

SASOL

Low foaming nonionic Surfactants and Specialities

Sasol Performance Chemicals



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1. 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 CO₂ 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. Foreword

Sasol Performance Chemicals products are based on our wide range of linear and semi-linear fatty alcohols. This brochure gives an overview of the range of speciality, low-foaming nonionic surfactants and defoamers which are produced by the alkoxylation of fatty alcohols with ethylene and propylene oxide.

Our worldwide manufacturing network, together with our highly-skilled people, are dedicated to helping you achieve your performance and formulation requirements.

3. Product description

Nonionic surfactants with low foaming behaviour are essential components for detergent and cleaning applications and important auxiliaries for various industrial processes. Standard nonionic fatty alcohol ethoxylates are efficient, but relatively high foaming surfactants. In some applications they cannot be used, because even lower sudsing behaviour or the complete absence of foam is required. Partly use of propylene oxide for the alkoxylation of the fatty alcohol positively influences the foam suppression.

The low foaming alcohol EO/PO surfactants are produced by the alkoxylation of fatty alcohols. The alkyl chain length ranges from C_{10} to C_{18} and varying amounts of ethylene oxide and propylene oxide. By this means a portfolio of low foaming surfactants and defoamers with tailor made properties is received.

MARLOX, BIODAC, NOVANIK, LORODAC and PLURODAC products are multi purpose low foaming nonionic surfactants which are applied in detergents, industrial cleaners, textile auxiliaries, metal working, pulp and paper and a variety of other technical applications.

MARLOX B grades are tert-butyl end-capped low foaming surfactants for industrial applications. They possess very low electrolyte content and are used in applications where a terminal hydroxyl group is chemically undesired.



4. Product range

	Products	Alcohol basis	Cloud point [°C]
Low foaming wetting agent	MARLOX K 158	linear C ₁₀	36–39 ¹
	MARLOX FK 64	linear C ₁₀ /C ₁₂	54–56 ¹
	MARLOX FK 86	linear C ₁₀ /C ₁₂	21–23 ³
	MARLOX FK 57	linear C ₁₀ /C ₁₂	32–36 ⁵
	MARLOX FK 69	linear C ₁₀ /C ₁₂	42–44 ³
	BIODAC 2-32	semi linear C ₁₁	34–36 ²
	MARLOX OP-1	semi linear C ₁₁	36–38 ²
	MARLOX 11027	semi linear C ₁₁	26–28 ²
	MARLOX 11009	semi linear C ₁₁	9–11 ²
	MARLOX 40	semi linear C ₁₁	60–62 ¹
	MARLOX 50	semi linear C ₁₁	38–44 ²
	MARLOX 80	semi linear C ₁₁	55–57 ²
	MARLOX MO 124	linear C ₁₂ /C ₁₄	38–40 ¹
	MARLOX MO 154	linear C ₁₂ /C ₁₄	40–43 ⁴
	MARLOX B 24/80	linear C ₁₂ /C ₁₄	34–38 ³
	MARLOX N 92	oxo C ₁₃	42–46 ³
	LORODAC L6-S-50	semi linear C ₁₂ /C ₁₅	37–41 ²
	NOVANIK 0633 A	semi linear C ₁₂ /C ₁₅	45–51 ¹
NOVANIK 1047 A	semi linear C ₁₂ /C ₁₅	46–52 ¹	
NOVANIK 1018 A	semi linear C ₁₂ /C ₁₅	34–40 ¹	
MARLOX LF 9353	semi linear C ₁₂ /C ₁₅	34–37 ¹	
Emulsifier	BIODAC 25059	semi linear C ₁₂ /C ₁₅	58–60 ⁴
	MARLOX RT 42	linear C ₁₆ /C ₁₈	51–53 ¹
	MARLOX RT 64	linear C ₁₆ /C ₁₈	60–62 ¹
Defoamer	EMULDAC PE 251	linear C ₁₆ /C ₁₈	
	MARLOWET 4756	linear C ₁₆ /C ₁₈	
	NONFIX 11011	branched C ₁₅	
	MARLOWET CPO	linear C ₁₂ /C ₁₄	
	MARLOX B 35	oxo C ₁₃	

		Molecular weight	Cloud point [°C]
EO-PO block co-polymers	PLURODAC 44	2400	64–66 ⁷
	PLURODAC 61	2000	22–25 ²
	PLURODAC 62	2200	25–28 ²
	PLURODAC 64	3000	59–60 ⁷
	PLURODAC F68	8000	70–75 ⁶
	PLURODAC 81	2700	17–21 ²

¹ 10 % in 25 % butyldiglycol solution

² 1 % in deionized water

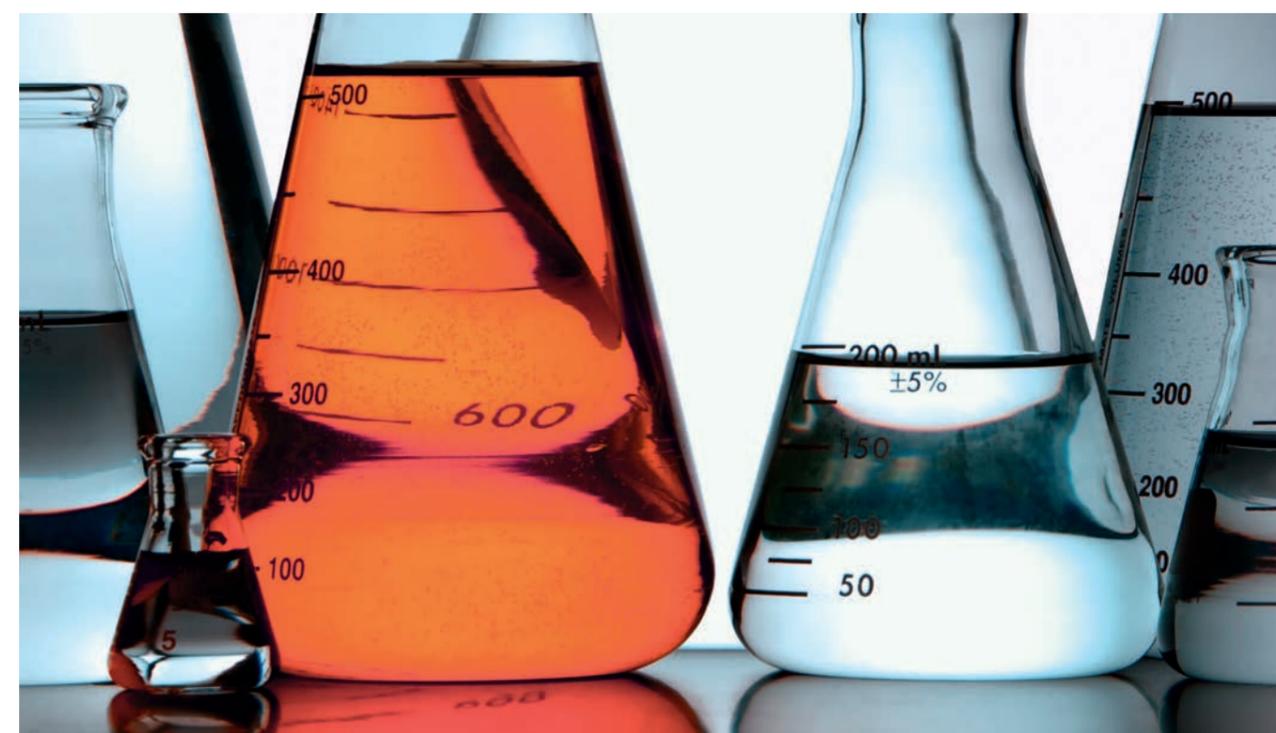
³ 2 % in deionized water

⁴ 20 % in 25 % butyldiglycol solution

⁵ 0,5 % in deionized water

⁶ 1 % in 10 % NaCl solution

⁷ 10 % in deionized water



5. Technical properties

5.1 Low foaming wetting agent

Table of typical technical data

	unit	MARLOX K 158	MARLOX FK 64	MARLOX FK 86	MARLOX FK 57	MARLOX FK 69	BIODAC 2-32	MARLOX O P-1
Appearance at 25 °C		clear to turbid liquid						
Concentration	%	100	100	100	100	100	100	100
pH (5 % in water)		6	6	6	6	6	6	6

Cloud point

BDG 1	°C	38	55	39	48	51	52	51
Water 2	°C	17	n.a.	21	34	43	35	36
Density 20 °C	g/ml	0.98	1.05	1.00	1.00	1.01	0.96	0.98
Solidification point	°C	< -20	< -20	< -10	< -10	ca. +2	< -10	< -10
Kin. viscosity at 50 °C	mm ² /s (cSt)	22	14	34	24	28	21	18
Av. molecular weight	g/mol	844	690	910	762	900	650	660
HLB (estimated)		10.6	12.0	11.6	12	12.4	12.4	12.4
CMC	g/l	0.18	0.02	0.13	0.09	0.11	0.06	0.12
Surf. tension at CMC	mN/m	30.4	29.1	30.0	32.1	31.4	28.5	29.1
Dyn. contact angle, stainless steel	°	32	29	39	40	32	15	37

Wetting value, cotton (DIN EN 1772)

23 °C, water, 1 g/l	s	15	25	15	15	26	15	20
23 °C, 1% NaOH, 1 g/l	s	55	>180	15	27	40	30	30
23 °C, 2% NaOH, 1 g/l	s	160	>180	35	30s	50	95	40

Foam, turbine (DIN EN 13996)

25 °C, 2 min, 1 g/l	ml	30	420	35	1960	2040	1450	1460
25 °C, 10 min, 1 g/l	ml	20	65	7	280	360	300	120
40 °C, 2 min, 1 g/l	ml	0	50	0	50	220	60	50
40 °C, 10 min, 1 g/l	ml	0	30	0	20	20	50	30

¹ 10 % in 25 % butyldiglycol

² 1 % in demineralised water

MARLOX 11027	MARLOX 11009	MARLOX 40	MARLOX 50	MARLOX 80	MARLOX MO 124	MARLOX MO 154	MARLOX B 24/80	MARLOX N 92	LORODAC L6-S-50	NOVANIK 0633 A
clear to turbid liquid	clear to turbid liquid	clear liquid	clear liquid	clear liquid	clear to turbid liquid	clear to turbid liquid	clear to turbid liquid	clear liquid	clear to turbid liquid	clear to turbid liquid
100	100	100	100	100	100	100	100	100	100	100
6	6	6	6	6	6	6	6	5-7	6	7

44	31	60	67	75	39	48	49	n.a	60	45-51
26	11	n.a.	43	56	n.a.	29	37	42-46	39	n.a.
0.98	1.00	0.96	0.98	1.00	0.94	0.97	0.96	ca. 1.01	0.98	0.97
< -10	< -10	ca. -5	ca. +2	ca. +8	< -10	ca. -7	ca. +7	ca. -3	ca. -3	ca. -6
23	34	16	16	18	14	20	14	15	38	24
760	970	445	550	650	510	640	610	712	580	670
11.2	9.4	9.5	10.5	13.2	9.6	11.4	11.5	12.8	11.8	12.3
0.07	0.02	0.03	0.03	0.04	0.01	0.01	0.01	0.06	0.01	0.01
29.8	31.5	27.8	27.9	28.1	29.8	29.0	28.3	29.7	29.3	29.2
31	29	25	20	36	46	26	51	33	25	44

15	35	20	11	20	>180	20	20	15.5	15	20
25	55	23	23	33	>180	40	30	27	30	30
40	90	34	29	41	>180	>180	40	29	40	60

140	0	480	1900	2060	45	700	1790	2000	2100	1560
40	0	120	910	1200	0	140	700	660	1260	360
20	0	400	1750	2060	0	40	1040	500	1690	40
10	0	80	760	920	0	10	160	60	560	30

	unit	NOVANIK 1047 A	NOVANIK 1018 A	MARLOX LF 9353	BIODAC 25059	MARLOX RT 42	MARLOX RT 64
Appearance at 25 °C		clear to turbid liquid	clear to turbid liquid	clear to turbid liquid	turbid liquid	clear to turbid liquid	turbid liquid
Concentration	%	100	100	100	100	100	100
pH (5% in water)		7	5-7	5-7	6	5-7	6
Cloud point							
BDG ¹	°C	46-52	34-40	34-37	62	51-53	60-62
Water ²	°C	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Density 20 °C	g/ml	1.00	0.97	0.95	1.01	0.94	0.96
Solidification point	°C	ca. 0	< -20	< -20	ca. -5	ca. +13	ca. +7
Kin. viscosity at 50 °C	mm ² /s (cSt)	58	40	15	66	23	30
Av. molecular weight	g/mol	1010	1140	550	1525	610	784
HLB (estimated)		11.5	8,6	9.6	12.5	8.5	10.0
CMC	g/l	0.02	n.a.	n.a.	0.02	n.a.	0.1
Surf. tension at CMC	mN/m	32.1	n.a.	n.a.	31.9	n.a.	31.1
Dyn. contact angle, stainless steel	°	43	55	61	36	55	41
Wetting value, cotton (DIN EN 1772)							
23 °C, water, 1 g/l	s	30	160	101	77	>180	>180
23 °C, 1% NaOH, 1 g/l	s	50	160	170	>180	>180	>180
23 °C, 2% NaOH, 1 g/l	s	60	150	>180	>180	>180	>180
Foam, turbine (DIN EN 13996)							
25 °C, min 2, 1 g/l	ml	1840	20	50	720	0	120
25 °C, min 10, 1 g/l	ml	360	10	40	240	0	80
40 °C, min 2, 1 g/l	ml	60	0	0	230	0	0
40 °C, min 10, 1 g/l	ml	40	0	0	100	0	0

¹ 10 % in 25 % butyldiglycol² 1 % in demineralised water

	unit	EMULDAC PE 251	MARLOWET 4756	NONFIX 11011	MARLOWET CPO	MARLOX B 35
Appearance at 25 °C		clear liquid	—	clear liquid	clear liquid	clear to turbid liquid
Concentration	%	100	100	100	100	100
pH (5 % in water)		4-6	5-7	4-6	—	5-9
Density 20 °C	g/ml	0.98	1.0	0.97	0.88	0.91
Solidification point	°C	ca. -7	<-20	<-10	—	<-20
Kin. viscosity at 50 °C	mm ² /s (cSt)	63	86	55	8	17

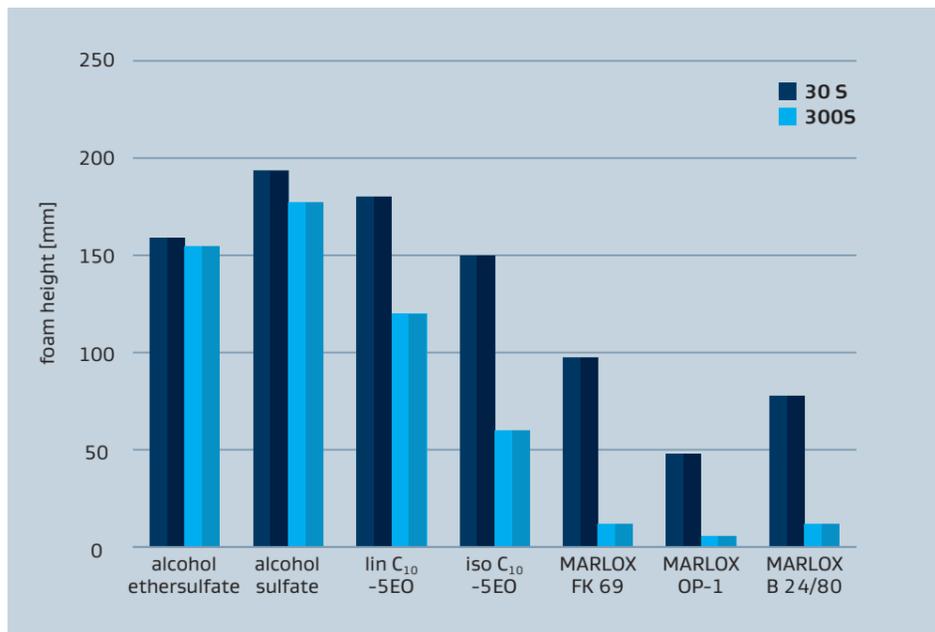


5.2 Foaming properties

The alcohol EO/PO products are low foaming surfactants. Especially products with low fractions of polyethylene glycol chains do not foam and are often used as foam regulators in surfactant mixtures.

Figure 1 shows as an example the foam volume of the alcohol EO/PO products MARLOX FK 69, MARLOX OP-1 and MARLOX B 24/80 in comparison to standard anionic and nonionic surfactants. Alcohol sulfates and alcohol ethersulfates show higher foam stabilities than nonionic surfactants. The alcohol EO/PO products generate at similar cloud points significantly reduced foam volumes compared to pure alcohol ethoxylates using the same origin.

Figure 1:
Foam behaviour according to Ross-Miles at 25 °C of alcohol EOPO products in comparison to standard anionic and nonionic surfactants



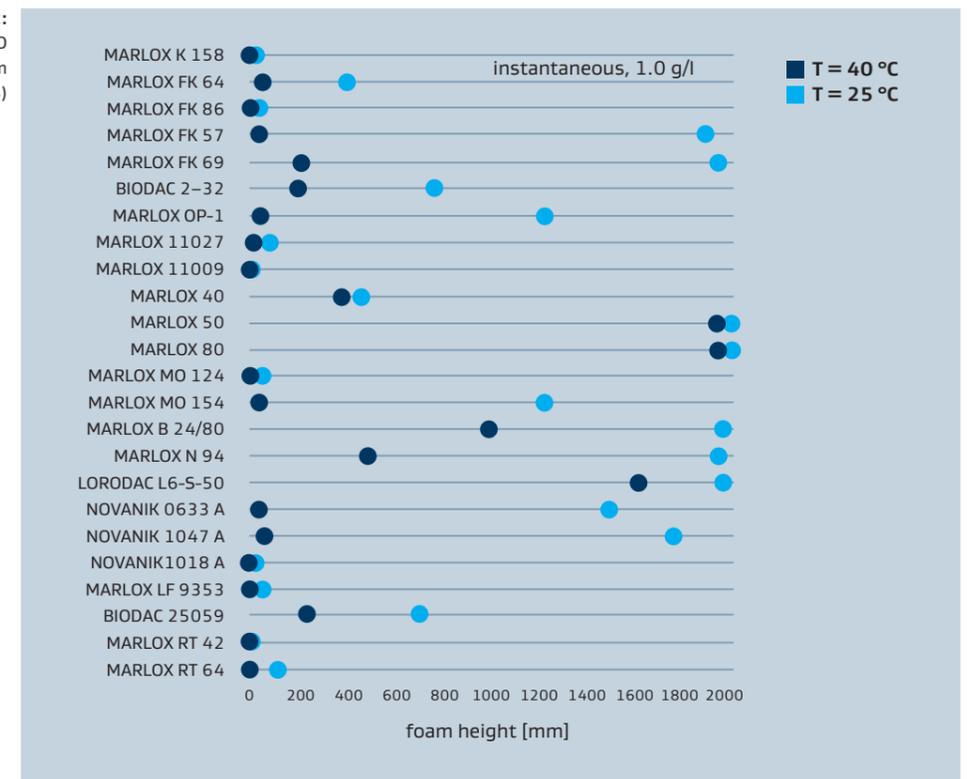
Foaming tests have been carried out by the turbine foam method (DIN EN 13996). According to the test procedure, the foam is generated by turbine stirring (5 min). The foam and liquid are poured in a cylinder. Upper and lower foam levels are measured over time. Figure 2 compares the foam heights measured directly after the foam generation at T = 25 °C and 40 °C.

With increasing temperature the foam volume reduces due to nonionic character and disappears for those products with low cloud points in BDG solution. The multi purpose wetting agents MARLOX K 158, MARLOX 11009 and NOVANIK 1018 A show very low foam values at 25 °C and no foam at 40 °C. These surfactants can even be used at turbulent processes with high air entrance.

Comparing the foaming values, one should remember that the best product for an application can be only found regarding all application requirements in the different formulations. Short chained alkoxyated products are optimal performers in applications on fast wetting, high electrolyte content or compatibility with other formulation ingredients.

Low foaming products with low cloud points are often used as co-surfactant in order to regulate foaming behaviour of anionic surfactants.

Figure 2:
Foam behaviour of alcohol EO/PO products according to turbine foam (DIN EN 13996)

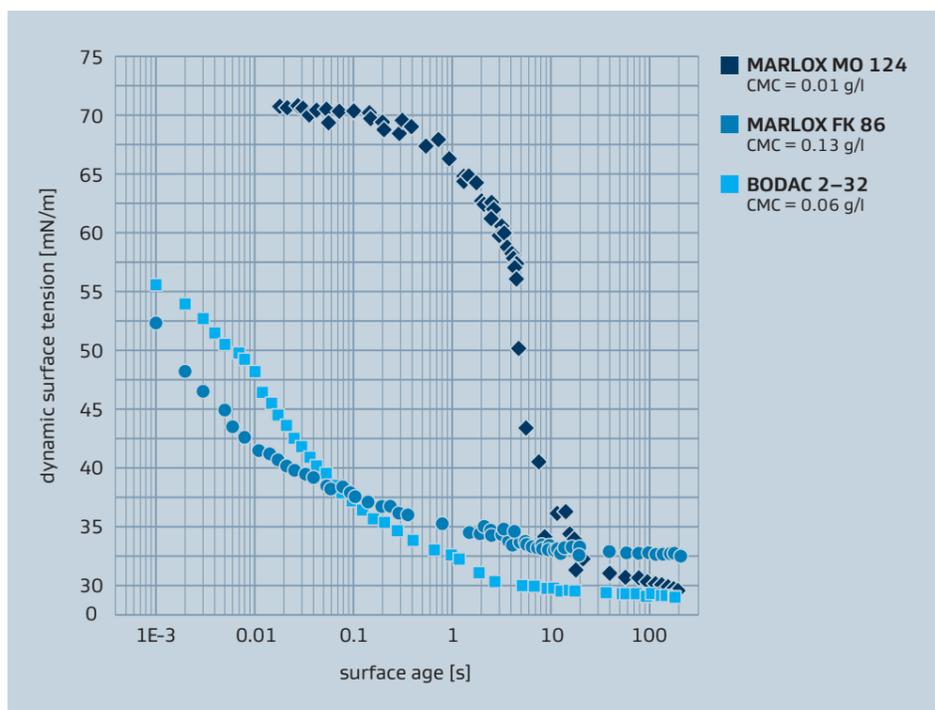


5.3 Surface activity

The alcohol EO/PO products are surface active in water when the degree of ethoxylation and propoxylation is chosen appropriately. All products show surface tensions in the range of 27–35 mN/m at their critical micelle concentration. Depending on the product the CMC varies between 0.01 and 0.2 g/l.

For fast wetting processes the dynamic surface tension of the surfactant solution is decisive. Figure 3 shows the dynamic surface tension measured over the time. Fast wetting products like BIODAC 2–32 and MARLOX FK 86 reduce the surface tension of the air/water surface already after a few milliseconds.

Figure 3:
Dynamic surface tension
of selected products (1g/l, 23 °C)

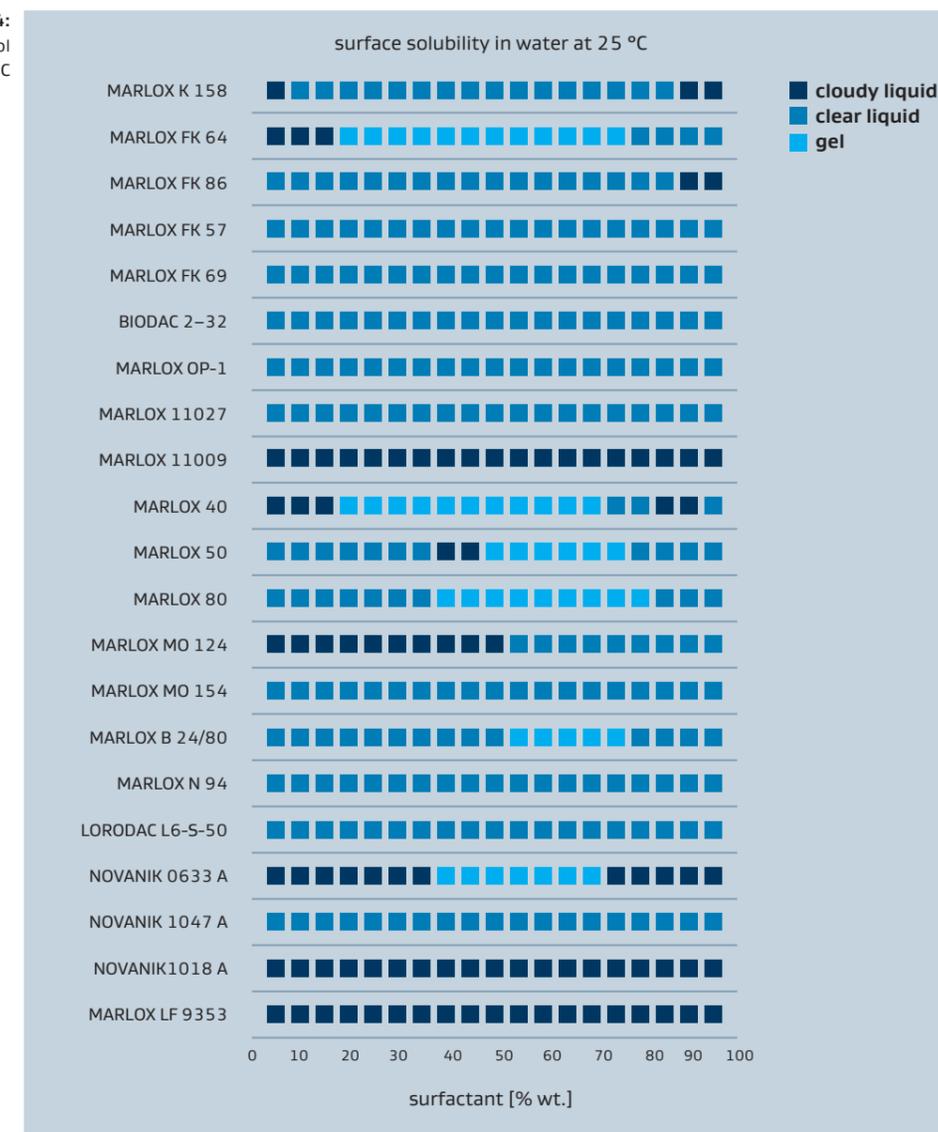


5.4 Aqueous solubility

The solubility of the alcohol EO/PO products increases according to the degree of ethoxylation and decreases using longer hydrophobic alcohol chains and additionally by the degree of propoxylation.

For the preparation of liquid formulations the compatibility with other active ingredients and solvents is important. Figure 4 shows the aqueous solubility over the whole concentration range. The outstanding property of alcohol EO/PO products is the low tendency to form gel phases. Several products like MARLOX OP-1, MARLOX 11027, MARLOX FK 69 or BIODAC 2–32 dissolve clear over the whole concentration range. Even in case of cloudy aqueous liquids the dispersions are often very stable against separation. An example is MARLOX FK 64 which is beneficial for the use in dispersions as aqueous lubricant or release agent for technical applications in concentrations below 15 %.

Figure 4:
Physical states of aqueous alcohol
EO/PO solutions at 25 °C



6. Applications

Nonionic alcohol EO/PO products are hard water tolerant and stable in acidic and alkaline conditions. Wetting and foam regulation are the main functions of the products in industrial cleaning applications. Table 4.1 gives an overview regarding important product functions and the applications of the individual products.

Products	Function					Application			
	Wetting	Foam regulation	De-greasing	Non-geling	Emulsi-fication	I&I and house-hold	Textile auxiliaries	Metal working/lubricating	Technical appl.
MARLOX K 158	■	■		■			■		■
MARLOX FK 64	■		■		■	■	■	■	■
MARLOX FK 86	■	■		■		■	■		
MARLOX FK 57	■	■				■			
MARLOX FK 69		■		■			■		■
BIODAC 2-32	■	■	■	■		■	■	■	■
MARLOX OP-1	■	■	■	■		■	■	■	■
MARLOX 11027	■	■				■	■	■	■
MARLOX 11009		■		■		■	■		■
MARLOX 40	■	■			■	■	■	■	■
MARLOX 50	■	■			■	■	■	■	■
MARLOX 80	■	■				■	■	■	■
MARLOX MO 124		■		■			■	■	■
MARLOX MO 154	■	■	■	■		■	■		■
MARLOX B 24/80	■	■					■		■

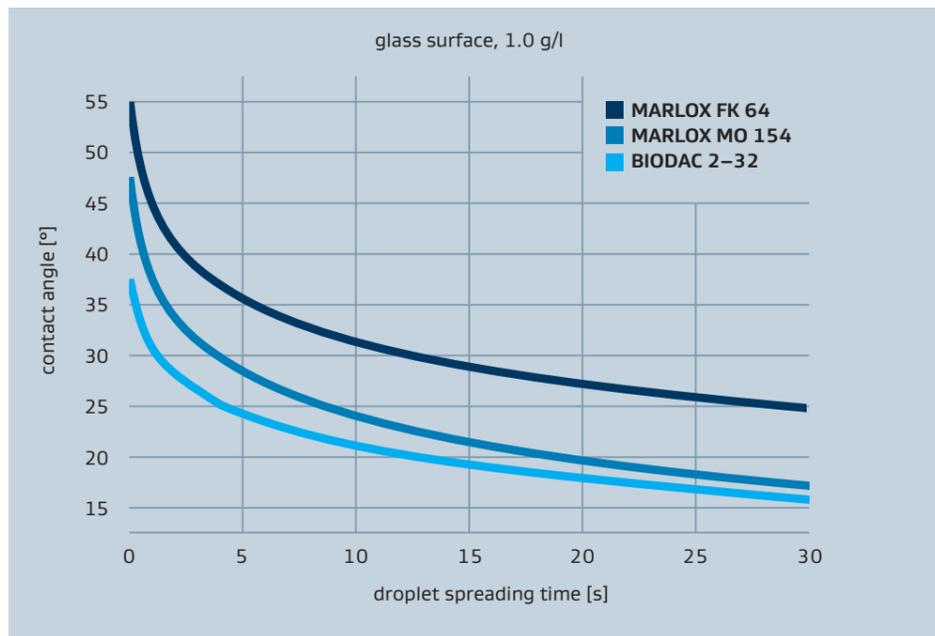
Products	Function					Application			
	Wetting	Foam regulation	De-greasing	Non-geling	Emulsi-fication	I&I and house-hold	Textile auxiliaries	Metal working/lubricating	Technical appl.
MARLOX N 92	■	■	■	■			■		■
LORODAC L6-S-50	■	■	■	■			■	■	■
NOVANIK 0633 A	■	■	■			■	■		■
NOVANIK 1047 A		■	■	■		■	■		■
NOVANIK 1018 A		■	■	■		■	■		■
MARLOX LF 9353			■	■		■			
BIODAC 25059					■				■
MARLOX RT 42				■	■			■	■
MARLOX RT 64					■			■	■
EMULDAC PE 251	■							■	
MARLOWET 4756	■								■
NONFIX 11011	■								■
MARLOWET CPO	■				■				
MARLOX B 35	■								■

6.1 Industrial cleaning & household

Alcohol EO/PO products are essential components of industrial cleaners and household products. Machine dishwashing powders and tablets comprise MARLOX and BIODAC grades to achieve optimal cleaning results even on tough food traces. In rinse aids the products cause fast water removal achieving shining glass ware. BIODAC 2-32 and MARLOX MO 154 have excellent wetting properties on hard surfaces with low foam formation under standard conditions.

Other application examples are industrial bottle cleaning for the beverage industry, floor cleaners and disinfectants. Products like MARLOX OP-1, MARLOX 11027, MARLOX FK 86 possess good detergency properties on difficult oily stains like hard fats or lipstick.

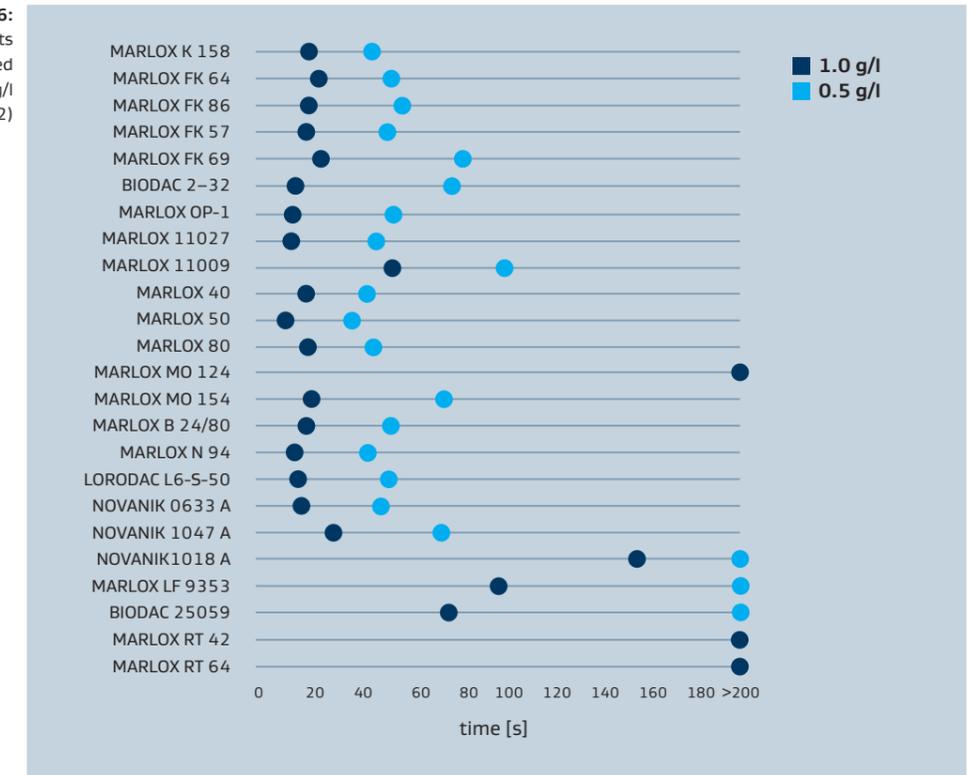
Figure 5:
Dynamic contact angle of aqueous solution on glass at 25 °C



6.2 Textile auxiliaries

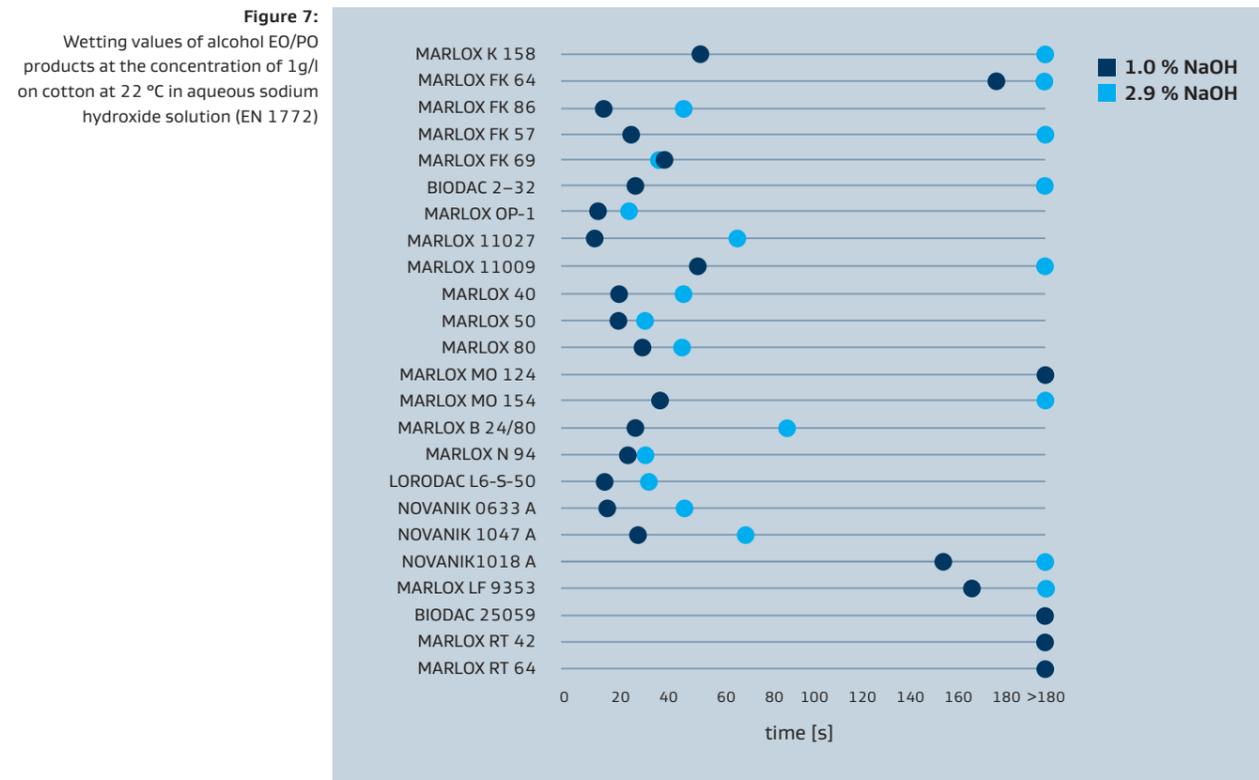
Nonionic surfactants are used as wetting agents in a variety of textile applications like scouring, bleaching and dyeing. Sasol offers a wide portfolio of nonionic surfactants for these applications.

Figure 6:
Wetting values of alcohol EO/PO products on cotton at 22 °C in demineralised water at the concentration of 1 g/l and 0.5 g/l (EN 1772)



A good wetting performance under alkaline conditions is necessary for scouring and washing formulations. LORODAC L6-S-50 and MARLOX OP-1 show the highest alkaline stability among those alcohol EO/PO's. LORODAC L6-S-50 generates advantages in the wetting while MARLOX OP-1 is better in low foam behaviour.

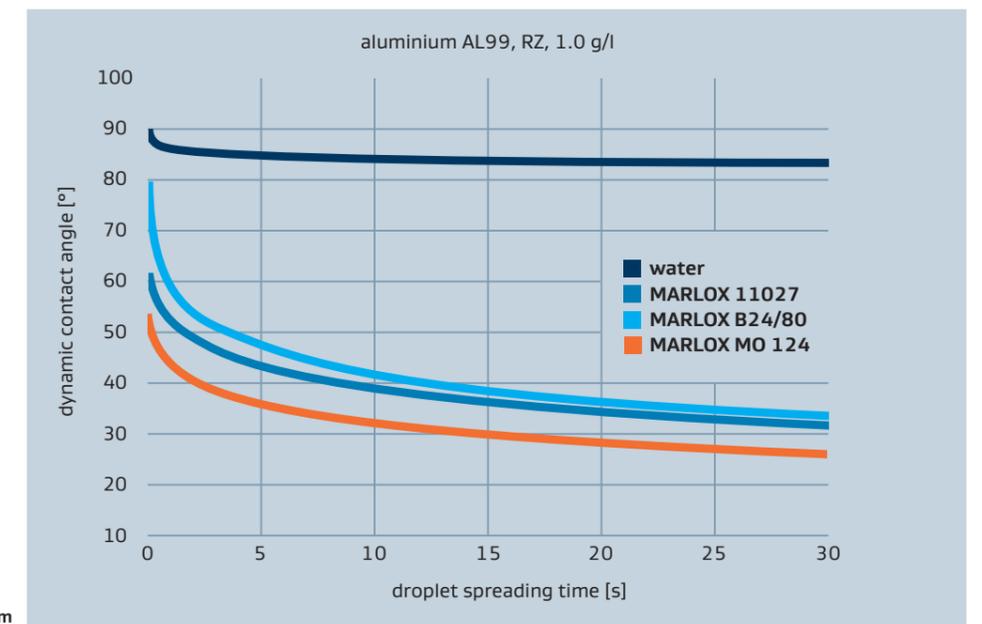
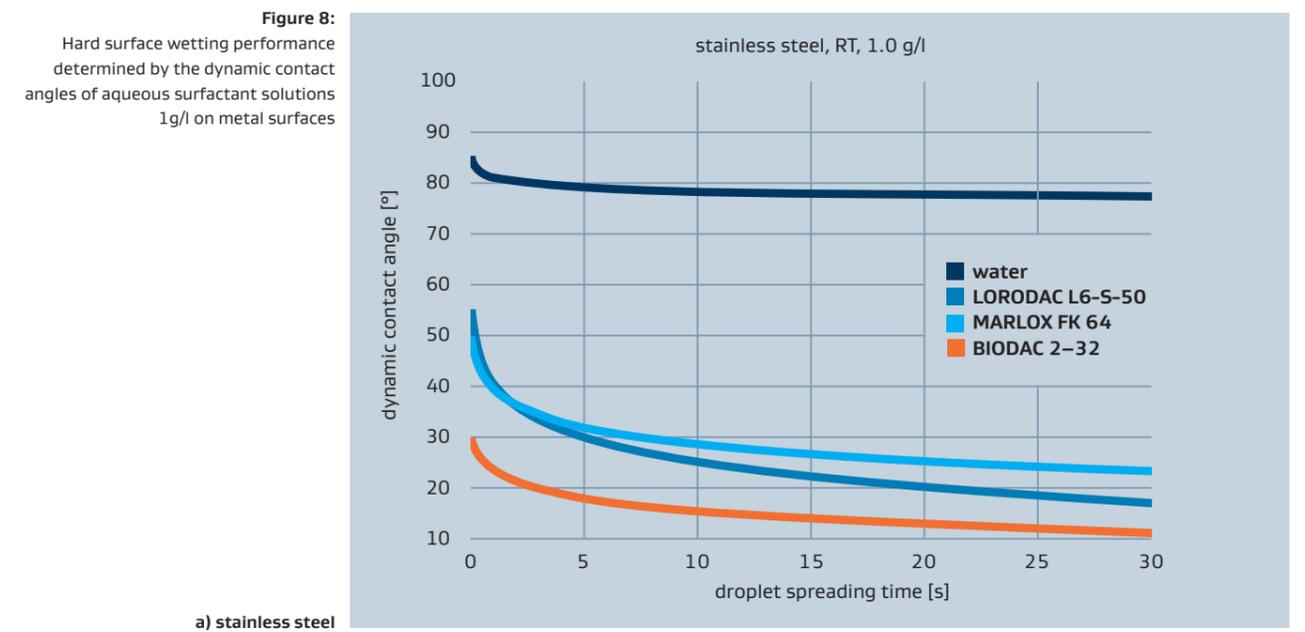
For jet dyeing applications under rigorous turbulent conditions, MARLOX K 158 would be the best choice.



6.3 Metal working applications

The alcohol EO/PO products are used widely in surface cleaners. Figure 8 demonstrates the spreading performance of selected products on metal surfaces. BIODAC 2-32, LORODAC L6-S-50, MARLOX FK 64, MARLOX MO 124, MARLOX 11027 and MARLOX B 24/80 are effectively reducing the contact angle on metal surfaces.

MARLOX RT 64 and RT 42 are effective low foaming emulsifiers used in metal working fluids. The polypropylene building block is located between the alkyl and the polyethylene glycol chain, which improves the emulsifying and lubricating properties along with the low foaming behaviour.



7. Product safety and environmental impact

The alcohol EO/PO products have low to moderate oral toxicities. Regarding the skin and eye irritation, safety precautions, such as skin and eye protection, have to be observed when handling alcohol alkoxylates.

The impact of Sasol alcohol EO/PO products on the aquatic environment has been investigated in various tests according to OECD principles. On the basis of these data, the majority of the products is not classified as hazardous to the environment.

For further information on handling as well as toxicological and environmental characterization of the individual grades please see our safety data sheets that are available on request. According to EC 1907/2006 (Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)) all alcohol EO/PO products are polymers. Polymers don't have to be registered as they are exempt from the REACH registration. The corresponding monomers have been registered already.

8. Storage and handling

The BIODAC, MARLOX, NOVANIK and LORODAC products can be stored in stainless steel tanks, which must be heatable in case of melting points closed to the outside temperature. If the products are stored at 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.

9. Registration

For registration status, please refer to the material safety data sheet or contact

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Our global footprint

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