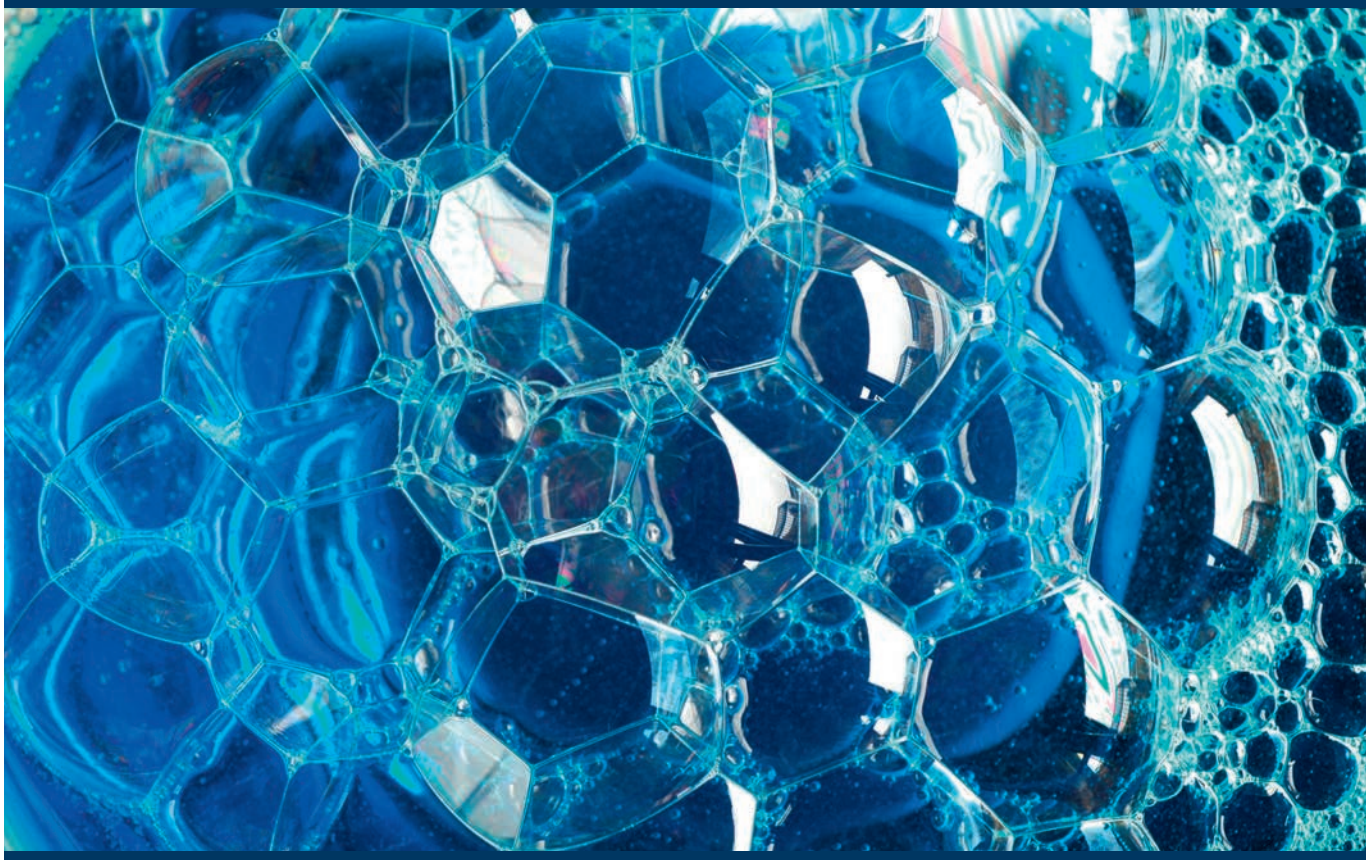
SAFOL 23E

C_{12}-C_{13} Oxo alcohol ethoxylates

Sasol Performance Chemicals



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About us

Sasol's Performance Chemicals business unit markets a broad portfolio of organic and inorganic commodity and speciality chemicals. Our business consists four key business divisions: Organics, Inorganics, Wax and PCASG (Phenolics, Carbon, Ammonia and Speciality Gases). About 6300 people (incl. employees from Regional Operating Hubs) in offices in 18 countries serve customers around the world with a multi-faceted 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, ethylene, petrolatum, paraffin waxes, synthetic waxes, cresylic acids, high-quality carbon solutions as well as high-purity and ultra-high-purity alumina. Our speciality gases sub-division supplies its customers with high-quality ammonia, hydrogen and CO_2 as well as liquid nitrogen, liquid argon, krypton and xenon gases.

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 and coatings, leather and metal processing, hot-melt adhesives, bitumen modification and catalyst support for automotive catalysts and other diverse specialty applications including oil and gas recovery, aroma production, plastic stabilisation, and polymer production. Every day, our researchers explore ways to improve our products and develop innovations that improve the quality of people's lives.

1. General remarks

The products of the SAFOL 23E series are alkylpolyethylene glycol ethers and belong to the class of nonionic surfactants. SAFOL 23 alcohol, a C_{12}–C_{13} oxo alcohol, is the feedstock alcohol on which these products are based.

The individual grades of the SAFOL 23E series differ in the number of moles of ethylene oxide added. The SAFOL 23 ethoxylates cover a broad spectrum of properties, useful in a wide range of applications.

In general the SAFOL 23E product group is characterized by the following properties:

- Nonionic surfactants with high surface activity
- Strong emulsifying power
- High detergency and cleaning performance
- Chemical stability over a wide pH range
- User-friendly viscosity and storage behaviour
- Favourable environmental characteristics

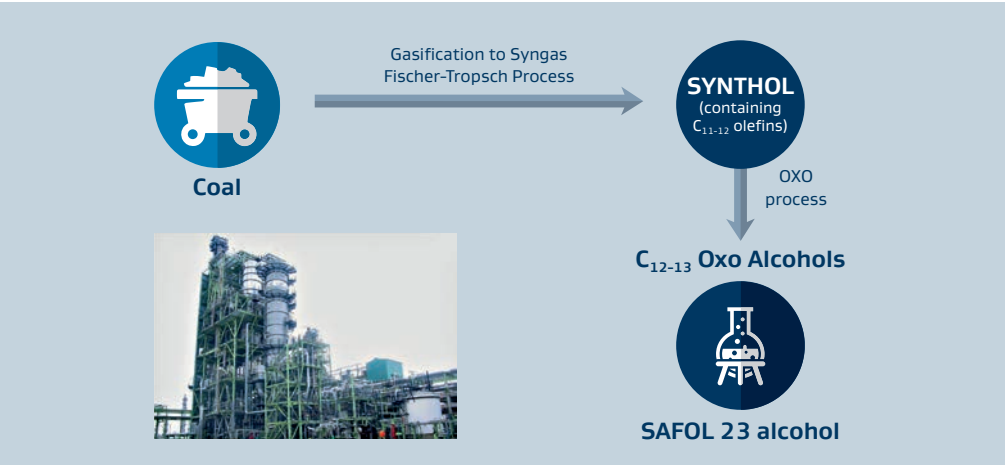
These favourable properties have opened up numerous fields of applications for the SAFOL 23E surfactants. They are applied in detergents and cleaning products, in personal care products, as auxiliaries in textile production, metal working, emulsifier technology, and also in chemical-industrial applications.

2. SAFOL 23 alcohol

2.1 Sasol's coal-to-alcohol technology

The SAFOL 23 alcohol is made in a unique industrial process from coal as primary feedstock. Sasol Ltd. pioneered Fischer-Tropsch technology that changes coal to synthetic fuels and chemicals. The Fischer-Tropsch route to produce SAFOL detergent-range alcohols via alpha olefin intermediates is a proprietary technology of Sasol.

Figure 1: Coal-to-Alcohol Process



The SAFOL coal-to-alcohol process begins with the gasification of ash coal to make synthesis gas. By Fischer-Tropsch condensation the syngas then is converted into a liquid hydrocarbon stream. The resulting Synthol intermediate consists of both even and odd chain-lengths hydrocarbons, the principal components of which are alpha olefins. Hydroformylation of the olefin portion of the C_{11}–C_{12} hydrocarbons with subsequent hydrogenation results in the C_{12}–C_{13} oxo alcohol with the trademark SAFOL 23.

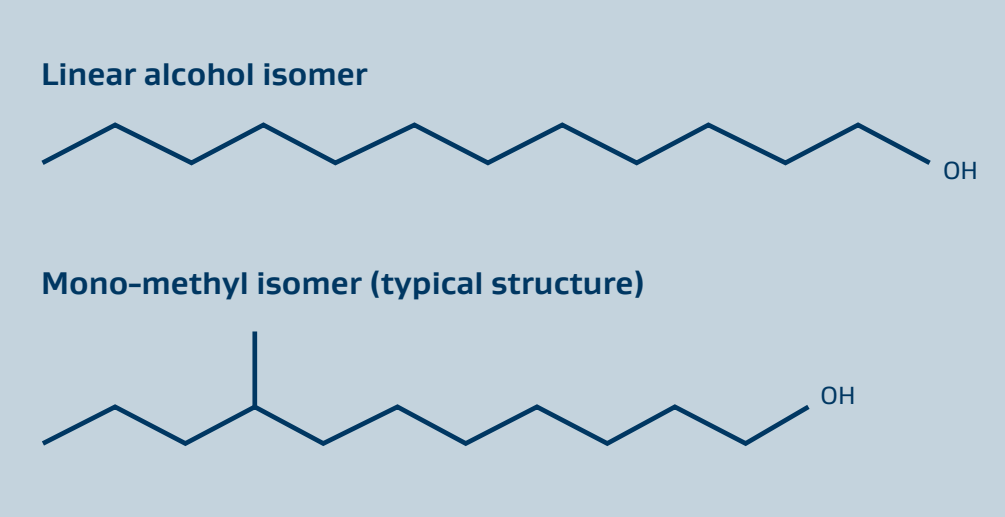
2.2 SAFOL 23 alcohol composition

SAFOL 23 alcohol is a C_{12}-C_{13} primary alcohol and consists of a mixture of linear and branched alcohol isomers. Figure 2 illustrates typical structural representations of SAFOL 23 alcohol.

Carbon distribution: (% by weight)

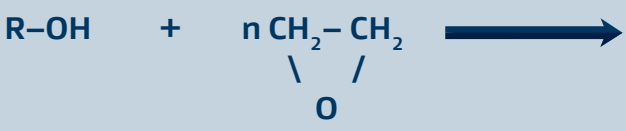
< C_{12}	max. 1
C_{12}	51–57
C_{13}	43–49
< C_{13}	max. 4
Average molecular weight:	194 g/mol

Figure 2:
Main structural representations of SAFOL 23 alcohol



3. SAFOL 23 alcohol ethoxylates

3.1 Process and preparation



SAFOL 23 Alcohol — Ethylene oxide — Alcohol polyethylene glycol ether **SAFOL 23E**

$R = C_{12}$-C_{13}-alkyl
n = number of added moles of ethylene oxide, degree of ethoxylation

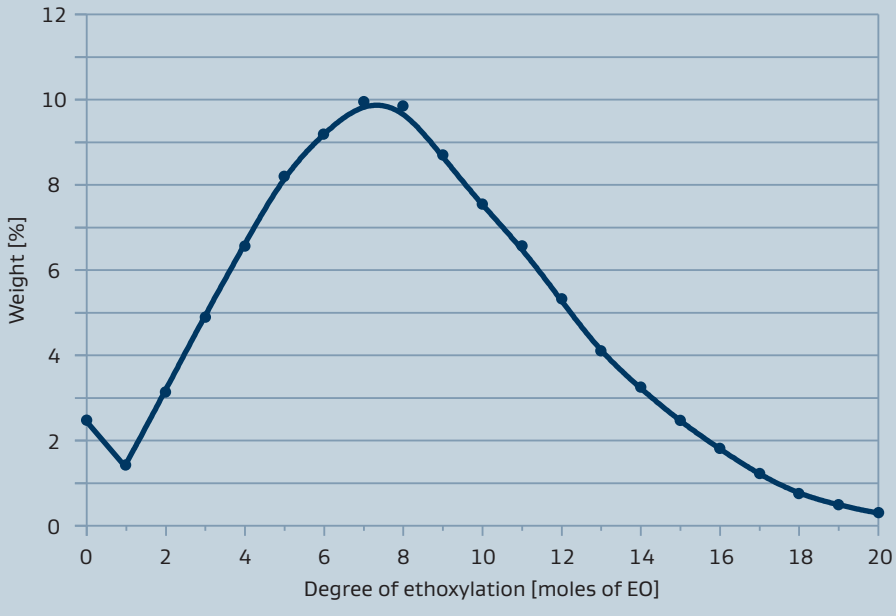
SAFOL 23 alcohol ethoxylates are manufactured by conventional ethoxylation processes. The alcohol polyethylene glycol ethers are formed by reacting SAFOL 23 alcohol with varying amounts of ethylene oxide in the presence of an alkaline catalyst:

The individual grades of the SAFOL 23E ethoxylates differ in the number n of added moles of ethylene oxide and thus in the length of the polyethylene glycol ether chain. The letter n denotes the average degree of ethoxylation, since a whole range of ethoxylation stages is produced during the reaction.

3.2 Ethoxymer distribution

The SAFOL 23E products are, like all fatty alcohol ethoxylates, mixtures of homologous fatty alcohol polyethylene glycol ethers. Figure 3 illustrates the typical EO distribution of the SAFOL 23E7 ethoxylate.

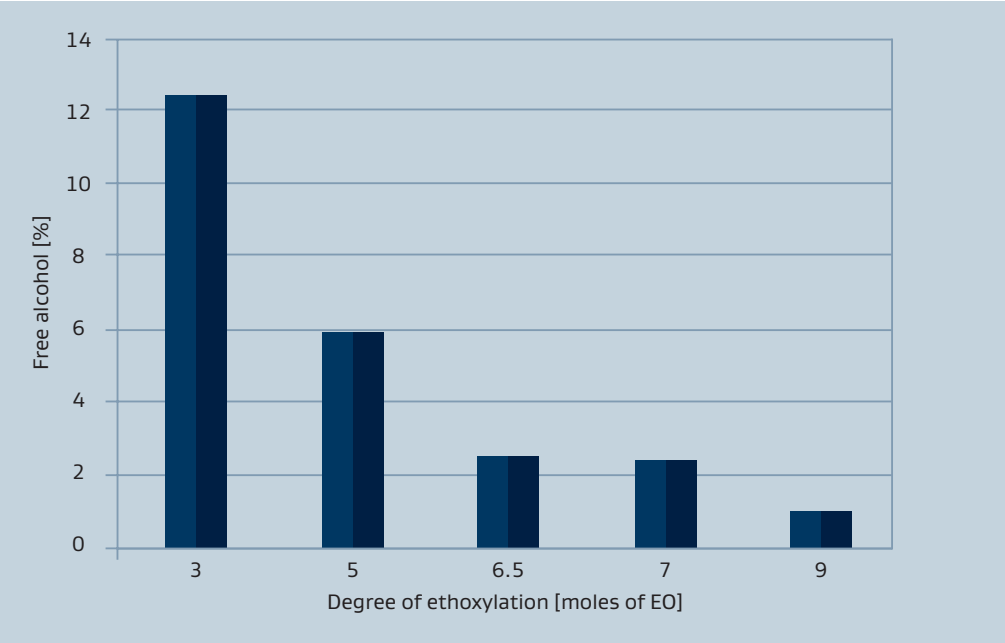
Figure 3:
SAFOL 23E7 – Typical ethoxymer distribution



3.3 Purity

SAFOL 23E products have a high active content of fatty alcohol polyethylene glycol ethers. Depending on the degree of ethoxylation, the products also contain varying amounts of starting alcohol. The free fatty alcohol, the portion of which decreases with increasing degree of ethoxylation, as shown in Figure 4, supports the cleaning action of the ethoxylates and contributes to foam regulation.

Figure 4:
Content of free alcohols in SAFOL 23E products



During the ethoxylation, secondary reactions yield polyethylene glycols having the structure $H(OCH_2CH_2)_nOH$. The proportion of polyethylene glycols having varying chain lengths typically is below 2 %. The polydiols are water-soluble products which do not impair the properties of the nonionic surfactants.

To neutralize the alkaline catalyst used for the ethoxylation reaction, SAFOL 23E grades are treated with an organic acid (e.g. acetic acid) and adjusted to a neutral pH range. Accordingly, the ethoxylate products contain a small quantity of organic salt and a small amount of water. The water content of the SAFOL 23E products is usually less than 0.5 %.

4. SAFOL 23E portfolio

The individual grades of the SAFOL 23E series have varying degrees of ethoxylation. The standard range of SAFOL 23 sales products includes the following grades:

Product Name	Chemical characterization	INCI
SAFOL 23E3	C_{12}–C_{13} oxo alcohol + 3 mol EO/mol	Laureth-3
SAFOL 23E5	C_{12}–C_{13} oxo alcohol + 5 mol EO/mol	Laureth-5
SAFOL 23E6.5	C_{12}–C_{13} oxo alcohol + 6.5 mol EO/mol	Laureth-6
SAFOL 23E6.5-90 % *)	C_{12}–C_{13} oxo alcohol + 6.5 mol EO/mol	Laureth-6
SAFOL 23E7	C_{12}–C_{13} oxo alcohol + 7 mol EO/mol	Laureth-7
SAFOL 23E7-90 % *)	C_{12}–C_{13} oxo alcohol + 7 mol EO/mol	Laureth-7
SAFOL 23E9	C_{12}–C_{13} oxo alcohol + 9 mol EO/mol	Laureth-9
SAFOL 23E9-90 % *)	C_{12}–C_{13} oxo alcohol + 9 mol EO/mol	Laureth-9

*) 90 % active product

The SAFOL 23 Ethoxylates are listed in the INCI inventory, the INCI names are shown in the product list.

5. Technical product data

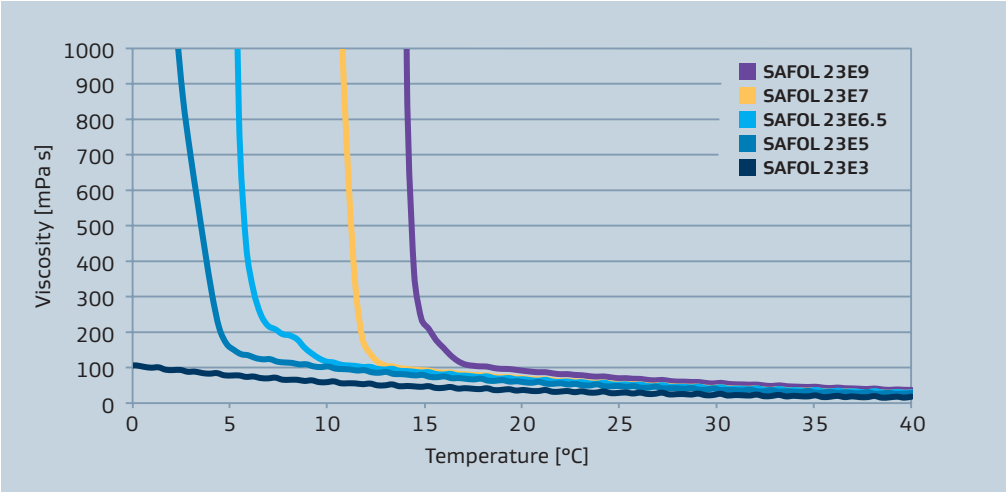
5.1 Viscosities

The viscosity profile of alcohol ethoxylates is important for transport and storage issues. The ethoxylates of the SAFOL 23E series with short EO chains are liquid with low viscosity at room temperature. Within the product series the viscosity increases continuously with increasing degree of ethoxylation. Viscosities measured at 20 °C and 50 °C according to Brookfield method are given in the table on page 12/page 13.

Viscosity was also determined over a range of temperatures. Temperature dependent viscosity of the SAFOL 23 ethoxylates is shown in Figure 5 (determined at a constant shear rate). The viscosity of the ethoxylates increases rapidly at lower temperatures.

The product grades SAFOL 23E7-90 % and SAFOL 23E9-90 % contain ca. 10 % water and are homogeneous clear liquids at room temperature.

Figure 5:
Viscosity as a function of temperature
Rotary viscometer in plate-plate geometry according to DIN 53018, shear rate D=10 1/s



5.2 Solubility in water

The solubility of the SAFOL 23E ethoxylates is determined by the chain length of the water soluble polyethylene glycol ether chain. Accordingly, the solubility increases at a higher degree of ethoxylation. Lower ethoxylates , e.g. SAFOL 23E3, are only sparingly soluble in water as these molecules are dominated by the hydrophobic alcohol part. SAFOL 23E3 is soluble in non-polar organic solvents and can be applied as emulsifier.

The higher ethoxylates SAFOL 23E6.5, SAFOL 23E7 and SAFOL 23E9 are readily soluble in water and they are used predominantly for cleaning applications.

5.3 Gel formation with water

Mixtures of SAFOL 23E surfactants with water can cover a large range of viscosities from free flowing liquids to solid gels in dependence of the amount of water added. The gel phases typically occur at medium concentrations and can have significant stability even when additional water is added. When diluting SAFOL 23E products to lower concentrations it is recommendable to avoid these gel phases during processing. This can be achieved by adding the non-ionic surfactant to water, to use warm water and to stir well. Additionally solvents, for example alcohols, but also salts and other electrolytes can help to suppress gel formation.

The viscosity profile of SAFOL 23E grades in dependence of their concentration in water is shown in Table 6. At very high surfactant concentrations (10 % water) and at relatively low concentrations below approximately 30 % surfactant (70 % water), the mixtures of the higher ethoxylates are homogeneous and clear. In the middle concentration range, on the other hand, the SAFOL 23 ethoxylates form pastes or gels which may be clear or cloudy.

The diagram, which is only intended as a guide to possible physical states on mixing with water, shows that the addition of 10 % of water to the SAFOL 23E grades always gives a homogenous and clear product. This fact is taken into account in our sale products SAFOL 23E7-90 % and SAFOL 23E9-90 %.

Appearance @ 20 °C

Water in %	0	10	20	30	40	50	60	70	80	90
SAFOL 23E3	●	●	●	■	■	■	■	■	○	○
SAFOL 23E5	●	●	■	■	■	■	■	■	○	○
SAFOL 23E6.5	●	●	■	■	■	■	■	●	●	●
SAFOL 23E7	●	●	■	■	■	■	■	●	●	●
SAFOL 23E9	○	●	●	●	■	■	■	●	●	●

● liquid ■ gel or paste ○ cloudy liquid

Table 6: Physical states of aqueous SAFOL 23E solutions at 20 °C

5.4 Cloud points

The cloud point is a leading parameter for characterizing nonionic surfactants and can be determined by standard test methods.

At a certain temperature, the initially clear solution of an ethoxylate becomes cloudy because a water-immiscible surfactant phase is formed. This process is reversible, i.e. upon cooling, the solution clarifies again at the same temperature. The temperature, at which the clouding occurs, is specific for each ethoxylate and is referred to as the cloud point of the surfactant.

Cloud points are typically measured using 1 % or 2 % aqueous surfactant solutions. If the ethoxylate is insoluble or only sparingly soluble in water, the cloud point is determined in aqueous butyldiglycol solution, as described in DIN EN 1890.

The cloud points of SAFOL 23E products are listed in Table 7.

Cloud point in °C				
	10 % in 25 % butyldiglycol solution	**5 g + 25 g of 25 % butyldiglycol solution**	**1 % in D.I. water**	**2 % in D.I. water**
SAFOL 23E3	58–60	ca. 52	-	-
SAFOL 23E5	70–72	ca. 69	-	-
SAFOL 23E6.5	ca. 78	ca. 76	44–46	ca. 45
SAFOL 23E6.5-90 %	ca. 78	ca. 76	44–46	ca. 45
SAFOL 23E7	ca. 80	ca. 79	54–56	ca. 55
SAFOL 23E7-90 %	ca. 80	ca. 79	54–56	ca. 55
SAFOL 23E9	ca. 84	ca. 83	79–82	ca. 80
SAFOL 23E9-90 %	ca. 84	ca. 83	79–82	ca. 80

Table 7: Cloud points according to DIN EN 1890

5.5 Technical data of SAFOL 23E products

Product name			**SAFOL 23E3**	**SAFOL 23E5**
Chemical composition		C_{12}-C_{13} oxo alcohol + n mol EO/mol	n = 3	n = 5
Technical data				
Appearance at 20°C			liquid, clear to turbid	liquid, clear to turbid
APHA No.		mg Pt/l	< 50	< 50
Cloud point	10 % in 25 % BDG solution	°C	58–60	70–72
	1 % in D.I. water	°C	–	–
pH value	5 % in D.I. water		5–7	5–7
Density	at 50 °C	g/ml	ca 0.91	ca. 0.95
Refractive index n 50/D	at 50 °C		ca. 1.442	ca. 1.445
Solidification point (laboratory method)		°C	ca. -7	ca. 3
Viscosity (Brookfield)	at 50 °C	mPa s	ca. 14	ca. 17
	at 20 °C	mPa s	ca. 36	ca. 48
Water		% by weight	max. 0.5	max. 0.5
Polyethylene glycol		% by weight	max. 2	max. 2
HLB value (calculated)		$\frac{20 \times \text{MW hydrophilic}}{\text{MW total}}$	ca. 8	ca. 10.5
Hydroxyl number		mg KOH/g	ca. 172	ca. 138

The obliging specifications for the SAFOL 23E sales products can be taken from the current product data sheets.

SAFOL 23E6.5	**SAFOL 23E6.5-90 %**	**SAFOL 23E7**	**SAFOL 23E7-90 %**	**SAFOL 23E9**	**SAFOL 23E9-90 %**
n = 6.5	n = 6.5	n = 7	n = 7	n = 9	n = 9
liquid, clear to turbid	liquid, clear	liquid, clear to turbid	liquid, clear	viscous liquid, turbid	liquid, clear
< 50	< 50	< 50	< 50	< 50	< 50
–	–	–	–	–	–
44–46	44–46	54–56	54–56	79–82	79–82
5–7	5–7	5–7	5–7	5–7	5–7
ca. 0.96	ca. 0.96	ca. 0.97	ca. 0.98	ca. 0.99	ca. 1.00
ca. 1.447	ca. 1.440	ca. 1.448	ca. 1.440	ca. 1.449	ca. 1.441
ca. 10	ca. 0	ca. 11	ca. 0	ca. 20	ca. 7
ca. 22	ca. 25	ca. 22	ca. 25	ca. 28	ca. 35
ca. 70	ca. 79	ca. 75	ca. 110	–	ca. 150
max. 0.5	ca. 10	max. 0.5	ca. 10	max. 0.5	ca. 10
max. 2	max. 2	max. 2	max. 2	max. 2	max. 2
ca. 12	ca. 12	ca. 12.2	ca. 12.2	ca. 13	ca. 13
ca. 115	ca. 114	ca. 110	ca. 110	ca. 96	ca. 96

5.6 Surface active properties

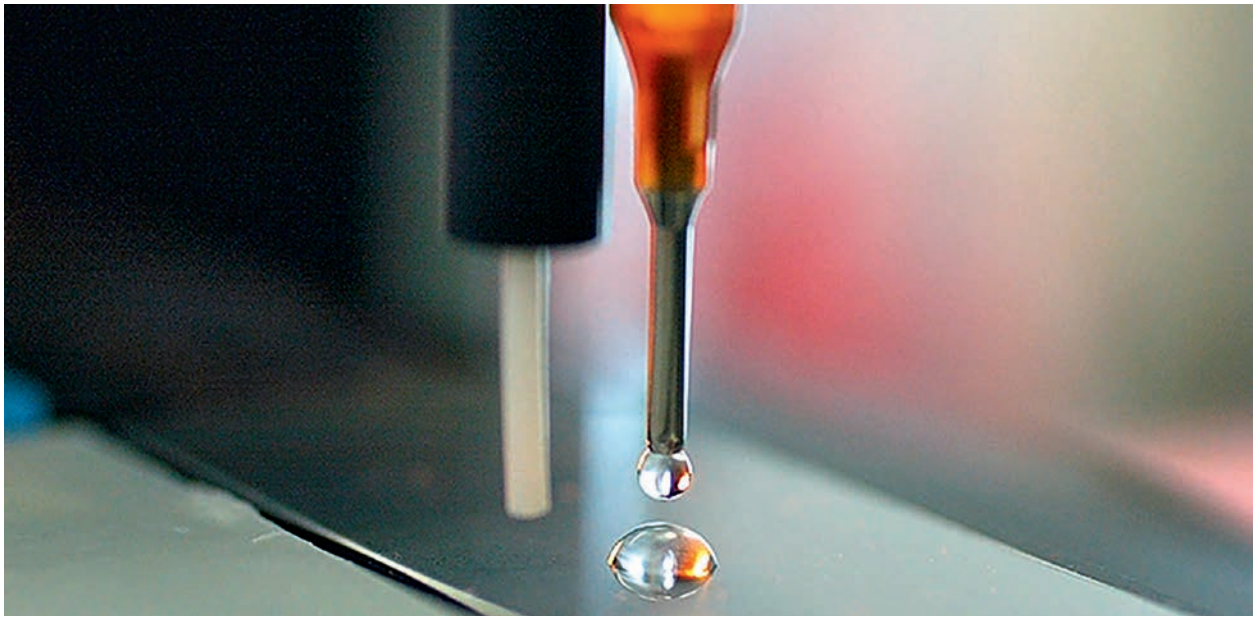
One of the most characteristic properties of surface active agents is their ability to reduce the surface tension of water. The SAFOL 23 ethoxylates provide an excellent surface tension reduction already at low concentrations. By adding SAFOL 23 ethoxylates the water surface tension of 72 mN/m can be reduced to values below 30 mN/m. Table 8 illustrates the surface activity at different surfactant concentrations in aqueous solution.

The Critical Micelle Concentration (CMC) is a further characteristic property of a surfactant. The CMC is the concentration at which single surfactant molecules start to build micellar aggregates. CMC values for the SAFOL 23E surfactants are given in Table 8.

	Surface tension in mN/m at 25 °C in D.I. water			Critical micelle concentration (CMC)
Surfactant concentration	**0.01 g/l**	**0.1 g/l**	**1.0 g/l**	**[mg/l]**
SAFOL 23E3	26.5 *	26.5 *	27 *	6
SAFOL 23E5	29 *	27.5 *	27.5 *	13
SAFOL 23E6.5	32	27.5	28	18
SAFOL 23E7	32	28	28.5	18
SAFOL 23E9	36.5	30.5	31	32

*) Turbid solutions, may lead to less accurate results

Table 8: Surface tension of aqueous SAFOL 23E solutions, ring method according to DIN EN 14370



5.7 HLB values

According to Griffin the hydrophilic-lipophilic balance (HLB) value of a nonionic surfactant is described by the ratio of the hydrophilic EO chain to the lipophilic alcohol part in the surfactant molecule. The HLB value simplifies the selection of emulsifiers from a given alcohol ethoxylate series.

The standard SAFOL 23E sales program provides ethoxylates with values in the range from HLB = 8 to HLB = 13. The HLB values for the individual products are given in the table on page 12/page 13.

5.8 Solidification points

The setting points of the SAFOL 23E products are given in the table on page 12/page 13. The solidification points were measured under laboratory conditions.

The solidification temperatures of the SAFOL 23 ethoxylates increase with increasing degree of ethoxylation. The solidification points are favourably low in comparison to linear C_{12}-C_{14} alcohol ethoxylates, as the partial branching of the alcohol hydrophobe affects the crystallization and solidification properties of the ethoxylated products.

The 90 % supply forms have significantly lower solidification points compared to the neat products.

To determine the solidification temperatures the SAFOL 23E products were slowly cooled down with gentle stirring until solidification occurred. If, however, the products are stored for an extended period in production, e.g. in tank containers, the solidification temperatures may be higher due to crystallization processes. Therefore, given solidification points are intended as guide information only.

6. Performance properties

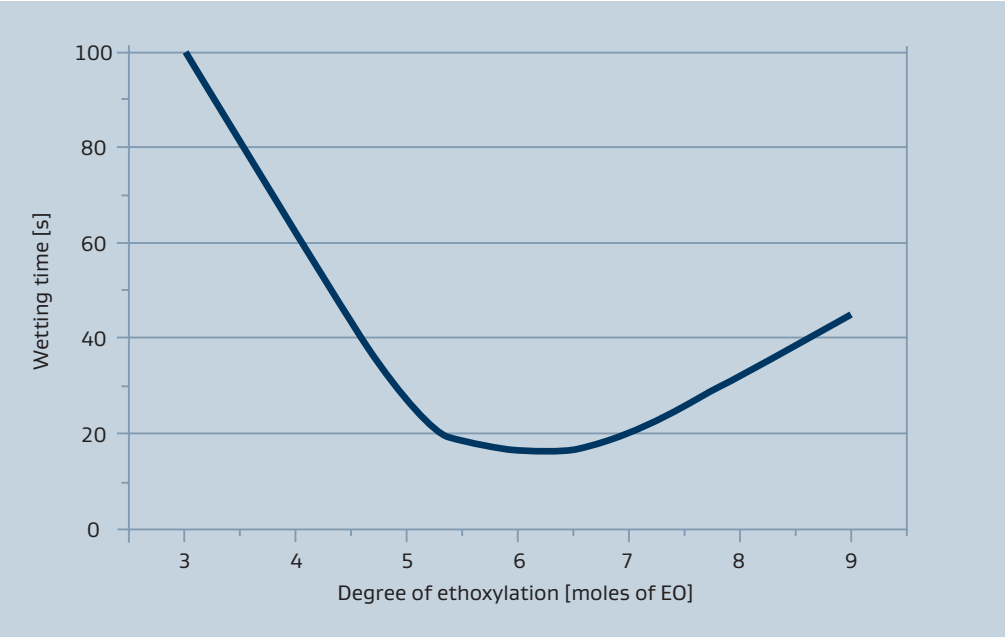
6.1 Wetting efficiency on textiles

In modern detergents, the surfactants are the active force which removes grease, soiling, and pigment particles from the fibres. The wetting efficiency on textiles is therefore an important criterion for assessing the performance of a surfactant.

The wetting times of the SAFOL 23E products were determined in aqueous solutions on cotton fabrics. The wetting performance, which corresponds to the time taken for a cotton disc to sink in aqueous solution, is a function of the degree of ethoxylation. The shorter the sinking time, the better the wetting efficiency.

The SAFOL 23 ethoxylates provide excellent wetting power on textiles, the best values being observed for SAFOL 23E5 to SAFOL 23E7.

Figure 9:
Wetting efficiency on textiles
Cotton disc method (DIN EN 1772),
1 g/l in D.I. water, 20 °C



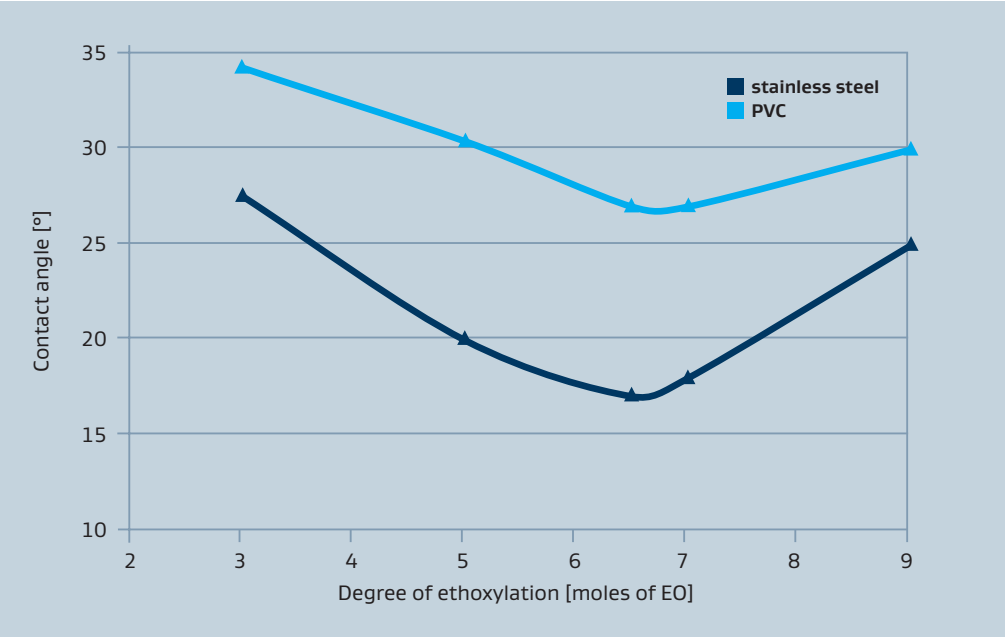
6.2 Wetting efficiency on hard surfaces

The wetting performance on hard surfaces such as metal or plastics can be assessed by contact angle measurements. The contact angle indicates how far a droplet of a surfactant solution spreads on the given surface. The lower the contact angle the better the wetting efficiency on the surface. Hydrophobic surfaces like plastics are usually more difficult to wet with water than hydrophilic surfaces. The SAFOL 23 ethoxylates show an excellent reduction of the surface angles on hard surfaces compared to pure water. The performance level is a function of the polyethylene glycol ether chain length.

The contact angles of SAFOL 23E surfactants dissolved in water at a concentration of 1 g/l are displayed on different surfaces. The best wetting performance is found for the SAFOL 23E ethoxylates with 6.5 to 7 moles EO.

The strong wetting power on hard surfaces correlates well with the good wetting properties on cotton fabrics.

Figure 10:
Contact angles of SAFOL 23E grades after a spreading time of 9 s on hard surfaces. Sessile drop method, 1 g/l in D.I. water, 25 °C, 50 % humidity.

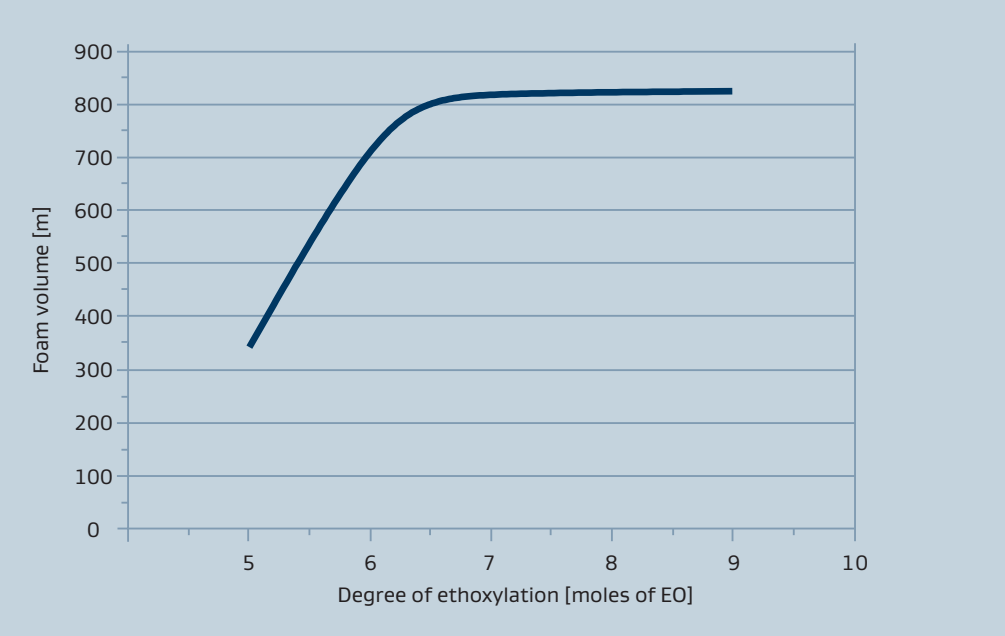


6.3 Foaming profile

SAFOL 23E ethoxylates are moderately foaming surfactants. Figure 11 shows the foaming profile determined by the SITA Foam method (foam generated by a rotating disc). At room temperature the foam level of the ethoxylates increases with increasing degree of ethoxylation. When compared to the market standards, the SAFOL 23E foaming profile is well within the typical range for fatty alcohol ethoxylates.

In comparison, anionic surfactants will generate significantly higher foam volumes. The moderate foaming properties make SAFOL 23E ethoxylates excellent candidates for front-loader detergents. The "controlled" foaming profile needed for laundry detergents applied in front loader washers can be achieved by using a smart combination of anionic surfactants, like LAS, and SAFOL 23E ethoxylates.

Figure 11:
Foaming profile SITA foam method, 1 g/l in D.I. water, 20 °C



6.4 Detergency performance

SAFOL 23 alcohol ethoxylates are versatile and efficient nonionic surfactants providing a strong performance in laundry detergents. The SAFOL 23 derivatives are excellent alternatives to existing C_{12-14} fatty alcohol ethoxylates, C_{13-15} alcohol ethoxylates, and other mid-cut alcohol ethoxylates present in the markets.

SAFOL 23 ethoxylates can be used both in liquid and in solid laundry products. The optimum detergency performance was found to be in the range of 5 to 7 moles of EO. Depending on the specific detergent type commonly the grades

- **SAFOL 23E5**
- **SAFOL 23E6.5**
- **SAFOL 23E7**

are applied in laundry detergent formulations.

7. Applications

The favourable properties of the SAFOL 23 alcohol ethoxylates result in advantageous end-use features in many fields of application. SAFOL 23E surfactants are excellent candidates for use in consumer products, like laundry detergents and home care products. Moreover the SAFOL 23E products are effective in I&I cleaners and in chemical-industrial products.

Typical application fields for SAFOL 23E surfactants	
Fabric care and home care detergents	• Laundry powders • Laundry tablets • Laundry liquids • Pre-treatment agents • All-purpose cleaners • Bathroom cleaners • Sanitary cleaners
I&I cleaners	• Professional laundry detergents • Janitorial products • Vehicle cleaners
Chemical-industrial products	• Auxiliaries for textile production and leather processing • Auxiliaries for metal working • Emulsions for technical processes • Paints and coatings
Personal care products	

7.1 Prototype formulations for cleaning products

For the formulator the SAFOL 23E ethoxylates are versatile ingredients for detergent compositions. By combining with other surfactants, e.g. anionics or cationics, it is possible to achieve synergistic and performance enhancing effects. It is advantageous that SAFOL 23 ethoxylates are chemically stable over a wide pH range both in an acidic and in an alkaline matrix and have good hard-water stability.

Prototype formulations are given below to illustrate some of the many possible applications of SAFOL ethoxylates in detergents and cleaning products. A major application is in laundry powders and in liquid detergents. In modern laundry liquids alcohol ethoxylates are present as an essential building block. In all-purpose and bathroom cleaners ethoxylates are used as primary surfactants due to excellent grease removal properties and the moderate foaming level.

Bathroom cleaner, acid	
SAFOL 23E9	2 %
Citric acid	2.0 %
Sodium hydroxide solution, 50 %	0.2 %
Isopropanol	4.0 %
Water, perfume, dye, preservative	add to 100 %
Acid spray cleaner with limescale removing properties	

Laundry liquid ca. 25 % surfactant actives	
Alkylbenzene sulfonic acid, MARLON AS3	5 %
SAFOL 23 E6.5	12 %
Coconut fatty acid	6 %
Potassium hydroxide solution (50 %), to pH 8.5	ca. 5 %
Sodium citrate dehydrate	3 %
Phosphonate, Na salt (32 % active)	1.5 %
1,2 Propylene glycol	3 %
Ethanol	4 %
Water, enzymes, dye, perfume oil, preservative	add to 100 %
Regular HDL for 30 °C, 40 °C, and 60 °C washes	

Water-free HDL concentrate ca. 70 % surfactant actives	
LAS-MIPA (77 % active), MARLON AMI 80	33 %
SAFOL 23E7	20 %
SAFOL 23E3	5 %
Coco fatty acid	15 %
Alkanolamine (MEA, to pH 8.5)	ca. 8 %
Phosphonate, Na salt (32 % active)	3 %
Solvents: 1,2 Propylene glycol, ethanol	16 %
Enzymes, dye, perfume oil	q.s.
Water-free HDL formulation, ultra-concentrated	

All purpose cleaner	
SAFOL 23 E7	3 %
LAS, SOLFODAC AC-3-I	1.5 %
SLES, COSMACOL AES 70-2-24	2 %
Coconut fatty acid	1 %
Sodium citrate dehydrate	1 %
Sodium hydroxide solution (50 %), to pH 9	ca. 0.7 %
Isopropanol	2 %
Water, perfume, dye, preservative	add to 100 %
Alkaline all-purpose cleaner. For heavy soiling, use as is.	

8. Product safety and environmental impact

SAFOL 23E surfactants meet the high European environmental and handling safety standards. No long term effects have been reported after many years of experience in various applications.

The SAFOL 23 ethoxylates show low to moderate oral toxicities. In view of their irritant action on skin and mucosa, safety precautions, such as skin and eye protection, have to be observed when handling the ethoxylates. The SAFOL 23 ethoxylates are notable for a low environmental impact due to rapid and complete biodegradation.

Precise information on safe handling, labelling, and toxicological and environmental characterisation of the individual grades is given in the Material Safety Data Sheets that are available on request.

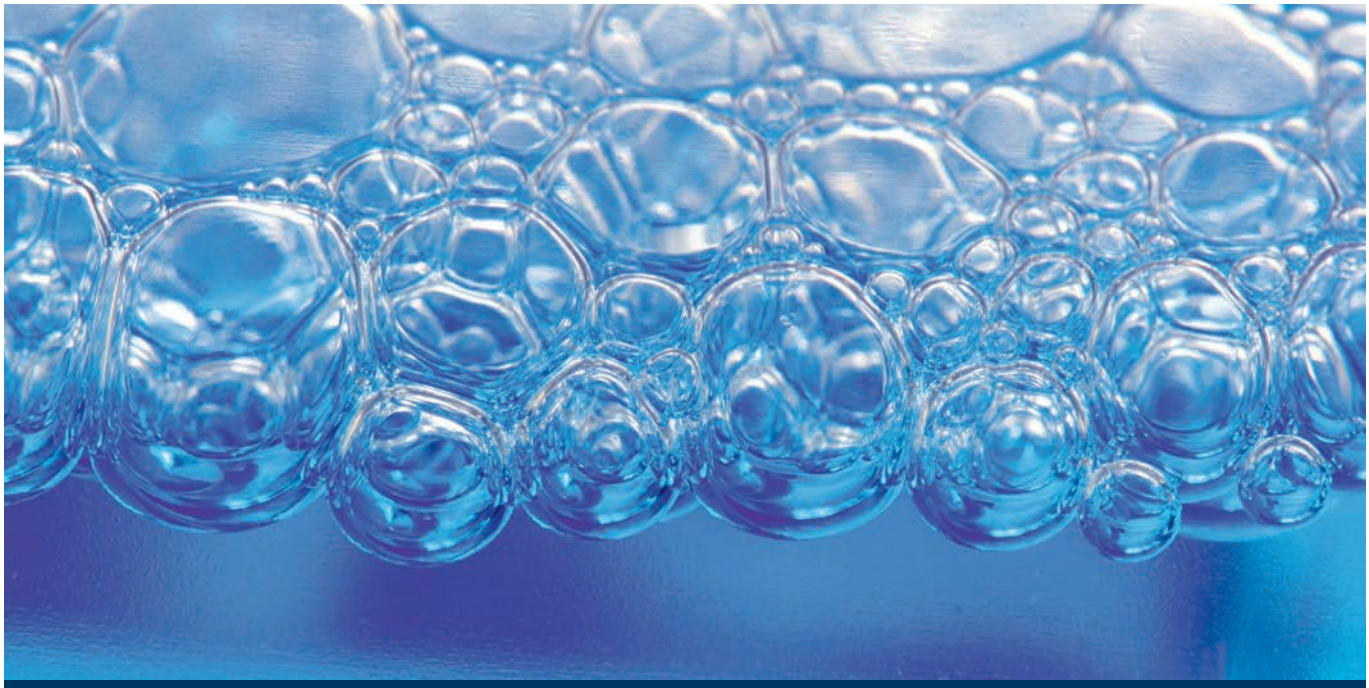
9. Storage and handling

SAFOL 23 ethoxylates are substances with good chemical stability, which will maintain product quality for a long period of time if properly stored. The bulk products can be stored in stainless steel tanks (steel grade 1.4541 or 1.4571), which must be heatable.

If the SAFOL 23E products are stored at a low temperature they may turn cloudy, solidify or form layers. It is therefore advisable to heat and thoroughly mix the contents of drums or containers before partially draining some of the contents, in order to obtain a homogeneous product.

For bulk storage we recommend a minimum storage temperature of 30-40 °C, even for the lower ethoxylated grades, like SAFOL 23E3.

Overheating is a variable that could have an adverse effect on product quality, e.g. on colour quality. Care should be taken, therefore, to store the product at a proper temperature and to use a heating medium that does not produce excessive localized temperature. It is generally recommended that SAFOL 23E products should not be stored at temperatures above 50 °C for extended periods. It is best to store the individual products at the lowest temperature necessary to keep them fluid enough to pump and process.



SAFOL 23E

C_{12}-C_{13} Oxo alcohol ethoxylates

for detergents & cleaning products

SAFOL 23E Portfolio

Product name		EO content	INCI name
SAFOL 23E3		3 EO	Laureth-3
SAFOL 23E5		5 EO	Laureth-5
SAFOL 23E6.5	SAFOL 23E6.5-90%	6.5 EO	Laureth-6
SAFOL 23E7	SAFOL 23E7-90%	7 EO	Laureth-7
SAFOL 23E9	SAFOL 23E9-90%	9 EO	Laureth-9

SAFOL 23 ethoxylate benefits

- Strong wetting performance on textiles and hard surfaces
- Moderate foaming profile – comparable to linear C_{12-14} alcohol ethoxylates
- Strong detergency and cleaning performance
- Favourable biodegradation properties and good environmental profile
- Produced at various Sasol sites across the world and marketed globally

At your service

Sasol Performance Chemicals
Organics Division
Anckelmannsplatz 1, 20537 Hamburg, Germany
info@de.sasol.com Telephone +49 40 63684-1000 Fax +49 40 63684-3700

Italy
sasol.italy@it.sasol.com
Telephone +39 025 8453-1
Fax +39 025 8453-285

Spain/Portugal
carlos.cabeza@de.sasol.com
Telephone +34 934 876 092
Fax +34 934 876 485

United Kingdom
info.uk@sasol.com
Telephone +44 1564 78 3060
Fax +44 1564 78 4088

Benelux
edwin.habers@de.sasol.com
Telephone +31 30 666 57 15

France
jean-francois.petit@fr.sasol.com
Telephone +33 1 44 010-537
Fax +33 1 47 662-425

Poland/Baltic States
janusz.duda@pl.sasol.com
Telephone +48 22 860 6146
Fax +48 22 860 6148

Slovakia
pavol.kuna@sk.sasol.com
Telephone +421 259 200 312
Fax +421 2 544 30 315

North America
info@us.sasol.com
Telephone +1 281 588 3000

South America
alvanei.martins@us.sasol.com
Telephone +55 11 4612 8199

Middle East
abbas.haroon@sasol.com
Telephone +97 14 8086 300
Fax +97 14 8086 400

Pacific Region
jackson.ding@cn.sasol.com
Telephone +852 3971 5988
Fax + 852 2530 4660

P. R. China
liangbo.lu@cn.sasol.com
Telephone +86 21 221 80 500
Fax +86 21 221 80 506

Japan
yoshihiro.ito@jp.sasol.com
Telephone +81 (3) 3248 6711
Fax +81 (3) 3248 6715

Russia
anna.kogut@de.sasol.com
Telephone +7 495 221 5142 750
Fax +7 495 926 4807

www.sasol.com

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