCl_2$	o	o	o	o	●	●	●
20% $CaCl_2$	o	o	o	o	●	●	●

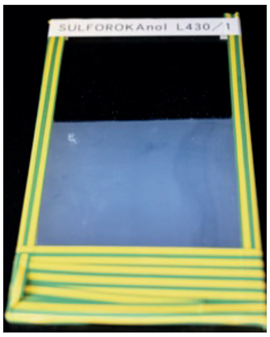
● excellent   o poor

The ethoxylation degree of an emulsifier has influence on chemical stability of the dispersion. Exhibit highly ethoxylated surfactants like SULFOROKAnol L1230/1, SULFOROKAnol IT2030 or a SULFOROKAnol TSP95.

Influence on water resistance

Samples of dispersions were mixed with 4% by weight of coalescent and applied on glass plates. The plates were conditioned for one week at ambient temperature and subsequently immersed in distilled water for 48 hours. After that time milkiness of the film was examined

ROSULfan L	SULFOROKAnol L225/1	SULFOROKANOL L430/1	SULFOROKAnol L725/1	SULFOROKANOL L1230/1



Anionic emulsifiers have strong influence on water resistance. The best results are achieved for SULFOROKAnol L430/1, L725/1 and L1230/1.

Acrylic dispersion - evaluation of selected nonionic surfactants

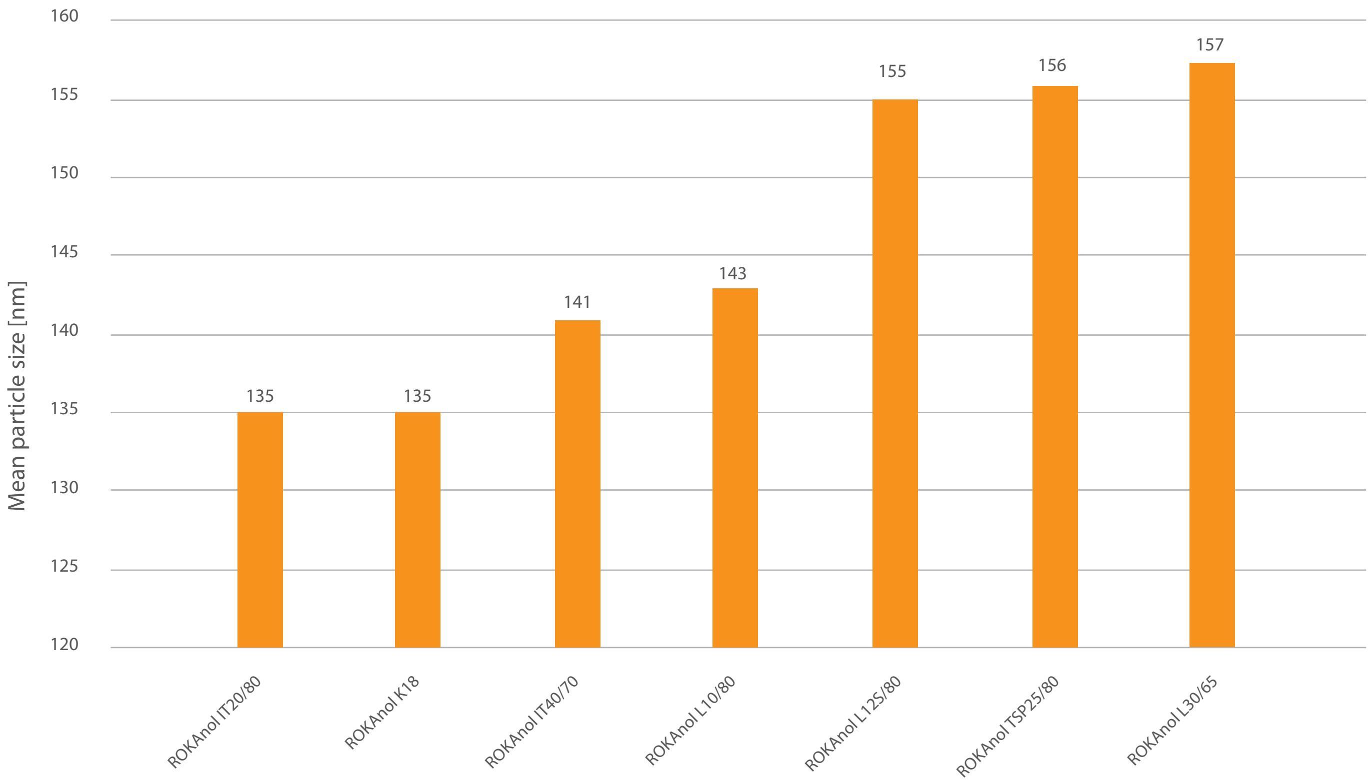
Component	grams	% pphm
REACTOR CHARGE		
Water	252.00	
ROSULfan L	1.25	0.08
$FeSO_4*7H_2O$	0.03	
PREEMULSION		
Water	173.00	
Rosulfan L	11.15	0.72
ROKAnol L12S/80	**8.70**	**1.50**
Sodium acetate	1.80	1.50
Methyl methacrylate	261.00	56.00
2-Ethylhexyl acrylate	200.00	43.00
Methacrylic acid	4.70	1.00
Water to clean	11.59	
INITIATOR SOLUTION I		
Ammonium persulfate	2.33	0.50
Water	32.60	
INITIATOR SOLUTION II		
Sodium bisulfite	1.55	0.33
Water	32.60	
pH ADJUSTMENT		
NH_4OH Solution (15%)	4.70	
BIOCIDE		
CIT/MIT 3:1	1.00	
TOTAL WEIGHT	1000	

Procedure

1. Add the REACTOR CHARGE to the reaction flask and heat up to 72°C.
2. Prepare PREEMUISION and solution of INITIATOR I and INITIATOR II.
3. Start metering the PREEMULSION and the INITIATOR I and II over 3 hours, keeping the temperature in range of 72 – 74 °C.
4. After the addition hold the temperature at 72–74°C for 60 min.
5. Cool below 50°C, adjust pH with ammonia solution and add the biocide.
6. After cooling down to ambient temperature discharge and filter obtained dispersion, and collect coagulum from the filter.

Influence on particle size

Mean particle size was determined by DLS method. The results are shown in the following graph:



Influence on chemical stability

2-3 droplets of analyzed dispersion were added to $CaCl_2$ solution. Stability of the dispersion was rated as "excellent" when no observed coagulum was formed.

	ROKAnol IT20/80	ROKAnol L10/80	ROKAnol L12S/80	ROKANOL IT40/70	ROKAnol K18	ROKANOL L30/65	ROKAnol TSP25/80
2.5% $CaCl_2$	•	•	•	•	•	•	•
5% $CaCl_2$	•	•	•	•	•	•	•
10% $CaCl_2$	o	o	o	•	•	•	•
15% $CaCl_2$	o	o	o	o	o	•	•
20% $CaCl_2$	o	o	o	o	o	o	•

• excellent o poor

Highly ethoxylated surfactants like ROKAnol L30/65 and ROKAnol IT40/70 provide good chemical resistance. The best results are achieved for ROKAnol TSP25/80.

Styrene-acrylic dispersion – influence of anionic emulsifiers on anticorrosive properties

Phosphate esters are known as effective anionic emulsifiers that provide some anticorrosive properties. However, in comparison with sulfates and sulfonates, they result in dispersions with larger particle sizes. These products can also deteriorate the adhesion of polymeric films. To overcome these issues, a combination of phosphate esters with an appropriate sulfate or sulfonate surfactant is recommended. The following example demonstrates the performance of a mixture of ROKAdis 900K/25 and SULFOROKAnol TSP95 in a styrene-acrylic dispersion.

Component	grams	% pphm
REACTOR CHARGE		
Water	221.00	
ROKAdis 900K/25	1.78	0.10
SULFOROKAnol TSP95	0.50	0.10
$FeSO_4*7H_2O$	0.03	
PREEMULSION		
Water	191.00	
ROKAdis 900K/25	16.00	0.90
SULFOROKAnol TSP95	4.46	0.90
ROKAnol IT20/80	11.30	2.00
Methacrylamide	5.80	1.30
Styrene	252.00	56.00
Butyl acrylate	185.00	41.10
Acrylic acid	7.00	1.60
Sodium acetate	3.00	
Water to clean	13.17	
INITIATOR SOLUTION I		
Ammonium persulfate	2.71	0.60
Water	32.00	
INITIATOR SOLUTION II		
Sodium bisulfite	1.81	0.40
Water	32.00	
INITIATOR SOLUTION III		
Bruggolite FF6	0.32	0.07
Water	4.96	
INITIATOR SOLUTION IV		
t-butyl hydroperoxide (70%)	0.45	0.07
Water	4.51	
pH ADJUSTMENT		
NH_4OH Solution (15%)	8.00	
BIOCIDE		
CIT/MIT 3:1	1.00	

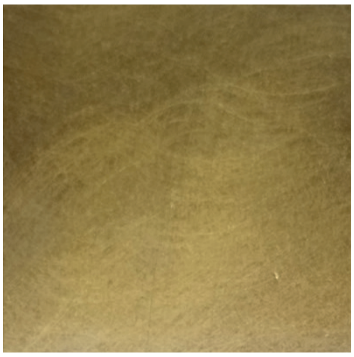
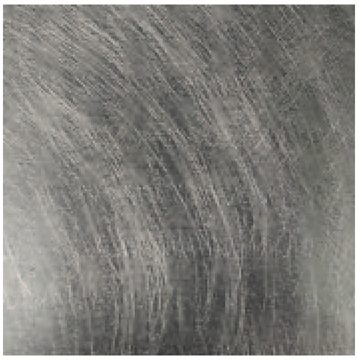
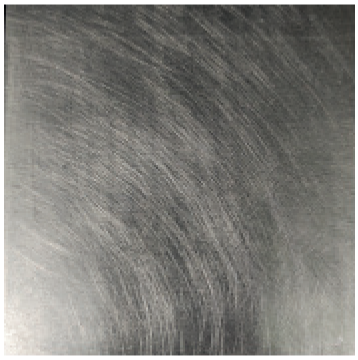
Procedure

1. Add the REACTOR CHARGE to the reaction flask and heat up to 72°C.
2. Prepare Pre-emu and solution of INITIATOR I and INITIATOR II.
3. Start metering the PREEMULSION and the INITIATOR I and II over 3 hours, keeping the temperature in range of 72–74°C.
4. After the addition hold the temperature at 72–74°C for 30 minutes.
5. Add INITIATOR III and INITIATOR IV simultaneously over 30 minutes.
6. Cool below 50°C, adjust pH with ammonia solution and add the biocide.
7. After cooling down to ambient temperature discharge and filter obtained dispersion, and collect coagulum from the filter.

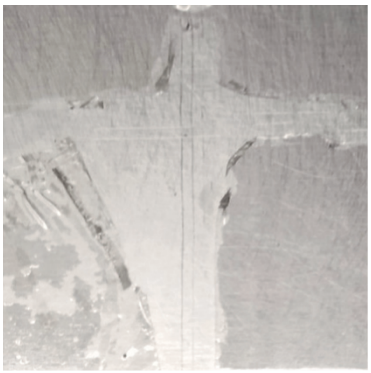
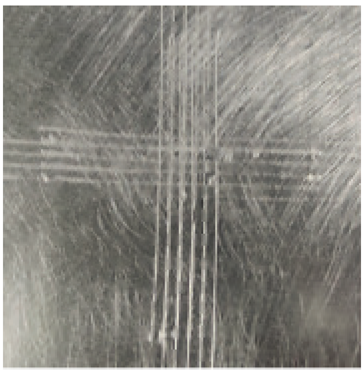
Influence on flash rust and adhesion to steel

Samples of dispersions were mixed with 4% by weight of coalescent and 0.2% by weight of anti-flash rust inhibitor and then applied on steel plates. After evaporation of water the flash-rust under dry film was examined. Then the plates were conditioned for one week at ambient temperature and adhesion using cross-cut method was determined. The results are presented in the following pictures:

Appearance after evaporation of water

SLES	ROKAdis 900K/25	ROKAdis 900K/25 + SULFOROKAnol TSP95
		

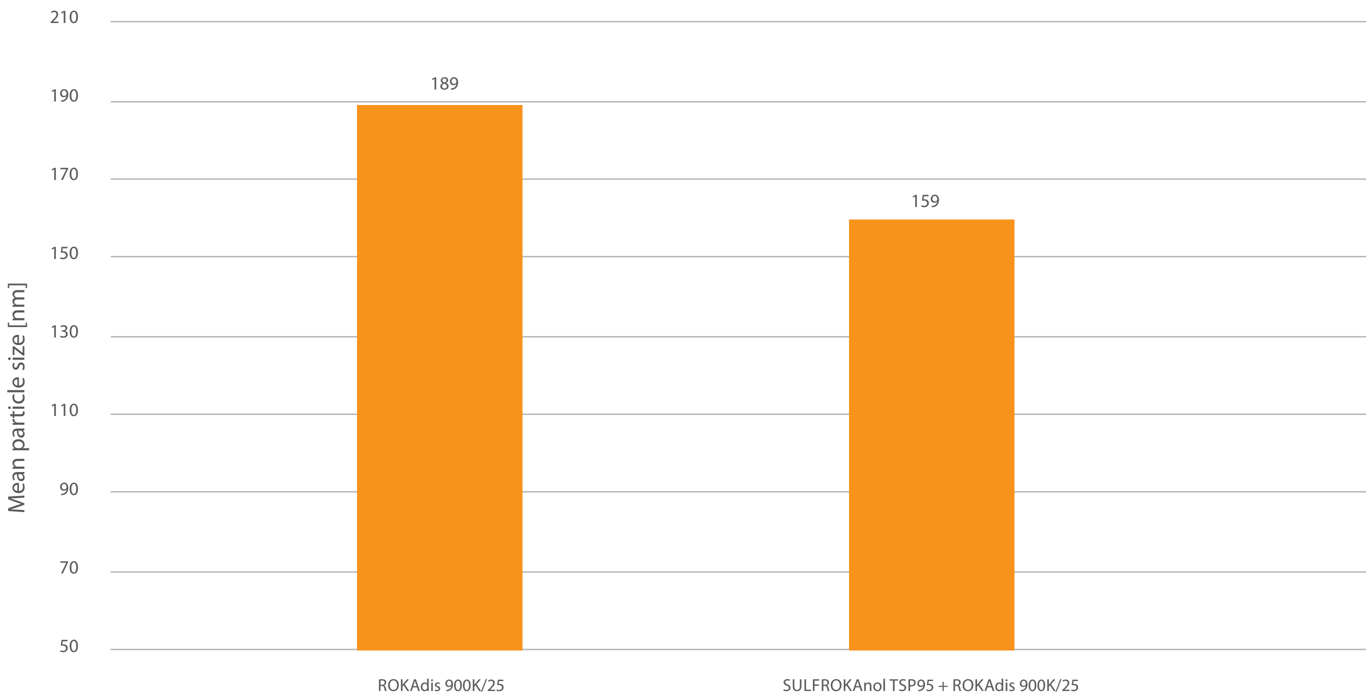
Adhesion after one week at ambient temperature

ROKAdis 900K/25	ROKAdis 900K/25 + SULFOROKAnol TSP95
	

Incorporation of ROKAdis 900K/25 as a single emulsifier as well as in combination with SULFOROKAnol TSP95 provides a synergistic effect with anti-flash rust inhibitor, preventing flash rust after the film-forming process. The combination of ROKAdis 900K/25 and SULFOROKAnol TSP95 also provides very good adhesion to the steel, which is poor when only the phosphate ester is applied.

Particle size comparison

Mean particle size was determined by DLS method. Results are shown in the following graph:



The addition of SULFOROKAnol TSP95 allows to achieve lower particle size of the dispersion.

PCC Group
We build value through sustainable innovation

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

Each project or venture with a long-term success story shares one common thing – it's based on in-depth market research and knowledge acquired through years of experience. It is knowledge and experience that enable us to constantly aim higher and deliver greater value through dynamic and sustainable world-wide development of the PCC Group.

The companies operating as a part of the PCC Group act with responsibility and care. We only embark on new business challenges when we are certain that we have the skills and knowledge to achieve success. We operate in three major markets: chemicals, energy and logistics. Several dozen business units managed by PCC SE work in synergy to generate the greatest possible competitive advantage in both local and international markets. Each day nearly three thousand professionals contribute their energy and effort to secure the

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Segments of the PCC Group

Chemicals 83%

Polyols & Derivatives

- Polyether polyols
- Polyester polyols
- Polyurethane systems
- Prepolymers
- Acryl phenols

Surfactants & Derivatives

- Anionic surfactants
- Non-ionic surfactants
- Amphoteric surfactants (betaines)
- Household and industrial cleaners, detergents, personal care products

Chlorine & Derivatives

- Chlorine
- Chlorine derivatives
- MCAA
- Phosphorus and naphthalene derivatives

Silicon & Derivatives

- Quartzite
- Metallic silicon

Logistics 12%

Logistics

- Intermodal transport
- Road transport
- Rail transport
- Container terminal in Kutno

Holding & projects 5%

Holding & Projects

- Investment management
- Projects
- Renewable energy
- Conventional energy

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 using environmentally 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	135
Number of pages	20
COVER PAGES	
Brand	Cocoon Silk
Grammage	250
Number of pages	4
PUBLICATION	
Size (cm)	21 x 29.7
Quantity	400

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11 kg of landfill

1 kg CO_2 and greenhouse gases

15 km travel in the average European car

447 liters of water

24 kWh of energy

18 kg of wood

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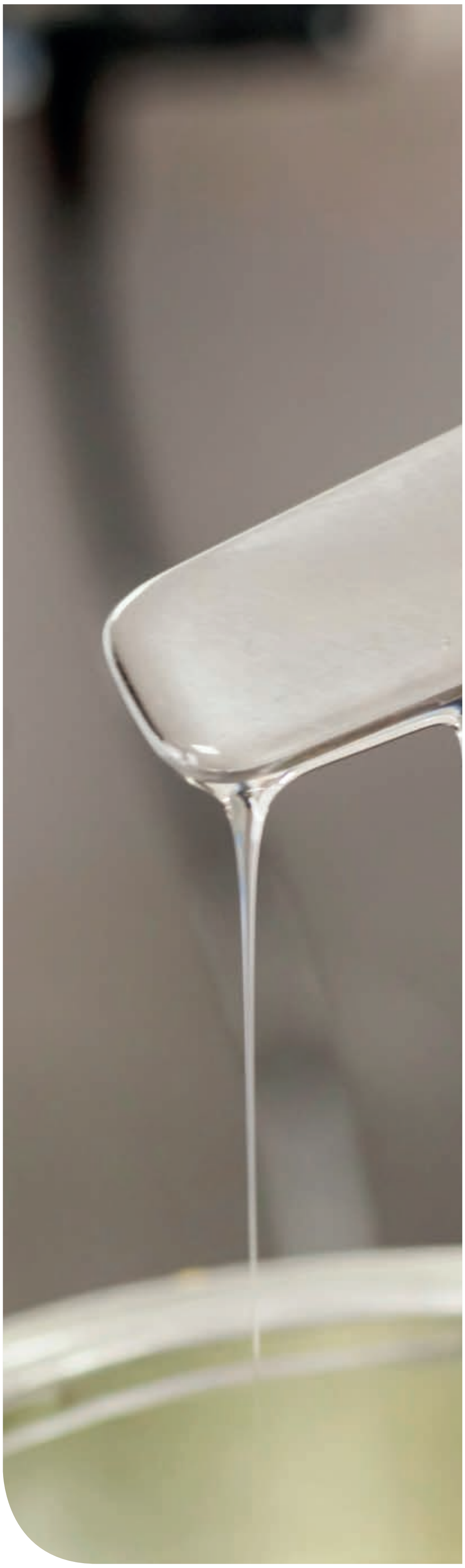

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April 2024

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