

# NOVELUTION

Product Portfolio  
for Inks, Paints and Coatings

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Sasol Performance Chemicals



SASOL



NORTH AMERICA

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The specification data and further general description as well as information on packaging the individual product can be obtained from the corresponding product data sheet.

Data on material safety, transport classes, toxicology and biodegradability can be obtained from the safety data sheets.

Regulations on food contact status (FDA) as well as recommendations are subject to change.

We recommend periodically reviewing these products in order to verify sustainability for a particular application.

Sasol cannot be held liable for legal compliance if our products are processed or modified from their original form.

# 1. About Us

Sasol Performance Chemicals develops and markets a broad portfolio of organic and inorganic commodity and speciality chemicals. Our business consists of three key business divisions: Organics, Advanced Materials and Wax. Our offices in 18 countries serve customers around the world with a multifaceted portfolio of state-of-the-art chemical products and solutions for a wide range of applications and industries.

Our key products include surfactants, surfactant intermediates, fatty alcohols, linear alkyl benzene (LAB), short-chain linear alpha olefins, mineral oil-based and synthetic paraffin waxes, high-purity and ultra-high-purity alumina as well as high-quality carbon solutions.

Our products are as individual as the industrial applications they serve, with tailor-made solutions creating real business value for customers. Ongoing research activities result in a continuous stream of innovative product concepts that help our customers position themselves successfully in future markets.

Our products are used in countless applications in our daily lives to add value, security and comfort. Typical examples include detergents, cleaning agents, personal care, construction, paints, inks and coatings, metalworking and lubricants, hot-melt adhesives, bitumen modification and catalyst support for automotive catalysts and refineries as well as other specialty applications including oil and gas recovery, agriculture, plastic stabilization, and polymer production. Every day, our researchers explore ways to improve our products and develop innovations that improve the quality of people's lives.







## Lake Charles Chemical Project

Sasol is constructing a worldscale petrochemical complex near our existing site in Southwest Louisiana. The Lake Charles Chemicals Project will roughly triple the company's chemical production capacity in the United States and enable it to build on its strong positions in robust and growing global chemical markets.

At the heart of the project is an ethane cracker that will produce 1.5 million tons of ethylene annually, benefiting from significant economies of scale. The complex also includes six chemical manufacturing plants.

Approximately 90 percent of the cracker's ethylene output will be converted into a diverse slate of commodity and specialty chemicals, such as for the Inks, Paints and Coatings market, underpinned by collaborative customer relationships.

## 2. Main Application Fields

Sasol Performance Chemicals is a global producer of innovative and high-performance products for the inks, paints, and coatings industry such as additives for emulsion polymerization, architectural coatings, tinting systems, wax emulsions and dispersions, building blocks for resins and associated thickener and surface modifiers.

This includes linear, branched and semi-branched fatty alcohols, nonionic and anionic additives, and polyethylene glycols.

Based on the broadest alcohol portfolio in the world, Sasol Organics offers with the NOVELUTION series, high performing alkyl phenol-free nonionic and anionic surfactants to assist in finding the ideal additive for different formulation systems in the world of inks, paints and coatings.



### Emulsion Polymerization

Anionic and nonionic surfactants, improving

- Reaction efficiency
- Product stability
- Waterproofing behavior

### Architectural Coatings

Additives to improve

- Color acceptance
- Freeze-thaw stability
- Rub resistance
- Washability

### Pigment Dispersions

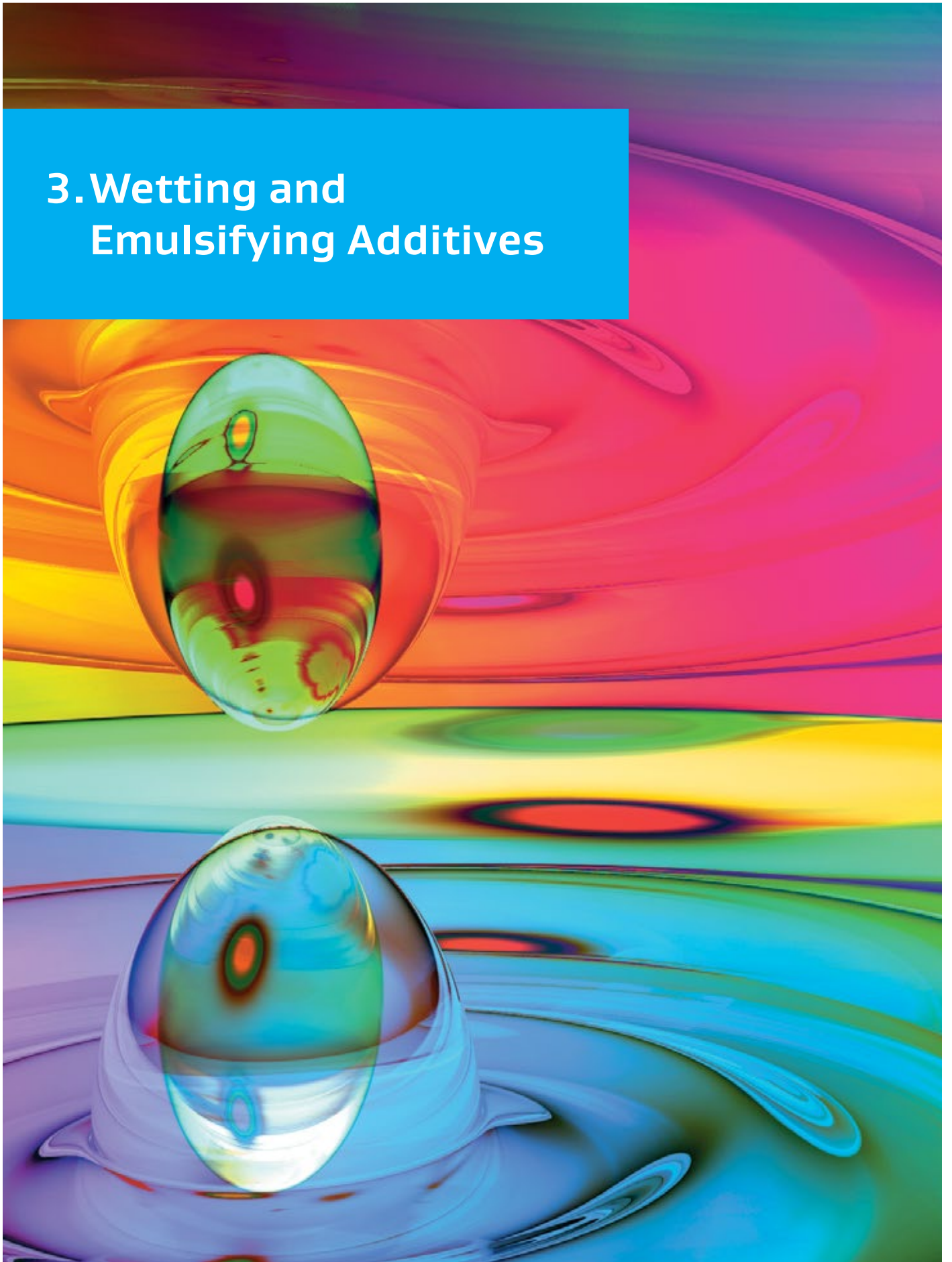
Additives to improve

- Color strength
- Freeze-thaw stability
- Viscosity stability

### Miscellaneous

- Speciality cleaner and degreaser for metals and plastics
- Emulsifier for paraffins, waxes, resins
- Resin building blocks

### 3. Wetting and Emulsifying Additives



### 3.1 Overview NOVELUTION Ethoxylates

Waterborne paint and coatings, tinting systems and printing inks are experiencing an upswing in the American market. Sasol Performance Chemicals has developed a broad range of wetting, emulsifying and dispersing additives to meet requirements for universal use. They are designed to reconcile the seemingly mutually exclusive issues of performance, sustainability and economy.

Sasol Performance Chemicals surfactants are APEO\*-free and can also be used as emulsifiers for emulsions polymerization, cleaners, degreasers, and silicon oil emulsions.

To meet the strict VOC requirements for paint formulations Sasol Performance Chemicals produces ethoxylates with an improved behavior compared to standard ethoxylates.

Sasol Performance Chemicals is flexible in providing nonionic surfactants with an ethoxylate grade from 1 mole EO up to 150 mole.

\*Alkylphenol ethoxylates

#### NOVELUTION Z

NOVELUTION Z ethoxylates are based on linear Ziegler alcohols.

Our portfolio's capability of having the widest and broadest range of back integrated C6 to C20+ alcohols enables us to find the ideal ethoxylate for the specific requirements in different application fields within the inks, paints and coatings industry.

The light cut alcohol ethoxylates (C6 – C10) are low foaming dynamic wetting agents with high performance for inks and pigment wetting.

The heavy cut alcohol ethoxylates (C16/18 – C20+) are suitable products for carbon black dispersions, tinting systems and as emulsifiers for Fischer-Tropsch waxes emulsions

#### NOVELUTION 3

This ethoxylate line is based on 100% branched tridecanol alcohol. NOVELUTION 3 line products have high wetting and low foaming performance properties.

NOVELUTION 3 70, 380, 390K and 3100K have outstanding performance in wetting, dispersing, stability and compatibility with pigments, and can be used as the wetting agent of pigments. The high mole ethoxylates such as NOVELUTION 3 307, NOVELUTION 3 407 and NOVELUTION 3 505 give the formulation good color acceptance and improve the stabilization and freeze-thaw stability in architectural coatings.

NOVELUTION 3 products have the broadest FDA confirmation regarding CFR 21 in the portfolio.

#### NOVELUTION L

The NOVELUTION L series is based on the oxo-process synthesis alcohols. The products are very suitable for waterborne formulas including inks, coatings, tints and have better wetting and stability performance for pigments.

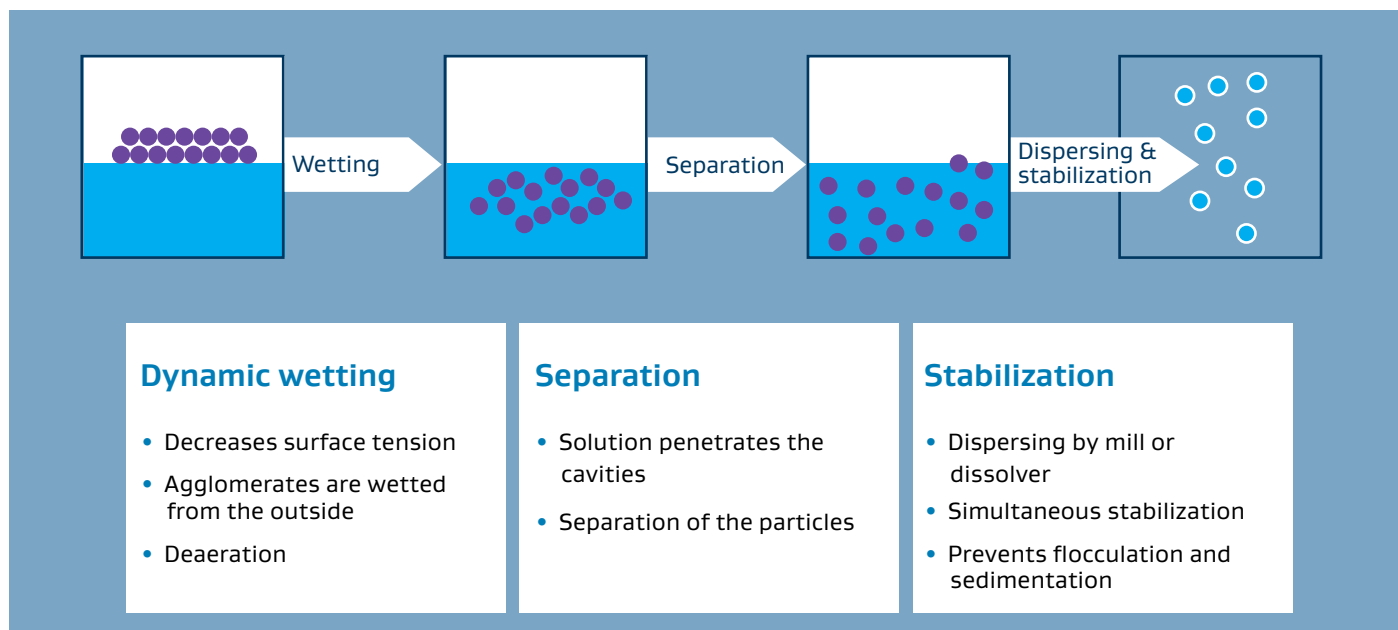
#### NOVELUTION N\*

Sasol Performance Chemicals' new NOVELUTION N ethoxylates are based on a linear, full saturated synthetic Ziegler alcohol with a chain of C20 to C30 and are made in North America.

\*Development samples available



### 3.2 General Process to Make Emulsions and Dispersions



#### Wetting additives

- No, respectively low foam
- Fast wetting
- High surface activity

#### Emulsifier and dispersing additives

- Ready to use
- Good water solubility
- No thickening effects



### 3.3 Product Overview NOVELUTION Ethoxylates

Products	Active matter	App at 20 °C	Kind of hydrophobe	HLB	Cloud point °C
NOVELUTION Z0630	100 %	Liquid	Linear	11.2	73 <sup>(1)</sup>
NOVELUTION Z1040	100 %	Liquid	Linear	10.5	60 <sup>(1)</sup>
NOVELUTION Z1080K	100 %	Liquid	Linear	13.8	81 <sup>(2)</sup>
NOVELUTION Z2630K	100 %	Liquid	Linear	10.6	64 <sup>(1)</sup>
NOVELUTION Z2670K	100 %	Liquid	Linear	12.2	60 <sup>(2)</sup>
NOVELUTION Z26120K	100 %	Pasty	Linear	14.6	72 <sup>(3)</sup>
NOVELUTION Z6860	100 %	Pasty	Linear	10.1	78 <sup>(2)</sup>
NOVELUTION Z68280	100 %	Solid	Linear	16.6	78 <sup>(3)</sup>
NOVELUTION Z68800	100 %	Solid	Linear	18.6	75 <sup>(3)</sup>
NOVELUTION N30*	100 %	Solid	Linear	5.3	tbd
NOVELUTION N60*	100 %	Solid	Linear	8.3	tbd
NOVELUTION N90*	100 %	Solid	Linear	10.3	tbd
NOVELUTION N120*	100 %	Solid	Linear	11.8	tbd
NOVELUTION N250*	100 %	Solid	Linear	15.0	tbd
NOVELUTION N500*	100 %	Solid	Linear	17.1	tbd
NOVELUTION N800*	100 %	Solid	Linear	18.1	tbd
NOVELUTION N1000*	100 %	Solid	Linear	18.5	tbd
NOVELUTION N1500*	100 %	Solid	Linear	18.9	tbd
NOVELUTION 330	100 %	Liquid	Branched	8.0	49 <sup>(1)</sup>
NOVELUTION 350	100 %	Liquid	Branched	10.5	65 <sup>(1)</sup>
NOVELUTION 370	100 %	Liquid	Branched	12.1	74 <sup>(1)</sup>
NOVELUTION 380	100 %	Liquid	Branched	12.8	77 <sup>(1)</sup>
NOVELUTION 390	100 %	Liquid	Branched	13.3	58 <sup>(2)</sup>
NOVELUTION 390K	100 %	Pasty	Branched	13.3	58 <sup>(2)</sup>
NOVELUTION 399K	90 %	Liquid	Branched	13.3	58 <sup>(2)</sup>
NOVELUTION 3100K	100 %	Pasty	Branched	13.7	75 <sup>(2)</sup>
NOVELUTION 3108K	80 %	Liquid	Branched	13.7	72 <sup>(2)</sup>
NOVELUTION 3130K	100 %	Pasty	Branched	14.8	57 <sup>(3)</sup>
NOVELUTION 3139K	90 %	Liquid	Branched	14.8	55 <sup>(3)</sup>
NOVELUTION 3300	100 %	Solid	Branched	17.3	76 <sup>(3)</sup>
NOVELUTION 3307	70 %	Liquid	Branched	17.3	76 <sup>(3)</sup>
NOVELUTION 3400	100 %	Solid	Branched	18.0	72 <sup>(3)</sup>

Products	Active matter	App at 20 °C	Kind of hydrophobe	HLB	Cloud point °C
NOVELUTION 3407	70 %	Liquid	Branched	18.0	73 <sup>(3)</sup>
NOVELUTION 3500	100 %	Solid	Branched	18.3	76 <sup>(3)</sup>
NOVELUTION 3505	50 %	Liquid	Branched	18.3	75 <sup>(3)</sup>
NOVELUTION 5301-85	85 %	Liquid	Branched	13.3	61 <sup>(2)</sup>
NOVELUTION 5302-65	65 %	Liquid	Linear	16.6	81 <sup>(2)</sup>
NOVELUTION 5464	100 %	Liquid	Linear	10.6	39 <sup>(1)</sup>
NOVELUTION 5486	100 %	Liquid	Linear	12.0	54 <sup>(3)</sup>
NOVELUTION 54RT64	100 %	Liquid	Linear	10.0	61 <sup>(3)</sup>
NOVELUTION LE07K	100 %	Liquid	Semi-branched	12.8	80 <sup>(1)</sup>
NOVELUTION LE217K	70 %	Liquid	Semi-branched	16.8	80 <sup>(2)</sup>
NOVELUTION LE407K	70 %	Liquid	Semi-branched	18.2	75 <sup>(2)</sup>

<sup>(1)</sup> 10 % active matter in 25 % BDG solution, <sup>(2)</sup> 1 % active matter in water, <sup>(3)</sup> 1 % active matter in 10 % NaCl solution

\*Development Product

HLB =  $\frac{20 \times \text{molecular weight hydrophilic}}{\text{molecular weight total}}$



### 3.4 Example Usage of NOVELUTION 5301-85

#### Description

**NOVELUTION 5301-85** is a liquid APEO free outstanding non-ionic emulsifier for paraffin and wax emulsions and micronized wax dispersions for the inks, paper, paints, coatings, and construction board industry as well for cleaning agents.

**NOVELUTION 5301-85** reduces the surface tension and improves wetting and stabilization of waxes and organic pigments in water based systems. It is particularly suitable for the production of high loaded micronized FT-wax dispersions with a low viscosity.

#### Technical properties NOVELUTION 5301-85

NOVELUTION 5301-85	Typical value	Method
Active content	85 wt. %	calculated
Water	15 wt. %	DIN EN 13267
HLB value	13.8	calculated
pH, 2 % in demin. water	5–7	DIN EN 1262
Setting point	< -5 °C / <23 °F	DIN ISO 3841

#### Guideline to Disperse Micronized Fischer-Tropsch Waxes for Water Based Ink Applications

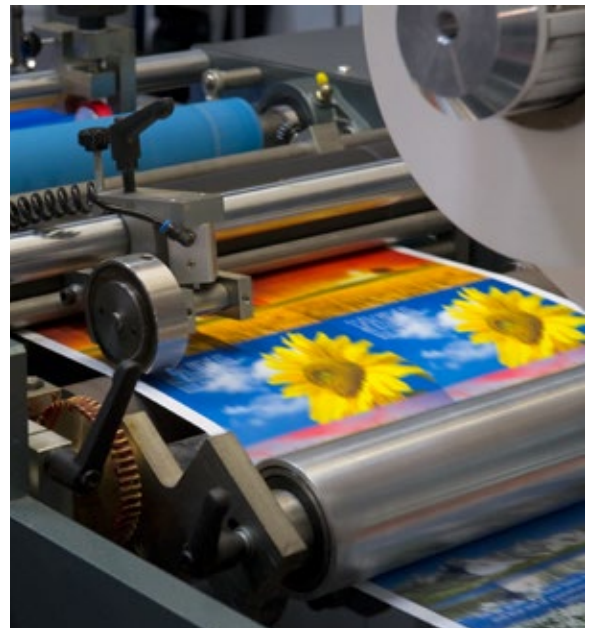
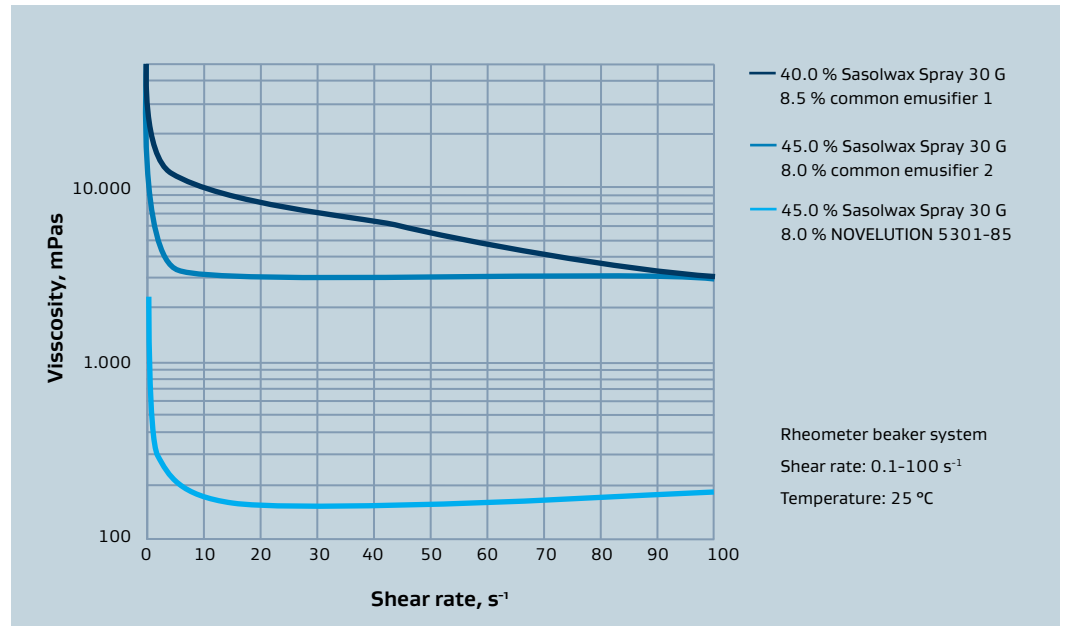
Generally it is recommended to add high loaded wax dispersion with needed concentration to the final ink formulation to avoid agglomerations and print defects during the printing process.

For that disperse 30 –45 % of the micronized FT-wax into a water/surfactant mixture while stirring with a dissolver plate or impeller stirrer. Below find an example for the dispersion of Sasolwax Spray 30 G in water.

Waterbased dispersion with a micronized FT-wax	
47 %	Water
10 %	NOVELUTION 5301-85
	Add NOVELUTION 5301-85 to the water and mix while stirring
45 %	Sasolwax Spray 30 G
	Add wax while stirring with a dissolver plate at 500 to 1000 rpm for app. 30 min

## Viscosity Profile

The usage of **NOVELUTION 5301-85** provides low viscous micronized FT-wax dispersions and avoids shear thickening behaviour compared to common emulsifier systems.



### 3.5 Replacement of Alkyl Phenol Ethoxylate in a Semi-Gloss Architectural Coating Formulation

Surfactant	Moles of EO	Active Content (%)	Cloud point (°C)	HLB	Appearance
Octylphenol ethoxylate (OPE-9.5)	9.5	100	66	13.4	Pale yellow liquid
NOVELUTION 390	9	100	59	13.2	Hazy liquid
NOVELUTION 570	7	100	58	12.4	Hazy liquid

#### Semi-Gloss Paint Formula

Material	Dosage	Use	Source
<b>Grind</b>			
Water	11.96	–	–
Ammonium hydroxide	0.16		Aldrich
Proxel® GXL	0.17	Preservative	Aldrich
Solsperse® 43000	0.90	Dispersant	Lubrizol
Drewplus® L-475	0.16	Defoamer	Ashland
Surfactant (see below)	0.28	Wetting agent	Sasol
Propylene glycol	2.70	Co-solvent	Aldrich
Potassium tripolyphosphate	0.13	Pigment	Aldrich
Ti-Pure® 706	18.99	Pigment	DuPont
417-W® zinc oxide	2.11	Pigment	Eagle Zinc
Minex® 4	10.63	Pigment	Unimim
Nyral® 300	4.22	Pigment	R.T. Vanderbilt
<b>Letdown</b>			
UCAR® 625	35.98	Latex	Dow
Texanol™	0.90	Co-solvent	Eastman
Drewplus® L 475	0.16	Defoamer	Ashland
Skane™ M-8	0.19	Mildewcide	Dow
Ammonium hydroxide	0.08	pH	Aldrich
Water	8.35	–	–
UCAR Polyphobe® 116	0.17	Rheology modifier	Dow
UCAR Polyphobe 117	1.76	Rheology modifier	Dow
<b>Total</b>	<b>100.00</b>		

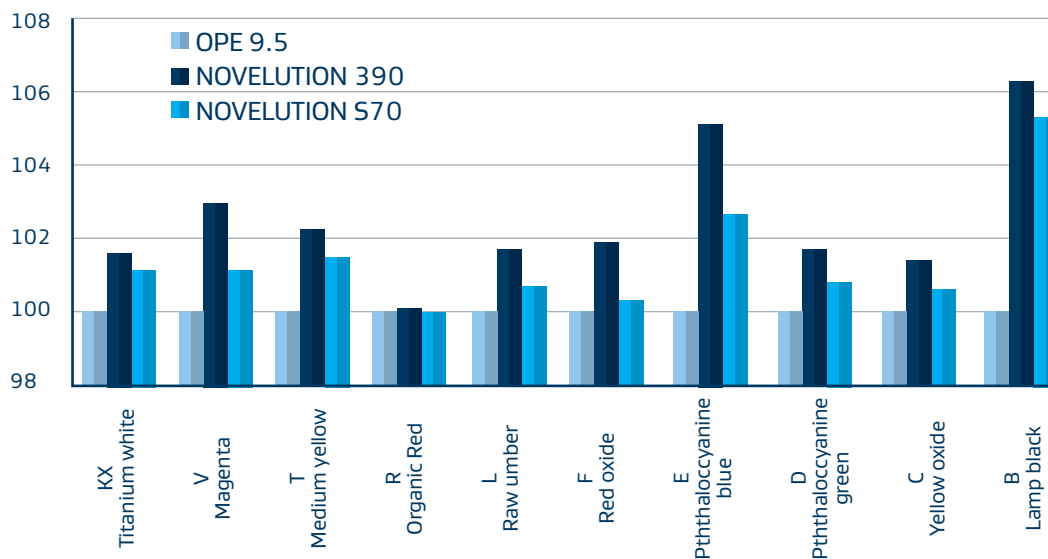
Color Acceptance Data (ASTM D4838)

Description	Type	Surfactant		
		OPE-9.5	NOVELUTION 390	NOVELUTION S70
Titanium white	KX	100	101.6	101.1
Magenta	V	100	103.0	101.1
Medium yellow	T	100	102.2	101.5
Organic red	R	100	100.1	100.0
Raw umber	L	100	101.7	100.7
Red oxide	F	100	101.9	100.3
Phthalocyanine blue	E	100	105.1	102.7
Phthalocyanine green	D	100	101.7	100.8
Yellow oxide	C	100	101.4	100.6
Lamp black	B	100	106.3	105.3

Three coatings passed:

- 3 Freeze-thaw resistance cycles (ASTM D2243)
- Heat-age stability (ASTM D1849)

Colortrend® 888 series tint were obtained from Evonik for the color acceptance test.



### 3.6 NOVELUTION N Ethoxylates (Development Products)

Sasol Performance Chemicals' new **NOVELUTION N ethoxylates** are based on a linear, full saturated synthetic Ziegler alcohol with a chain of C20 to C30 and are made in North America.

#### Applications

The NOVELUTION N ethoxylates can be used as emulsifiers for a wide range of applications in the inks, paints and coatings industry such as emulsifiers for silicon oils, resins and bitumen. The NOVELUTION N grades are preferred additives for PE-wax, microcrystalline and/or micronized Fischer-Tropsch hard wax emulsions and dispersions. Due to their high cloud point NOVELUTION N ethoxylates are excellent emulsifiers for pressure emulsification of hard waxes to form emulsions with a particle size  $<1 \mu\text{m}$ .

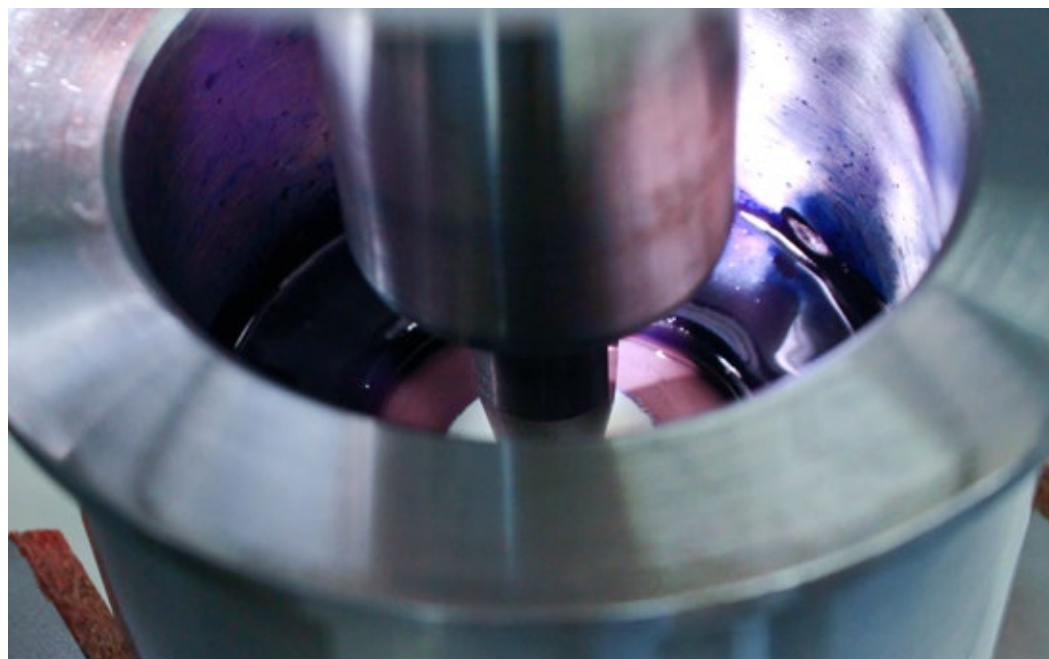
NOVELUTION N1000 and NOVELUTION N1500 are outstanding nonionic grinding additives for hydrophobic pigments such as non-modified carbon black, iron oxide or uncoated titanium dioxide.

Typical properties	HLB
NOVELUTION N30	5.3
NOVELUTION N60	8.3
NOVELUTION N90	10.3
NOVELUTION N120	11.8

Typical properties	HLB
NOVELUTION N250	15.0
NOVELUTION N500	17.1
NOVELUTION N1000	18.5
NOVELUTION N1500	18.9



Perl mill for pigment grinding

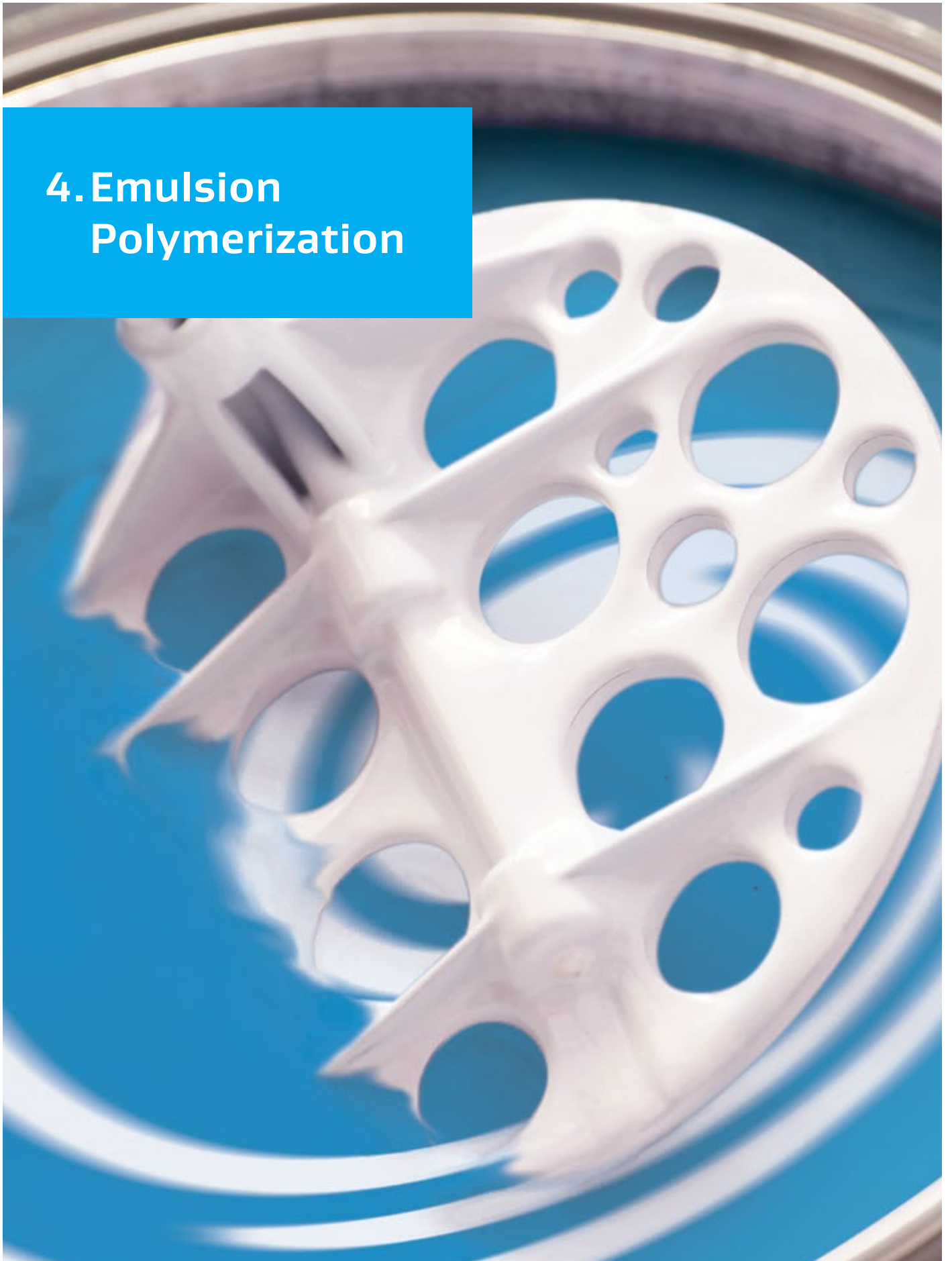




## 3.7 Quick Selection List NOVELUTION Nonionic Emulsifiers

	Color acceptance	Dispersing stability	Dynamic wetting	Emulsifier for FT waxes, paraffins	Freeze-thaw stability	Ink formulations	Pigment dispersing	Pigment wetting	Resin emulsifier	Low foam	Scrub resistance
NOVELUTION Z0630			•	•	•	•		•		•	
NOVELUTION Z1030			•	•	•	•		•		•	
NOVELUTION Z1080K			•	•	•	•		•		•	
NOVELUTION Z25640K	•			•		•		•			•
NOVELUTION Z2670K	•			•							•
NOVELUTION Z26120K				•							•
NOVELUTION Z6860	•		•			•					•
NOVELUTION Z68280		•					•		•		
NOVELUTION Z68800		•					•		•		
NOVELUTION N30			•		•	•	•	•	•	•	•
NOVELUTION N60						•	•		•	•	
NOVELUTION N90	•						•		•		
NOVELUTION N120	•			•			•		•		•
NOVELUTION N250		•		•			•		•		
NOVELUTION N500		•		•			•		•		
NOVELUTION N1000		•		•	•		•		•		
NOVELUTION N1500		•		•	•		•		•		
NOVELUTION 330			•		•	•		•	•	•	
NOVELUTION 350	•		•		•	•		•	•	•	
NOVELUTION 370	•		•					•	•		•
NOVELUTION 380	•			•				•			•
NOVELUTION 390	•			•				•			•
NOVELUTION 399K	•			•			•		•		•
NOVELUTION 3108K	•	•		•			•		•		•
NOVELUTION 3138	•	•		•			•		•		
NOVELUTION 3208				•			•		•		
NOVELUTION 3300		•					•		•		
NOVELUTION 3307		•					•		•		
NOVELUTION 3400		•					•		•		
NOVELUTION 3407		•					•		•		
NOVELUTION 3505		•		•			•		•		
NOVELUTION 5301-85		•		•		•	•		•		
NOVELUTION 5302-65				•		•	•		•		
NOVELUTION 5464	•		•	•		•				•	•
NOVELUTION 5486	•		•	•		•				•	•
NOVELUTION LE07K	•							•	•		•
NOVELUTION LE217K		•			•		•		•		
NOVELUTION LE407K		•			•		•		•		

## 4. Emulsion Polymerization



## 4.1 Anionic Emulsifiers

Sasol Performance Chemicals offer a range of alcohol ether sulfates used as main emulsifier for emulsion polymerization. All of them are alkyl phenol ethoxylate free and contain no organic solvents like ethanol.

Our anionic products provide electrostatic stabilization leading to a stable monomer pre-emulsion, and prevent coagulum formation during the production process. In addition they allow to control of the particle size and related distribution.

**NOVELUTION FES** series are standard linear alcohol ether sulfates and can be used without any additional nonionic emulsifier for the production of emulsion polymers, e.g. in styrene-acrylic, all acrylic, and vinyl acetate-acrylic systems. At the same time, they improve the mechanical stability of the emulsion and minimizes formation of coagulum.

**NOVELUTION 3** series are ether sulfate based on branched alcohol ethoxylates. They are a suitable emulsifier of various monomer emulsions, leading to a lower grit level and better stabilization of the latex compared to alcohol sulfates.

**NOVELUTION PA 89N** is a low-foaming anionic product with a very low CMC that allows good performance with a low dosage. The surfactant yields a small particle size, excellent pre-emulsion stability and the opportunity to produce microemulsions. They are available with high actives and low viscose behavior, and exhibit a low pour point for ease of use.

Product	Hydrophobe	Active matter (%)	State @ 25°C	CMC ppm	Surface tension 1 g/L @ 25°C mN/m
NOVELUTION 333	branched	27	liquid	230	35
NOVELUTION FES 104-L	linear	27	liquid	200	34
NOVELUTION FES 107-L	linear	27	liquid	100	37
NOVELUTION FES 112-L	linear	27	liquid	220	34
NOVELUTION FES 130-L	linear	27	liquid	240	36
NOVELUTION PA89N	branched	27	liquid	50	33

CMC = critical micelle concentration

## 4.2 Nonionic Emulsifier for Emulsion Polymerization

Sasol alcohol ethoxylates are versatile products that are used as co-surfactant in all types of formulations, improving latex stability and having a positive influence on freeze-thaw stability, the shelf life and the handling of the emulsions.

The **NOVELUTION 3** products are available in a wide range of HLB values to match the requirements on wetting and dispersing during the polymerization and stabilizing the final latex dispersion.

The NOVELUTION Z68800 is an excellent dispersant and stabilizer for versatile recipes.

### Nonionic Surfactants

Products	Active matter	State 25 °C	Viscosity 20 °C cps	Cloud point °C	Pour point °C	HLB	Surface tension 25 °C, 1g/L mN/m
NOVELUTION 330	100 %	liquid	38	49 <sup>(1)</sup>	<-10	8.0	—
NOVELUTION 350	100 %	liquid	55	65 <sup>(1)</sup>	<-10	10.5	27
NOVELUTION 370	100 %	liquid	70	74 <sup>(1)</sup>	-5	12.1	28
NOVELUTION 380	100 %	liquid	74	77 <sup>(1)</sup>	0	12.8	29
NOVELUTION 390	100 %	liquid	78	58 <sup>(2)</sup>	5	13.3	30
NOVELUTION 3307	70 %	liquid	1444	76 <sup>(3)</sup>	9	17.3	46
NOVELUTION 3400	100 %	waxy solid	—	80 <sup>(3)</sup>	49 – 52	18.0	42
NOVELUTION Z68800	100 %	waxy solid	—	>100 <sup>(2)</sup>	59	18.6	53

(1) 10 % A.M. in 25 % BDG aq.

(2) 1 % A.M. aq.

(3) 1 % A.M. in 10 % NaCl aq.

(4) 5 % A.M. in 25 % BDG aq.



## 4.3 Formulation Example

### Styrene/Acrylic

- Load the reactor with the product listed under A and heat to 80 °C
- Prepare the monomer pre-emulsion using the products listed under B, all the while stirring vigorously
- Start adding 5 % of pre-emulsion B in 10 minutes and allow to initiate for 30 minutes
- Add the remaining pre-emulsion continuously over 4 hours
- After adding, allow to react at 80 °C for 60 minutes
- Add C and allow the reaction to finish for an additional 60 minutes
- Allow to cool to 45 °C and add D

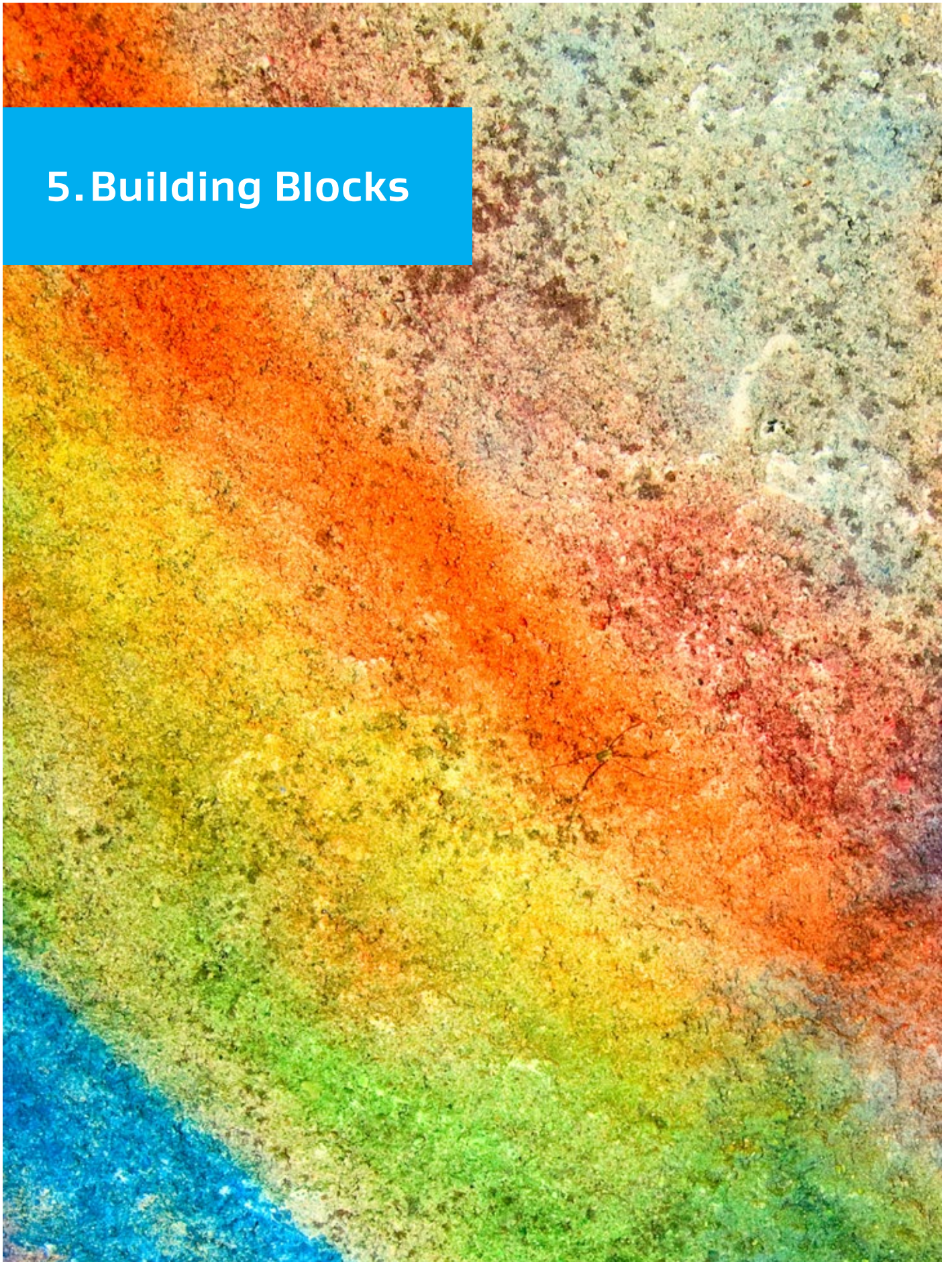
	Reagent	Amount (%)
A	Water	19.06
	NOVELUTION 333	0.2
	Sodium bicarbonate	0.05
B	Water	27.55
	NOVELUTION 333	1.75
	NOVELUTION 3307	1.92
	Styrene	23.0
	Butyl acrylate	23.0
	Acrylamide	0.6
	Methacrylic acid	1.1
	Ammonium persulfate	0.25
C	Ammonium persulfate	0.07
	Water	0.55
D	Ammonia (25 %)	0.7
	Biocide	0.2

Brookfield viscosity at 25 °C		
SPD	RPM	Viscosity (mPa·s)
3	20	850

Solid content (%)	pH at 10 % in deionized water
50.1	8.6

Particle size	
D50 (nm)	PDI
132	0.02 (monodisperse)

# 5. Building Blocks





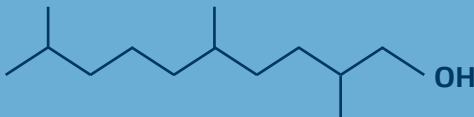
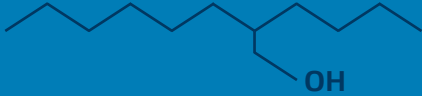
## 5.1 Fatty Alcohol Overview

### Description

Sasol Performance Chemicals is one of the world's largest suppliers of C6+ alcohols and offers one of the broadest portfolios of specialty and commodity alcohols based on different production technologies. Sasol Performance Chemicals' C6 – C20+ alcohols serve a huge number of different industries along the chemical value chain.

The fatty alcohols are based on petrochemical, oleochemical and Fischer-Tropsch-based feedstocks. Depending on the production process, the character of these saturated alcohols with carbon chain lengths ranging from 6 to 20+ and higher and can be linear, semi-linear or branched.

### Product Portfolio

Product	Linearity	Carbon chain distribution	Structure
ALFOL	100 %	Even C6–C20+	
ISALCHEM LIAL ALCHEM	5 % 50 % 95 %	Odd & even C9–C17	
MARLIPAL O13	0 %	Odd C13	
ISOFOL	0 %	Even C12–C32	

The diagrams show only one example of the isomeric chemical structures of the branched alcohols.



**Ziegler Alcohols – ALFOL**

Sasol's Ziegler alcohols are high-purity, petrochemical-based, linear primary alcohol homologues with an even number of carbon chains ranging from C6 to C20+. All Ziegler alcohols are either colorless liquids or white solids under ambient conditions. Ziegler alcohol derivatives are biodegradable, and are physically and chemically equivalent to alcohols made from oleochemicals.

**Oxo Alcohols – LIAL, ISALCHEM, ALCHEM**

**LIAL** alcohols are oxo alcohols consisting of mixtures of linear and mono-branched primary alcohols with alkyl chain distributions from 9 to 17 carbon atoms. **LIAL** alcohols are high-purity, clear liquids with very little odor. Their molecular structure helps retain their liquid state at room temperature. **LIAL** alcohols are fully saturated, resistant to oxidation and show excellent color stability.

**ISALCHEM** alcohols are prepared from Sasol's oxo alcohols (**LIAL**) by a fractionation process that yields  $\geq 90$  percent branched material. **ISALCHEM** alcohols are high-purity, clear liquids with very little odor. Their isomeric molecular structure results in lower melting points compared to the blend.

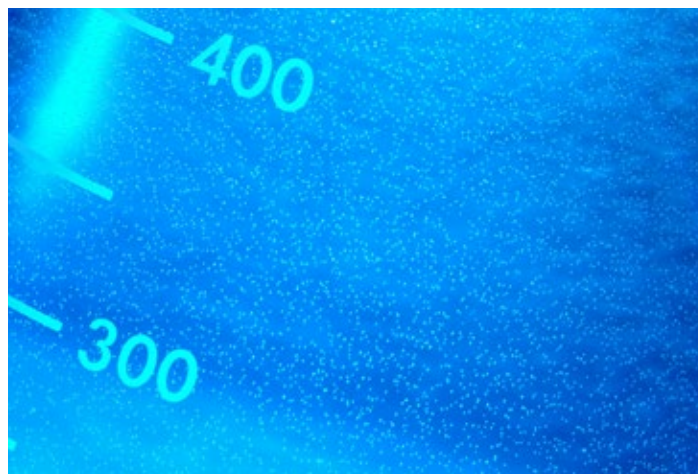
**ALCHEM** alcohols are prepared from Sasol's oxo alcohols (**LIAL**) by a fractionation process that yields  $\geq 90$  percent linear material.

**Isotridecyl Alcohol (ITDA) – MARLIPAL O13**

Sasol's ITDA alcohol is based on a C12 olefin, which is prepared by the trimerization of n-butene. In contrast to an isotridecyl alcohol produced with other starting materials, MARLIPAL O13 is a 100 % C13 alcohol and has a unique, significantly milder odor.

**Guerbet Alcohols – ISOFOL**

Sasol's ISOFOL alcohols range between 12 and 32 carbon atoms. They are liquid at ambient temperature up to carbon chains of C24, whereas corresponding linear and saturated alcohols are solid. While oleyl alcohol starts to solidify at approximately 10 °C, ISOFOL alcohol of a similar chain length remains liquid. Due to complete saturation, ISOFOL alcohols show excellent oxidative and color stability.





## 5.2 Alcohols for Ester Synthesis (Study)

Sasol's fatty alcohol product portfolio of linear, semi-branched and branched primary alcohols are the basis for the production of monomer esters such as acrylates and methacrylates. These monofunctional monomers are hydrophobic with low glass transition temperatures. They impart flexibility and plasticizing properties to the coatings.

Figure 1: UV-cured coating

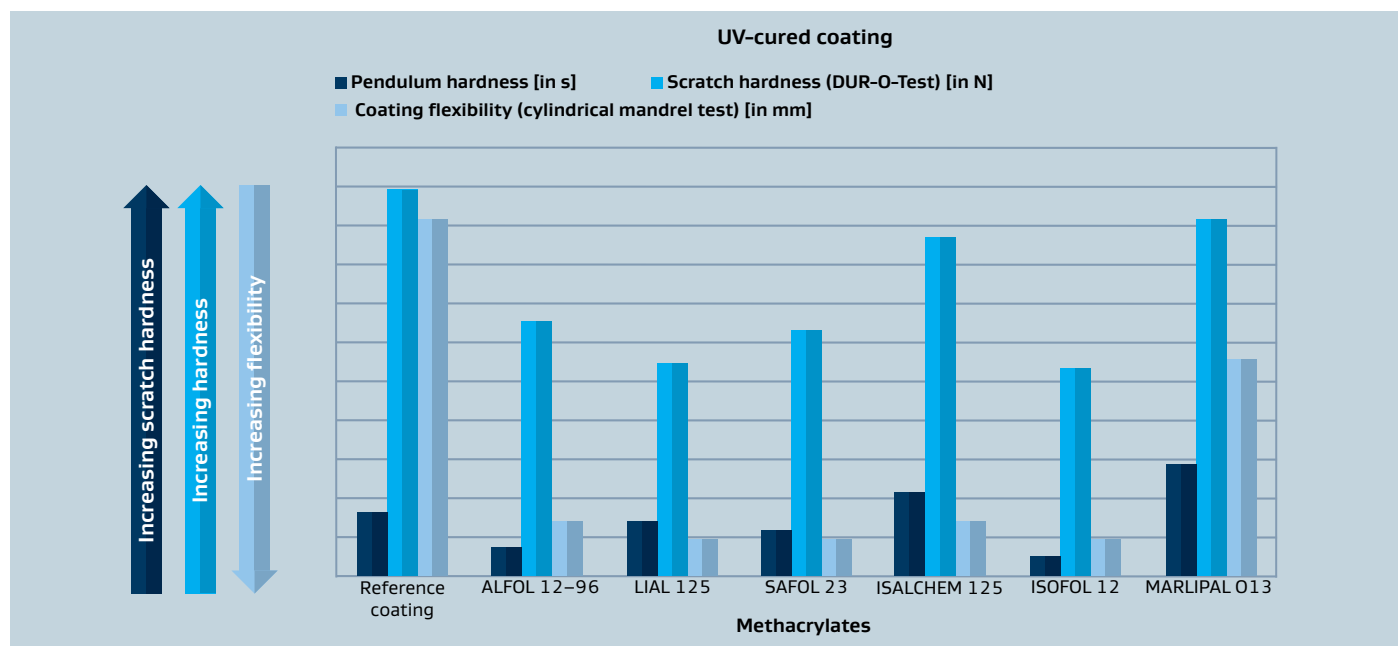


Table 1: Typical properties of fatty alcohols and their methacrylic acid esters

	ALFOL 12-96	LIAL 125	SAFOL 23	ISALCHEM 125	ISOFOL 12	MARLIPAL O13
Chemical description	1-dodecanol	C12–C15 alcohols	C12–C13 alcohols	Mono-branched C12–C15 alcohols	2-butyloctanol	Isotridecanol
Carbon chain structure	100 % linear	50 % linear	50 % methyl-branched	95 % mono-branched	100 % 2-alkyl-branched	100 % 2-alkyl-branched
≤ C11 [%]	-	0.5 max.	1.0 max.	1.0 max.	-	-
C12 [%]	96.5 min.	19–25	51–57	18–25	97.0 min.	-
C13 [%]	-	28–34	43–49	26–34	-	100
C14 [%]	-	27–33	4.0 max.	27–36	-	-
C15 [%]	-	15–21	4.0 max.	16–22	-	-
≥ C16 [%]	-	1.5 max.	4.0 max.	2.0 max.	-	-
<b>Methacrylic acid ester (stabilized with hydroquinone monomethyl ether)</b>						
Appearance at RT	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid
Purity [%]	96	96	99	97	97	98
Color [Hazen]	10	10	19	50	5	22
Viscosity @ 20 °C [mPa·s]	4.8	6.0	5.6	5.6	5.1	5.8
Pour point [°C]	-21	-30	-42	-63	-90	-84
Glass transition temperature [°C]	-65	-66	-65	-77	-108	-69

### 5.3 Building Blocks for Associative Thickeners

Sasol Performance Chemicals provide single cut alcohol ethoxylates with a narrow ethoxylate distribution to influence the rheological behavior of associative thickeners.

Product	Hydrophobe
NOVELUTION Z1610	C16 linear
NOVELUTION Z1810	C18 linear
NOVELUTION Z2225	C22 linear
NOVELUTION G1210*	C12 Guerbet
NOVELUTION G1625*	C16 Guerbet

\*development product

**Further products on request.**



The background of the page is a close-up photograph of a wood grain, showing concentric, wavy rings of light and dark brown wood. A solid blue rectangular box is overlaid on the upper left portion of the image, containing the section header text in white.

## 4. NOVELUTION PEG Series – Polyethylene Glycols

The excellent solvent properties of NOVELUTION PEG grades are important for paints, coatings or lacquers.

NOVELUTION PEG 200, 300 and 400 serve as humectant and plasticizer for adhesives and coatings to remain these materials elastic for a long period of time.

NOVELUTION grades are important intermediates for fatty acid esters, polyurethanes and polyesters. The fatty acid esters are of industrial importance for example in the textile and leather industry where they are used as softeners, antistatic agents, wetting or finishing agents.

The reaction of NOVELUTION PEG grades with diisocyanates results in polyurethanes (PUR) and used as components for the manufacture of elastic polyurethane foam materials.

NOVELUTION PEG grades show excellent humidification and plasticizing effects. NOVELUTION PEG 200 to 1000 are used in the wood industry to prevent the drying and cracking of wood and maintain its flexibility. This dimensionally stabilized high quality wood is used for furniture.

#### **Physical Form**

The temperature of the melting and solidification range of the NOVELUTION PEG grades increase with growing molecular weight. NOVELUTION PEG 200, 300 and 400 are liquids at room temperature. The solidification range of NOVELUTION PEG 600 and 1000 is in the range of room temperature. Both products show a paste like consistency.

#### **Solubility**

An important property of the NOVELUTION PEG grades is their readily solubility in water. The liquid NOVELUTION PEG grades give clear solutions with water in all mixing proportions. With increasing molecular weight the solubility in water is slightly lowered. The NOVELUTION PEG grades are soluble in polar organic solvents like alcohols, benzene, glycerine glycol and chloroform. No or slight solubility is given in aliphatic hydrocarbons, ethers and fats.

#### **Hygroscopicity**

NOVELUTION PEG grades are hygroscopic and therefore take up moisture from air when stored open. Due to this behavior NOVELUTION PEG grades are used as moisturizers. The hygroscopicity of the NOVELUTION PEG grades decreases with increasing molecular weight. The hygroscopicity of the NOVELUTION PEG grades must be considered for the storage. They should be stored only in well sealed containers in a dry place.

### Polyethylene Glycols (PEG)

- Water-soluble diols
- Low water content
- Molecular weights: 200, 300, 400, 600, 1000

### Areas of Application

Solvents	Humectant	Resin building blocks
Film formation	Coatings	Polyacrylates
Freeze-thaw resistance	Papers	Fatty acid ester
Fountain solution	Wood industry	Polyurethane
		Polyester

NOVELUTION PEG	Unit	200	300	400	600	1000
Ethylene oxide units	–	4	6	8	12	20
Appearance at 20 °C	–	Liquid	Liquid	Liquid	Liquid	Pasty
Hydroxyl number	mg KOH/g	534–590	356–394	267–295	178–197	107–118
Average molar mass	g/mol	190–210	285–315	380–420	570–630	950–1,050
Solidification range	°C	-55 up to -40	-20 up to -10	4–8	15–25	36–40
Solubility in water at 20 °C	g/l	Complete	Complete	Complete	Complete	Approx 750
Specific heat	kJ/g (125 °C)	2.1	2.1	2.1	– <sup>1)</sup>	– <sup>1)</sup>
Specific heat	kJ/g (25 °C)	2.5	2.5	2.5	2.5	2.5

<sup>1)</sup> Not liquid at specified temperature



## Quick Selection, NOVELUTION PEG

Application	Important properties								Polyethylene glycols				
	Environmental & Human Safety	Solvent Properties	Water Solubility	Viscosity Modifying	Solidification Range	Lubricity	Hygroscopicity	Chemical Structure	NOVELUTION PEG 200	NOVELUTION PEG 300	NOVELUTION PEG 400	NOVELUTION PEG 600	NOVELUTION PEG 1000
Adhesive	•			•	•				•	•	•	•	•
Antistatic agent	•						•		•	•	•	•	•
Freeze-thaw stability	•	•	•						•	•	•		
Heat transfer medium	•		•		•				•	•	•		
Ink	•	•	•			•	•		•	•	•	•	
Lubricants	•			•		•			•	•	•	•	•
Humectant	•						•		•	•	•	•	
Mold release	•		•	•		•			•	•	•	•	•
Paint	•	•		•					•	•	•	•	•
Paper	•		•				•	•	•	•	•	•	•
Plasticizer	•							•	•	•	•	•	•
Resin building block	•	•	•					•	•	•	•	•	•
Solvent	•	•	•	•		•			•	•	•		
Surface glaze	•	•		•			•				•	•	•
Viscosity modifier	•		•	•					•	•	•		
Wood processing	•	•					•	•			•	•	•

NOVELUTION PEG 400 is used as a humectant to recover the terracotta figures



# Our Global Footprint

- Sasol Performance Chemicals headquarters
- Sasol Performance Chemicals locations, including sales offices and laboratories



### Source reference

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