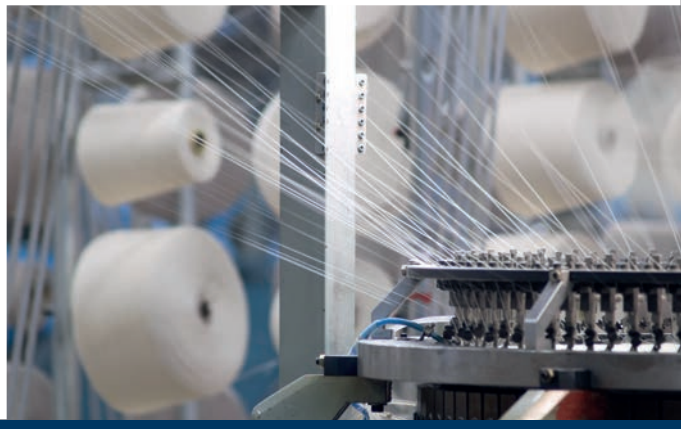
Specialty Ethoxylates

based on short chain alcohols

Sasol Performance Chemicals



Contents

1. About us

Sasol's Performance Chemicals business unit markets a broad portfolio of organic and inorganic commodity and speciality chemicals. Our business employs about 1300 people in four key business divisions: Organics, Inorganics, Wax and PCASG (Phenolics, Carbon, Ammonia and Speciality Gases). Our 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.

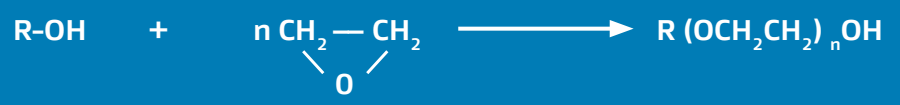
Our products are as individual as the industrial applications they serve, with tailor-made solutions creating real business value for customers. Ongoing research activities result in a continuous stream of innovative product concepts that help our customers position themselves successfully in future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

2. Product description

Sasol produces a broad range of short chain alcohols derived via Ziegler synthesis yielding linear primary alcohols with even-numbered carbon chain lengths. Further short chain alcohols are synthesized by hydroformulation processes giving access to mixtures of linear and monobranched alcohols.

The alcohol polyethylene glycol ethers are formed by reacting fatty alcohol with varying amounts of ethylene oxide according to the following equation.



Fatty alcohol **Ethylene oxide** **Alcohol polyethylene glycol ether**

R = Alkyl group with varying C-chains

n = number of added moles of ethylene oxide, degree of ethoxylation

In general the ethoxylates based on short chain alcohols show the following properties:

- Fast wetting
- Good solubility in water
- User-friendly viscosity and storage behaviour
- Chemical stability over a wide pH range
- High surface activity
- High cleaning performance
- Favourable environmental characteristics

These favourable properties open up numerous fields of application. The short chain alcohol ethoxylates are applied in cleaning products for household and I&I applications, as auxiliaries in textile production, metal working, in chemical-industrial applications and as intermediates for further derivatisation processes.

3. Product range

The following range of ethoxylates based on short chain alcohols are part of Sasol's nonionic surfactants portfolio produced in Europe:

Product names	Alcohol basis	moles EO	Cloud point (°C)
MARLIPAL 10/4	linear C10	4	60 [2)]
MARLIPAL 10/6	linear C10	6	55 [4)]
MARLIPAL 10/8	linear C10	8	82 [4)]
MARLIPAL 1012/6	linear C10/C12	6	54 [4)]
BIODAC 310	iso C10	3	56 [1)]
BIODAC 410	iso C10	4	67 [1)]
BIODAC 510	iso C10	5	37 [3)]
BIODAC 610	iso C10	6	55 [3)]
BIODAC 710	iso C10	7	65 [3)]
BIODAC 810	iso C10	8	80 [3)]
LIALET 111-3	semi linear C11	3	53 [1)]
LIALET 111-5.5	semi linear C11	5.5	70 [1)]
LIALET 111-7	semi linear C11	7	54 [3)]
LIALET 111-8	semi linear C11	8	65 [3)]
SLOVASOL 610D-3.5	linear C6/C10	3.5	64 [1)]
LIALET 91-5N	semi linear C9-C11	5	68 [1)]

1) 10% in 25% BDG solution
2) 5g + 25ml 25% BDG solution
3) 1% in deionized water
4) 2% in deionized water

In addition to the products available in Europe which are focussed on in this bulletin, Sasol also offers a range of ethoxylates based on so called light Ziegler alcohols in the range of C6 to C12 produced in Lake Charles, North America. Ethoxylates based on these even numbered short chain alcohols or mixtures thereof are offered under the trade names ALFONIC and NOVEL by Sasol N.A. These alcohol ethoxylates also cover a broad field of applications (see Table 1).

Table 1: Typical fields of application

Products	**Function / Application**							
	House-hold and I&I	Agro-chemicals	Textile auxiliaries	Oilfield applica-tions	Solubili-zing agent	Paint, Ink, Coating	Emulsifi-cation	Interme-diate
ALFONIC 610-3.5					■			■
ALFONIC 810-2								■
ALFONIC 810-6	■						■	
ALFONIC 1012-3								■
ALFONIC 1012-5	■	■	■	■		■	■	
ALFONIC 1012-6	■	■	■	■		■	■	
NOVEL 6-2				■	■	■		■
NOVEL 6-3				■	■	■		■
NOVEL 610-3.5					■			■
NOVEL 8-7	■							
NOVEL 810-2								■
NOVEL 810FD-5	■	■	■	■				
NOVEL 810FD-7	■	■	■	■				
NOVEL 10-4	■		■	■		■	■	
NOVEL 1012-3						■	■	■
NOVEL 1012-6	■	■	■	■		■	■	

4. Technical Data

4.1 Solubility in water

As for all alcohol ethoxylates the solubility of this product group mainly depends on the base alcohol and the length of the water soluble polyethylene glycol ether chain. Accordingly, the solubility increases with the degree of ethoxylation. Ethoxylates based on short chain alcohols with 3 to 5 moles of EO are only sparingly soluble in water whereas higher ethoxylated types are readily soluble in water and show excellent wetting properties.

4.2 Gel formation in water

Aqueous solutions of short chain alcohol ethoxylates 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.

For ease of handling it is recommended to avoid gel phases when diluting ethoxylates to lower concentrations. 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 like ethanol, can help to suppress gel formation. Table 2 gives an overview of the gel formation of the different alcohol ethoxylates.

Table 2: Physical states of aqueous solutions at 20°C

Appearance at 20°C	Water in %									
	0	10	20	30	40	50	60	70	80	90
MARLIPAL 10/4	○	●	○	■	■	■	■	○	○	○
MARLIPAL 10/6	○	●	●	○	○	●	●	●	●	●
MARLIPAL 10/8	○	●	●	●	○	○	●	●	●	●
MARLIPAL 1012/6	○	●	●	■	■	■	■	●	●	●
BIODAC 310	○	●	●	●	○	○	○	○	○	○
BIODAC 410	○	●	●	■	■	■	○	○	○	○
BIODAC 510	○	●	●	○	○	●	●	●	●	●
BIODAC 610	○	●	●	●	●	●	●	●	●	●
BIODAC 710	○	●	●	●	●	●	●	●	●	●
BIODAC 810	○	●	●	●	●	■	●	●	●	●
LIALET 111-3	○	●	●	●	○	○	○	○	○	○
LIALET 111-5.5	○	●	●	■	■	○	○	○	○	○
LIALET 111-7	○	●	●	■	■	●	●	●	●	●
LIALET 111-8	○	●	●	●	●	●	●	●	●	●
SLOVASOL 610D-3.5	○	●	●	●	○	○	○	○	○	○
LIALET 91-5N	○	○	■	■	■	○	●	●	●	○

● = transparent liquid
■ = gel or paste
○ = cloudy liquid

4.3 Surface active properties

One of the most characteristic properties of surface active agents is their ability to reduce the surface tension of water. Ethoxylates based on short chain alcohols provide a typical surface tension reduction. Upon addition of ethoxylates, the water surface tension of 72 mN/m can be reduced to values below 30 mN/m. Table 3 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 as well as surface tension data at 0.1 g/l resp. 1.0 g/l for the ethoxylates based on short chain alcohols are given in Table 3.

Table 3: Surface tension of aqueous solutions
(Ring method according to DIN EN 14370)

	Surface tension in mN/m, at 25°C in D.I. water Surfactant concentration		Critical micelle concentration (CMC) [g/l]
	0.1 g/l	1.0 g/l	
MARLIPAL 10/4	30	26	0.16
MARLIPAL 10/6	39	28	0.34
MARLIPAL 10/8	44	31	0.54
MARLIPAL 1012/6	29	28	0.15
BIODAC 310*	39	26	0.38
BIODAC 410*	41	26	0.54
BIODAC 510*	42	26	0.70
BIODAC 610*	44	27	0.85
BIODAC 710*	48	27	0.95
BIODAC 810*	48	29	1.26
LIALET 111-3	26	26	0.04
LIALET 111-5.5	28	27	0.09
LIALET 111-7	30	27	0.15
LIALET 111-8	33	27	0.21
SLOVASOL 610D-3.5	38	26	0.30
LIALET 91-5N	32	27	0.20

* data derived from pilot plant samples

5. Performance properties

5.1 Wetting efficiency on textiles

The wetting efficiency on textiles is an important criterion for assessing the performance of a surfactant.

The wetting times of the alcohol ethoxylates 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.

Ethoxylates based on short chain alcohols provide excellent wetting power on textiles, the best values being observed for the products MARLIPAL 10/4, LIALET 111-5, Novel 911-5 as well as the BIODAC types with 3 to 5 moles of EO.

Figure 1 illustrates the wetting performance of homologues based on different short chain alcohols. The wetting properties of the products which are not part of a homologues series are described in Table 4.

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

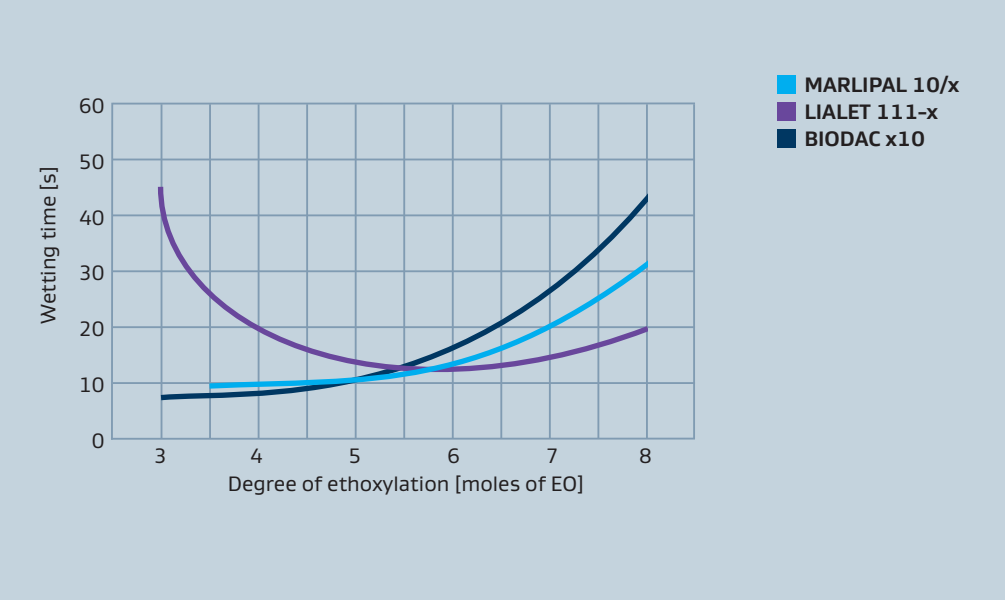


Table 4: Wetting efficiency on textiles,
Cotton disc method (DIN EN 1772),
1 g/l in D.I. water, 20 °C

Cotton disc method acc. to DIN EN 1772

	Wetting time [s]
MARLIPAL 1012/6	14
SLOVASOL 610D-3.5	20
LIALET 91-5N	10

5.2 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. Ethoxylates based on short chain alcohols show an excellent reduction of the surface angles on hard surfaces compared to pure water.

As an example the contact angles of the LIALET 111 and the MARLIPAL 10 series dissolved in water at a concentration of 1 g/l on different surfaces are given in Figure 2 and 3. The best wetting performance on stainless steel and on PVC surfaces within the LIALET 111 series is observed with 5.5 and 7 moles of EO.

The good wetting power of these products on hard surfaces correlates with the wetting properties on cotton fabrics.

Figure 2:
Contact angles of ethoxylates based on short chain alcohols on steel after a spreading time of 9s on hard surfaces.

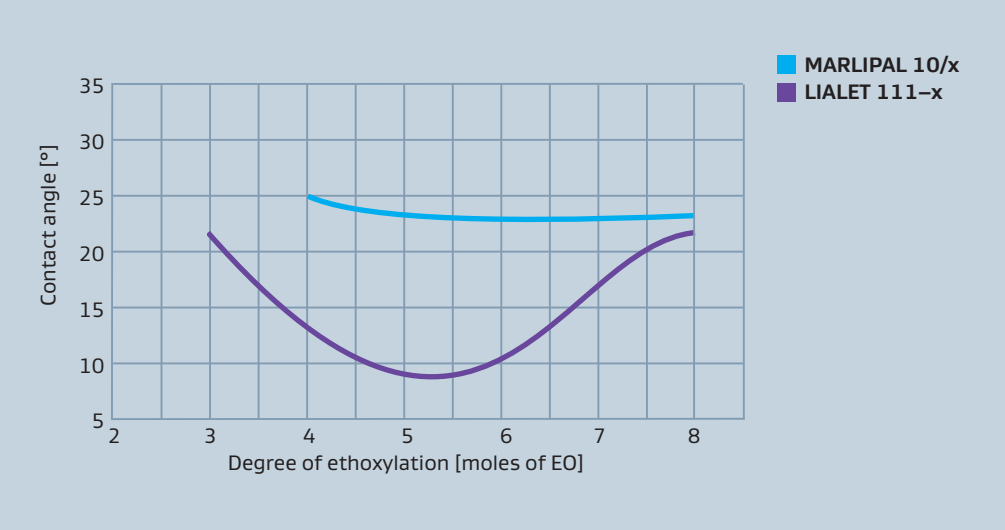


Figure 3:
Contact angles of ethoxylates based on short chain alcohols on plastics after a spreading time of 9s on hard surfaces.

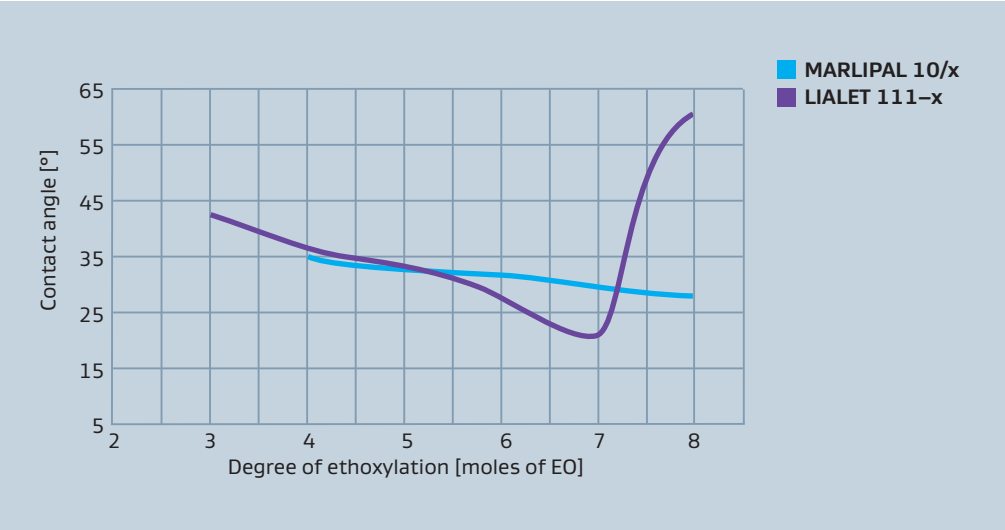


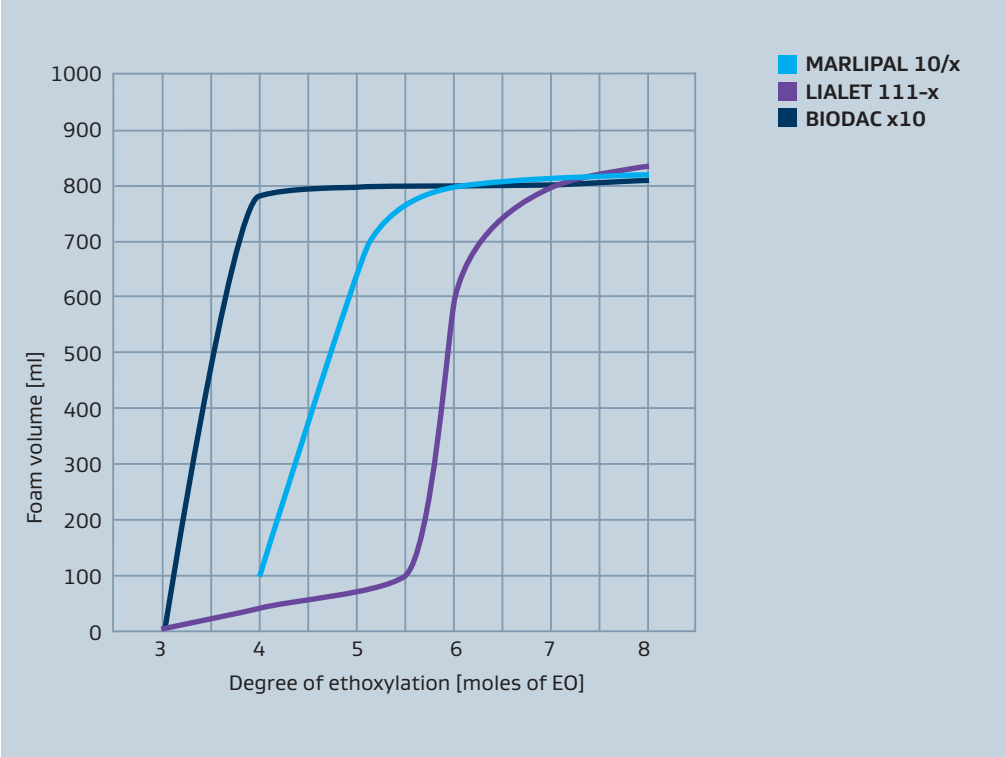
Table 5: Contact angles of ethoxylates based on short chain alcohols after a spreading time of 9s on hard surfaces

	Contact angle on steel [°]	Contact angle on plastics [°]
MARLIPAL 1012/6	9	29
SLOVASOL 610D-3.5	12	31
LIALET 91-5N	13	31

5.3 Foaming profile

Ethoxylates based on short chain alcohols are moderate to high foaming surfactants. Figure 4 shows the foaming profile of MARLIPAL 10, BIODAC x10 and LIALET 111 ethoxylates. At room temperature the foam level of the ethoxylates increases with increasing degree of ethoxylation. The foaming behaviour is determined by the SITA foam method (foam generated by a rotating disc).

Figure 4:
Foaming profile
SITA foam method,
1 g/l in D.I. water, 20°C



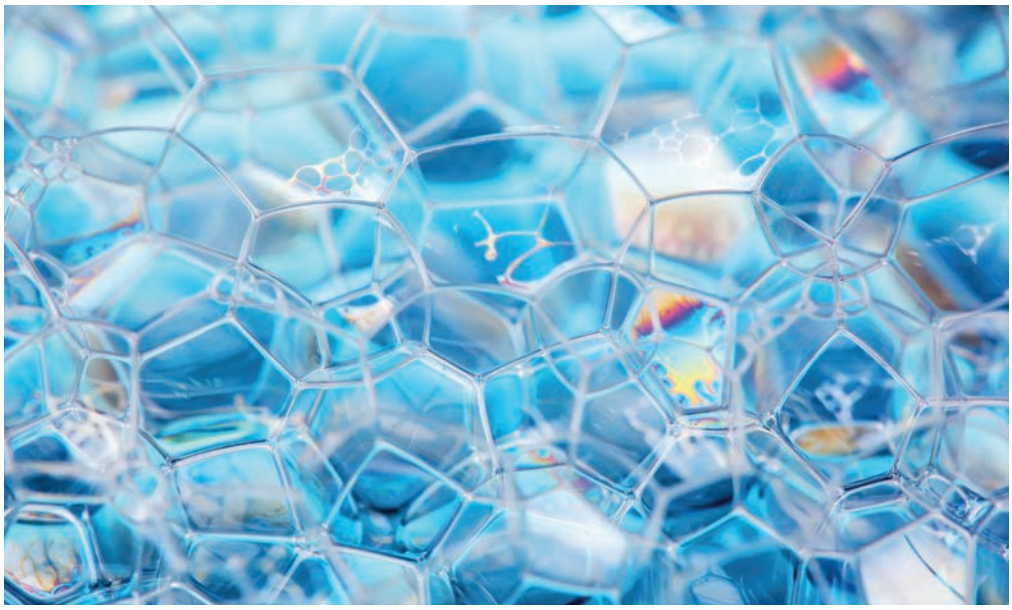
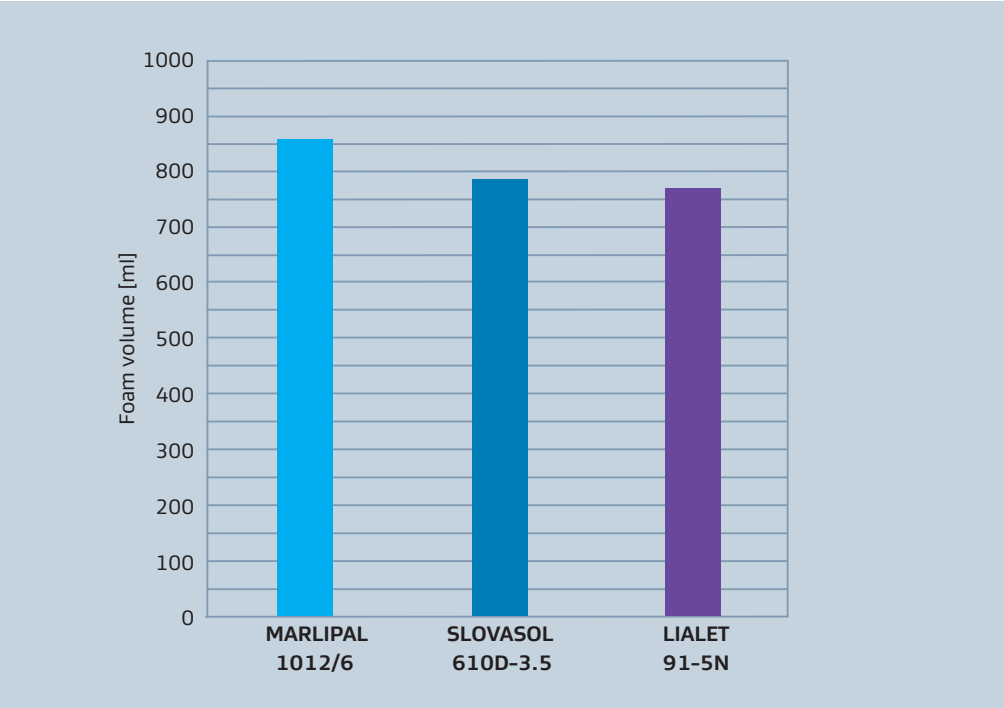


Figure 5 gives an overview of the max. foam level of further ethoxylates based on short chain alcohols which are not part of a homologues series.

Figure 5:
Foaming profile
SITA foam method,
1 g/l in D.I. water, 20°C



SITA Foam Test

6. Applications

The favourable properties of ethoxylates derived from short chain alcohols result in advantageous end-use features in many fields of application. These surfactants are excellent candidates for use in consumer products like home care products and I&I cleaners for hard surface cleaning applications. Moreover these ethoxylates are effective in chemical-industrial products and as raw materials for further derivatisations like sulfation or phosphating processes.

Typical application fields for ethoxylates based on short chain alcohols

Home care detergents

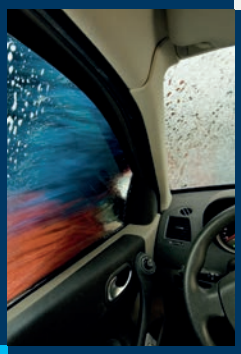
- All-purpose cleaners
- Bathroom cleaners
- Sanitary cleaners
- Pre-treatment agents (textile cleaning)

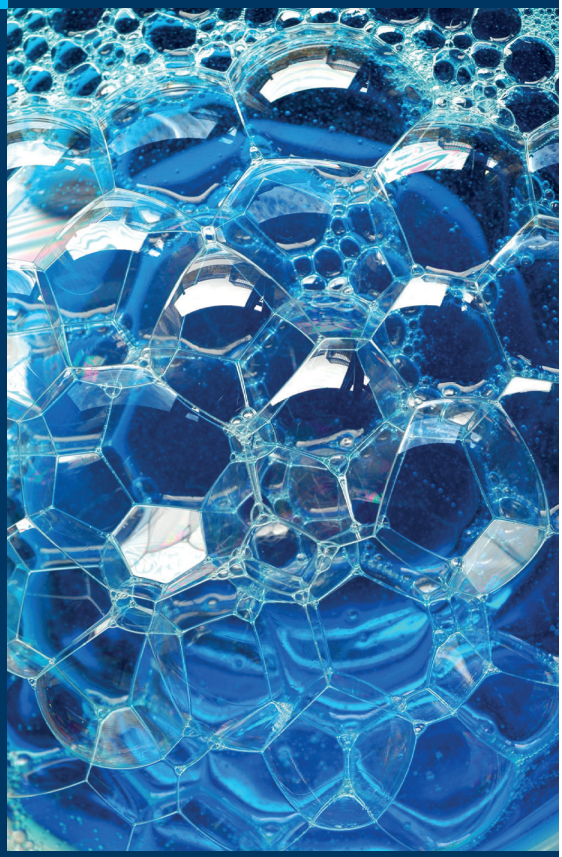
I&I cleaners

- Janitorial products
- Vehicle cleaners

Chemical-industrial products

- Auxiliaries for textile production and leather processing
- Auxiliaries for building and constructions
- Paints and coatings
- Raw materials for chemical processes





Our products are used in countless applications in our daily lives to add value, security and comfort.

7. Product safety and environmental impact

Sasols non-ionic 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 described alcohol 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.

Ethoxylates based on short chain alcohols 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.

8. Storage and handling

Short chain alcohol ethoxylates are products 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).

If the 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.

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 short chain alcohol ethoxylates should not be stored at temperatures above 50 °C for extended periods.

Our global footprint

- Sasol Performance Chemicals Headquarters
- Sasol Performance Chemicals Locations eg. Sales offices, laboratories, etc.

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
karina.pareick@de.sasol.com
Telephone +49 2365 49 19902
Fax +49 40 63684 2026

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

Specialty Ethoxylates 08/15 GB