LIPOXOL

Polyethylene Glycol

Sasol Performance Chemicals

Contents

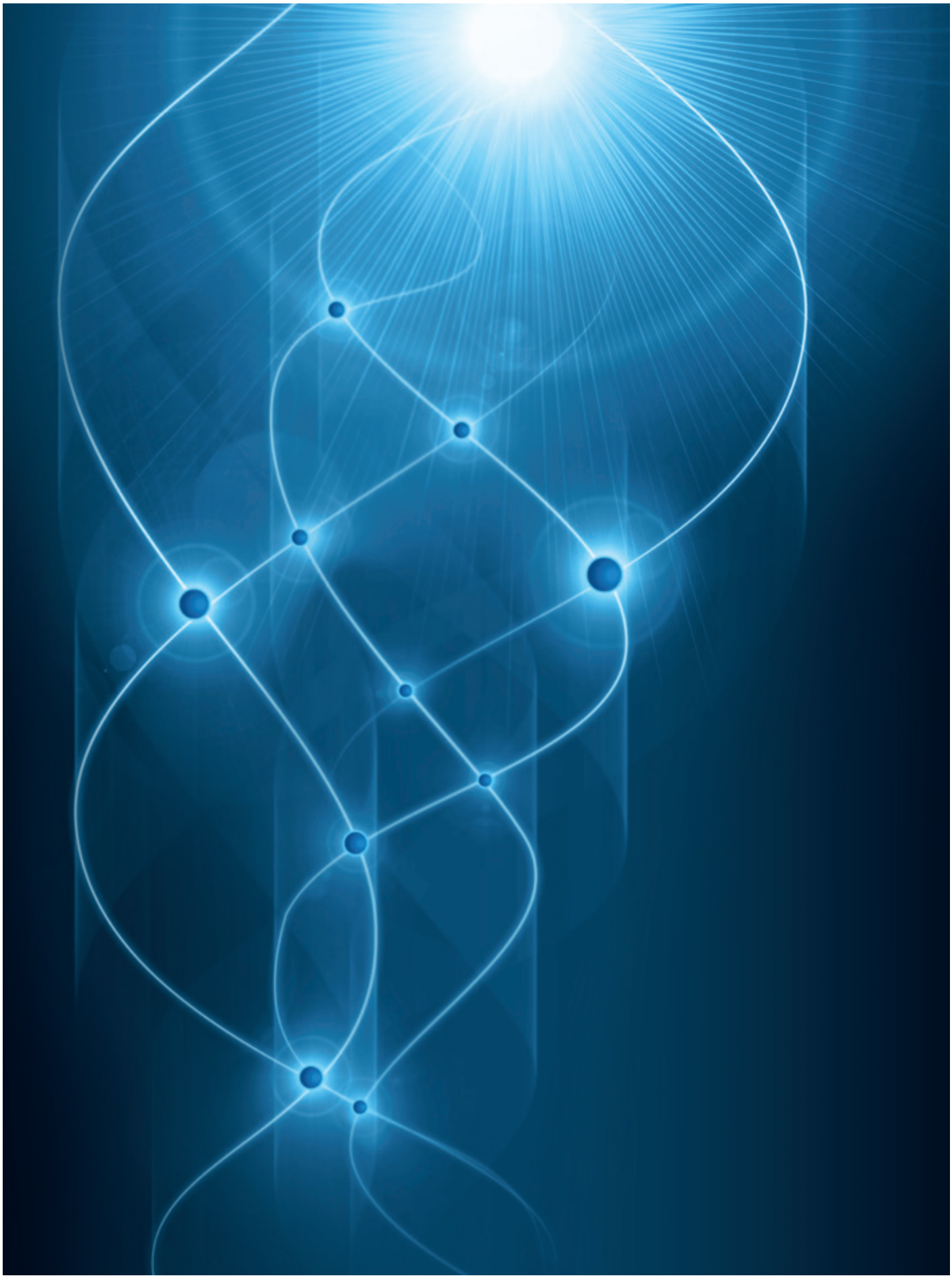
1. About Us

Sasol Performance Chemicals develops and markets a broad portfolio of organic and inorganic commodity and specialty 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.



2. Product Description

Chemical name Polyethylene glycol

Synonyms PEG, α-hydro-ω-hydroxypoly-(oxy-1,2-ethynediyl), polyoxyethylene glycol

CAS number 25322-68-3

Formula $HO-(CH_2CH_2O)_n-H$, n = number of ethylene oxide units

Grades LIPOXOL grades are available with an average molecular weight of 200 to 8,000 g/mole. The average molecular weight is given in the product name.

Trade name	Number of ethylene oxide units
LIPOXOL 200	4
LIPOXOL 300	6
LIPOXOL 400	8
LIPOXOL 600	12
LIPOXOL 1000	20
LIPOXOL 1500	32
LIPOXOL 3000	60
LIPOXOL 4000	90
LIPOXOL 6000	150
LIPOXOL 8000	180

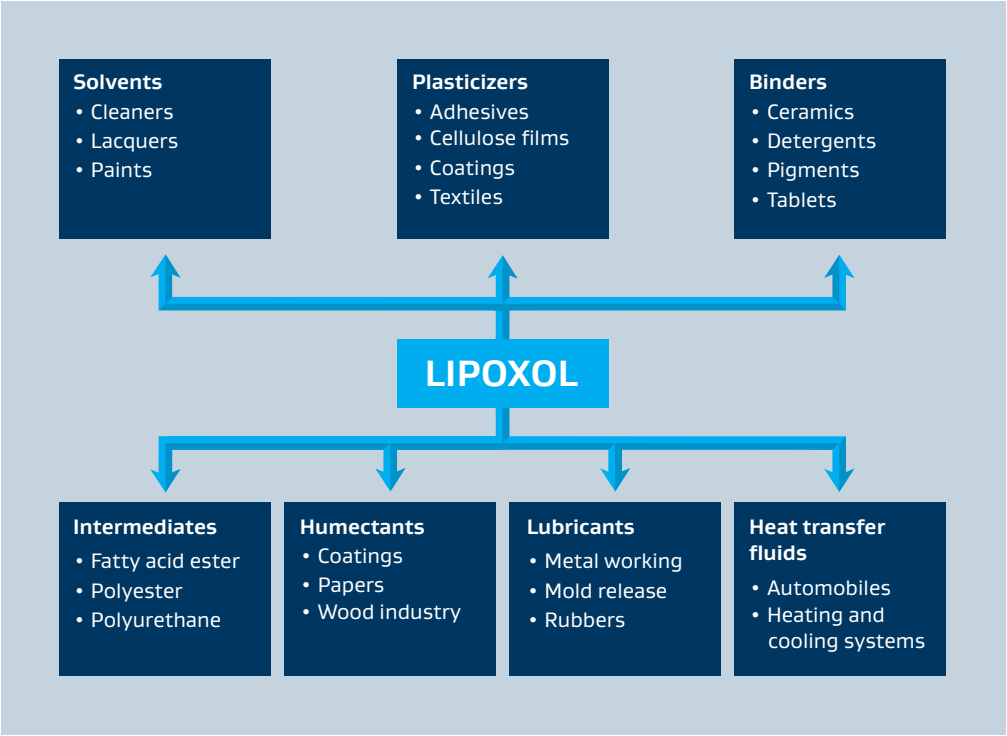
LIPOXOL MED

For the pharmaceutical and cosmetic industries, we offer LIPOXOL MED series. LIPOXOL MED grades satisfy the current requirements of the Pharmacopoeia (Ph. Eur.) and USP–NF. For more information on LIPOXOL MED grades, please refer to the LIPOXOL MED product information.

3. Application and Function

LIPOXOL grades are essential auxiliaries in numerous application fields like household products, metal working, ceramics, plastics and wood treatments. LIPOXOL grades provide a unique property profile, combining high water solubility, lubricity and low toxicity with excellent solvent properties. In addition to their value as auxiliaries, they are also intermediates for the manufacture of resins, textile auxiliaries and emulsifiers. For pharmaceutical and cosmetic applications we recommend using LIPOXOL MED grades.

Figure 1:
Key functions of LIPOXOL grades in individual applications



The excellent solvent properties of LIPOXOL grades are important in cosmetics, pharmaceutical preparations, paints, lacquers and liquid household products. Due to their viscosity-reducing effect, LIPOXOL 200, 300 and 400 are used as solvents in cleaners.

The lubricating properties of LIPOXOL grades and their derivatives make them important for metal working. They are components for lubricants in cases in which physiological safety and preventing skin irritation are required. LIPOXOL grades also add the necessary lubrication to the processes of the rubber industry and allow molded pieces to be removed from the molds easily.

LIPOXOL grades demonstrate excellent moisturizing and plasticizing effects. LIPOXOL 200 to 1500 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.

LIPOXOL 200, 300 and 400 serve as humectant and plasticizer for adhesives and coatings, keeping these materials elastic for a long period of time.

The binder and plasticizer properties are utilized in the ceramics and pigment industry. For many granulation processes, they are important auxiliaries since they bind the ingredients and impart plasticity to granules. For these reasons LIPOXOL grades are also used in the production of detergent powders and tablets.

Liquid LIPOXOL grades are used as heat transfer fluids. In situations in which good water solubility, an easy cleaning procedure and a low environmental impact are important, for instance with laboratory thermostats, LIPOXOL grades are favored over other heat transfer fluids.

LIPOXOL 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, anti-static agents, wetting or finishing agents.

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

Application	Important properties							LIPOXOL									
	Environmental & human safety	Solvent properties	Water solubility	Viscosity-modifying	Solidification range	Lubricity	Hygroscopicity	Chemical structure	LIPOXOL 200	LIPOXOL 300	LIPOXOL 400	LIPOXOL 600	LIPOXOL 1000	LIPOXOL 1500	LIPOXOL 3000	LIPOXOL 4000	LIPOXOL 6000	LIPOXOL 8000
Adhesive	●			●	●				●	●	●	●	●	●	●	●	●	●
Anti-static agent	●						●		●	●	●	●	●	●	●	●	●	●
Binder	●		●	●		●									●	●	●	●
Ceramic binder	●		●	●		●											●	●
Ceramic glaze	●	●		●			●				●	●	●	●	●	●	●	●
Detergents	●	●	●													●	●	●
Heat transfer medium	●		●		●				●	●	●							
Humectant	●						●		●	●	●	●						
Ink	●	●	●			●	●		●	●	●	●						
Intermediate	●	●	●					●	●	●	●	●	●	●	●	●	●	●
Lubricants	●			●		●			●	●	●	●	●	●	●	●	●	●
Mold release	●		●	●		●			●	●	●	●	●	●	●	●	●	●
Paint	●	●		●					●	●	●	●	●	●	●	●	●	●
Paper	●		●				●	●	●	●	●	●	●	●				
Plasticizer	●							●	●	●	●	●	●					
Viscosity modifier	●		●	●					●	●	●							
Wood processing	●	●					●	●			●	●	●	●				

4. Properties of LIPOXOL

LIPOXOL	200	300	400	600	1000
Product data					
Appearance at 20°C	Clear, colorless liquid	Clear, colorless liquid	Clear, colorless liquid	Liquid to pasty	Pasty
Color number (APHA)	≤ 20	≤ 20	≤ 20	≤ 15	≤ 15
Hydroxyl number	534 to 590	356 to 394	267 to 295	178 to 197	107 to 118
Average molar mass calc. from hydroxyl number	190 to 210	285 to 315	380 to 420	570 to 630	950 to 1,050
pH (10% in water)	4.5 to 7.5	4.5 to 7.5	4.5 to 7.5	4.5 to 7.5	4.5 to 7.5
Water	≤ 0.4	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5
General product description					
Solidification range	–55 to –40	–20 to –10	4 to 8	15 to 25	36 to 40
Acid number	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2
Solubility in water at 20°C	Complete	Complete	Complete	Complete	Approx. 750
Viscosity at 20°C	60 to 70	80 to 105	105 to 130	15 to 20[1]	24 to 29[1]
Density at 20°C	1.124	1.125	1.126	1.086[2]	Approx. 1.088[2]
Bulk density (flakes)	–[3]	–[3]	–[3]	–[3]	–[3]
Ash content	Approx. 0.05	Approx. 0.05	Approx. 0.05	Approx. 0.05	Approx. 0.05
Hygroscopicity (glycerine = 100)	70	60	55	40	35
Flash point (approx.)	180	220	240	270	260
Ignition temperature (approx.)	350	370	370	380	420
Specific heat at 20°C	2.1	2.1	2.1	–[2]	–[2]
Specific heat at 125°C	2.5	2.5	2.5	2.5	2.5
Heat of combustion	23.4	25	25.4	25.6	25.9
Thermal expansion coefficient	0.00073	0.00073	0.00073	0.00073	–[2]
Thermal conductivity	0.23	0.23	0.23	0.23	–[2]
Plant of origin	Europe USA	Europe USA	Europe USA	Europe USA	Europe USA

[1] 50% in water [2] Solid at specified temperature [3] Liquid at specified temperature

1500	3000	4000	6000	8000	Unit
Solid	Flakes	Flakes	Flakes	Flakes	–
≤ 15	≤ 15	≤ 15	≤ 15	≤ 15	mg Pt/l
70 to 80	34 to 42	26 to 31	17 to 21	12.5 to 16	mg KOH/g
1,400 to 1,600	2,700 to 3,300	3,600 to 4,400	5,400 to 6,600	7,000 to 9,000	g/mole
4.5 to 7.5	4.5 to 7.5	4.5 to 7.5	4.5 to 7.5	4.5 to 7.0	–
≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	% by mass
42 to 48	50 to 56	53 to 58	55 to 61	55 to 62	°C
≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2	mg KOH/g
Approx. 630	Approx. 550	Approx. 500	Approx. 500	Approx. 500	g/l
35 to 50[1]	70 to 110[1]	115 to 170[1]	200 to 270[1]	260 to 510[1]	mPa·s
Approx. 1.088[2]	Approx. 1.088[2]	Approx. 1.090[2]	Approx. 1.090[2]	Approx. 1.090[2]	g/cm^3
Approx. 0.5	Approx. 0.5	Approx. 0.5	Approx. 0.49	Approx. 0.55	g/cm^3
Approx. 0.05	Approx. 0.05	Approx. 0.05	Approx. 0.05	Approx. 0.05	% by mass
30	Low	Low	Low	Low	–
260	250	250	250	250	°C
420	420	420	420	420	°C
–[3]	–[3]	–[3]	–[3]	–[3]	kJ/kg K
2.5	2.5	2.5	2.5	2.5	kJ/kg K
26	26	26	26	26	kJ/g (25°C)
–[2]	–[2]	–[2]	–[2]	–[2]	K^{-1} (20°C)
–[2]	–[2]	–[2]	–[2]	–[2]	W/mK (20°C)
Europe	Europe	Europe	Europe	Europe	Europe

5. Physical Properties

The physical properties of LIPOXOL grades depend on their molecular weight.

Molar mass g/mole	Solidification range	Viscosity	Solubility	Hygroscopicity	Vapor pressure
200	Lower	Lower	Higher	Higher	Higher
300	↓	↓	↑	↑	↑
400	↓	↓	↑	↑	↑
600	↓	↓	↑	↑	↑
1000	↓	↓	↑	↑	↑
1500	↓	↓	↑	↑	↑
3000	↓	↓	↑	↑	↑
4000	↓	↓	↑	↑	↑
6000	↓	↓	↑	↑	↑
8000	Higher	Higher	Lower	Lower	Lower

Physical Form

The temperature of the melting and solidification range of LIPOXOL grades increases as the molecular weight grows. LIPOXOL 200, 300 and 400 are liquids at room temperature.
The solidification range of LIPOXOL 600 and 1000 is in the range of room temperature.
Both products show a paste-like consistency. Starting with an average molecular weight of 1,500 g/mole and higher, LIPOXOL grades are solid at room temperature. The solidification ranges are provided in the tables on pages 8 and 9.

Viscosity

LIPOXOL grades demonstrate Newtonian flow behavior above melting temperature, meaning the viscosities are independent of the shear rate. The viscosities of LIPOXOL grades rise as the average molecular weight increases (see Figure 2). The viscosities of aqueous solutions of LIPOXOL grades rise as concentration and average molecular weight increase (see Figures 3 to 5). The density of molten LIPOXOL grades and of their solutions is almost independent of their molecular weight. Increasing the temperature results in decreasing of the density of molten LIPOXOL MED grades from 1.12 g/cm³ at 20°C to 1.06 g/cm³ at 100°C (see Figure 8). The kinematic viscosity, provided in mm²/s, can be converted into the dynamic viscosity [mPa·s] by reference to the density of the substances.

$$\eta\ [mm^2/s] = \frac{\eta\ [mPa{\cdot}s]}{\text{Density}\ [g/cm^3]}$$

Solubility

An important property of LIPOXOL grades is their ready solubility in water. Liquid LIPOXOL grades provide clear solutions with water in all mixing proportions. The solubility in water lowers slightly as the molecular weight increases. However, even the solubility of LIPOXOL 8000 is in water about 500 g/l. LIPOXOL grades are soluble in polar organic solvents like alcohols, benzene, glycerin glycol and chloroform. No or slight solubility occurs in aliphatic hydrocarbons, ethers and fats.

Hygroscopicity

LIPOXOL grades are hygroscopic and therefore absorb moisture from air when stored open. Due to this behavior, LIPOXOL grades are used as humectants. The hygroscopicity of LIPOXOL grades decreases as the molecular weight increases. The hygroscopicity of LIPOXOL grades must be considered for storage (see Chapter 7). They should be stored only in well-sealed containers in a dry place.

Vapor Pressure/Stability

The vapor pressure of LIPOXOL grades is very low and diminishes as the molecular weight increases. High temperatures only result in a low increase of vapor pressure with LIPOXOL grades featuring a low molecular weight (see Figure 7). Because LIPOXOL grades are not volatile, they are important auxiliaries in applications in which persistent humectant or plasticizer effects are of importance.

In the absence of oxygen, LIPOXOL grades are stable up to temperatures of approximately 250°C. The good stability of LIPOXOL grades qualifies them as heat transfer fluids. The degradation is mainly influenced by the presence of oxygen. If LIPOXOL grades are exposed to oxygen for a longer period of time at a temperature of more than 100°C, the addition of antioxidants is recommended. The thermal degradation of LIPOXOL grades does not lead to incrustations or deposits. Degradation of LIPOXOL grades results in volatile components.

6. Figures

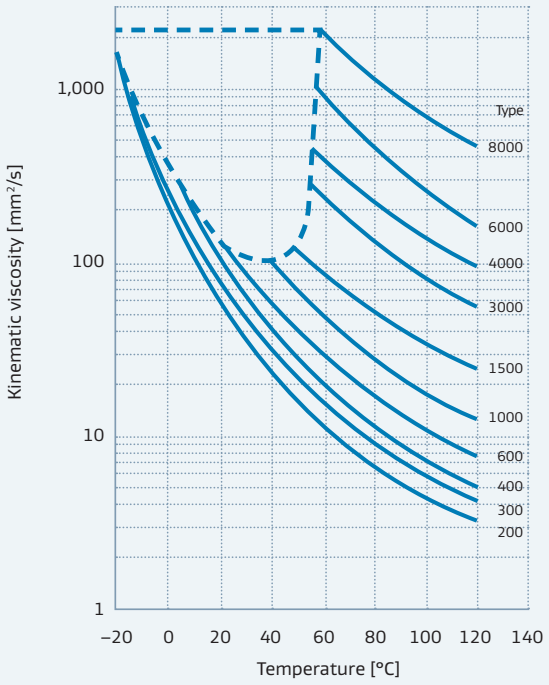


Figure 2: Kinematic viscosity of LIPOXOL grades

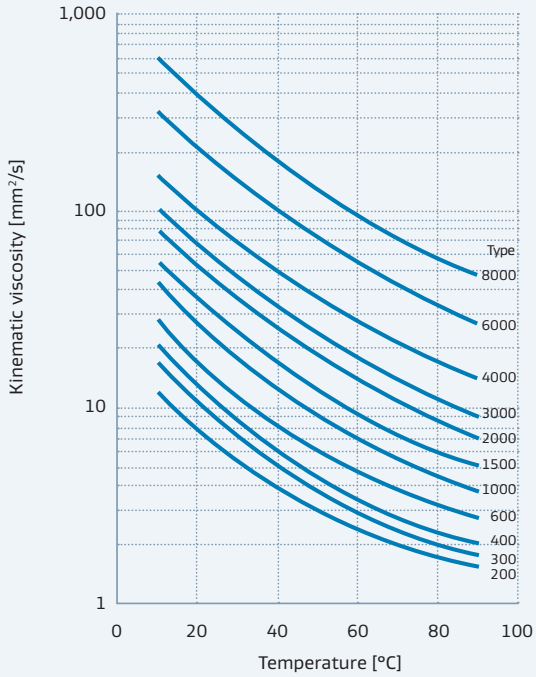


Figure 3: Kinematic viscosity of LIPOXOL grades (50% LIPOXOL in aqueous solution)

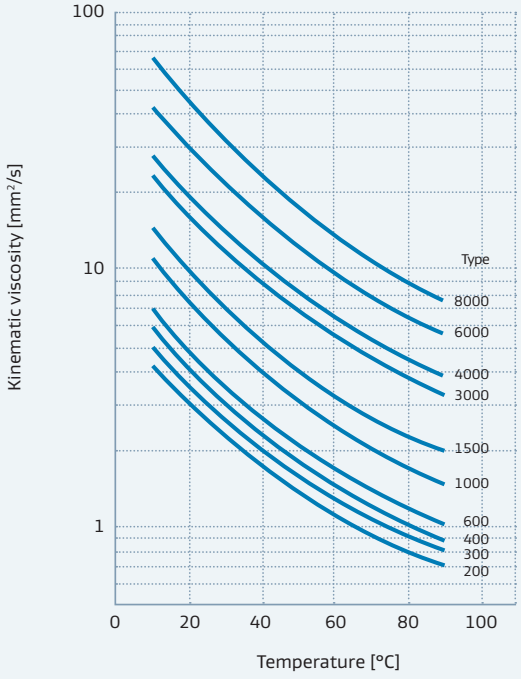


Figure 4: Kinematic viscosity of LIPOXOL grades (30% LIPOXOL in aqueous solution)

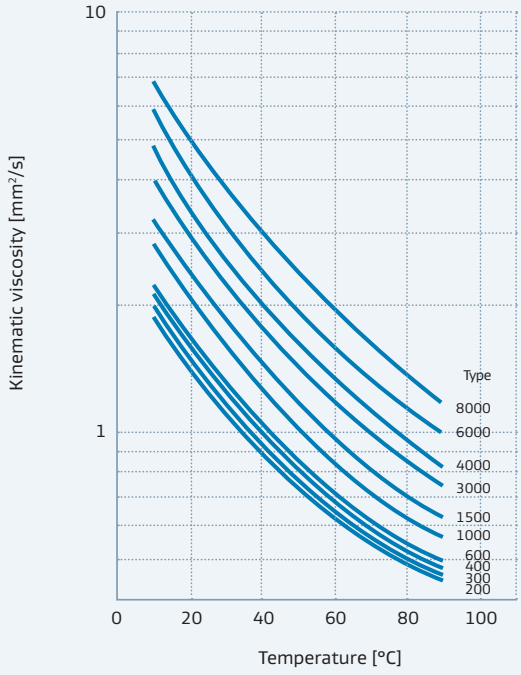


Figure 5: Kinematic viscosity of LIPOXOL grades (10% LIPOXOL in aqueous solution)

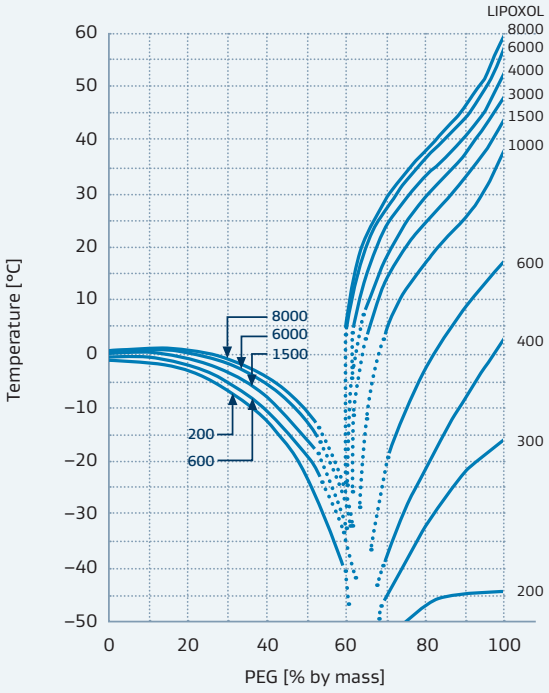


Figure 6: Solidification temperature of aqueous LIPOXOL solution

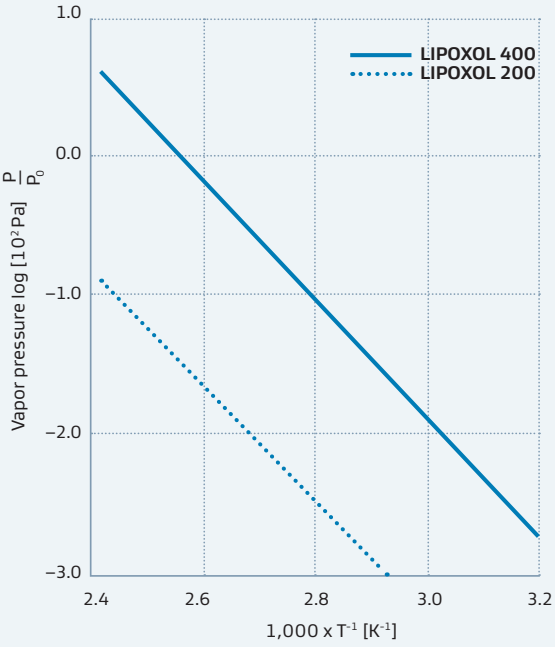


Figure 7: Vapor pressure of LIPOXOL 200 and LIPOXOL 400

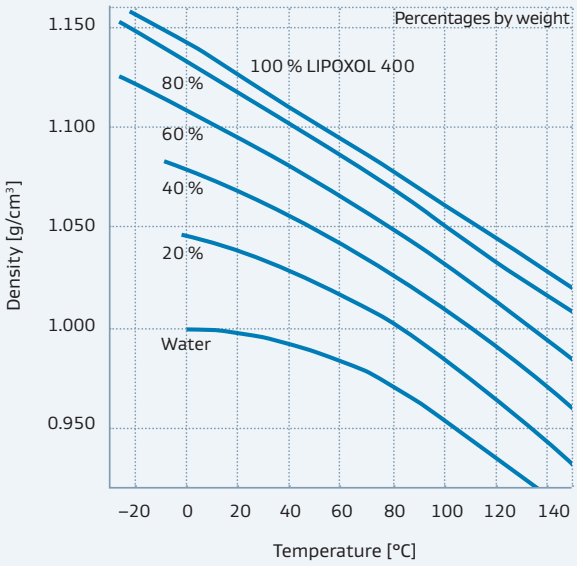


Figure 8: Density of aqueous LIPOXOL solution as function of temperature

7. Storage

LIPOXOL grades are relatively easy to store and process since they have high flash points and are not corrosive to most common construction materials. Due to the different solidification temperatures, LIPOXOL grades are available as liquids, solids, flakes and in molten form.

If higher molecular LIPOXOL grades are stored in molten form, the storage temperature should be chosen 10 to 20°C above the solidification range. For short storage times (one month at most) storage in the presence of air is acceptable. If the storage time is longer, we recommend storing the products under a nitrogen atmosphere. This helps to keep the product quality constant. We recommend stainless steel as a material for storage tanks. Alumina may also be used.

Delivered drums or containers containing LIPOXOL grades should remain sealed until used. LIPOXOL grades with a lower molecular weight can be stored inside a warm building without provision of heating. Excessively high temperatures should not be used to melt solid LIPOXOL grades. We recommend controlled heating chambers or water baths to avoid local overheating.

The sacks or big bags containing LIPOXOL grades as flakes should be stored in a dry and cold place and kept sealed until used. Because the flakes soften and melt at elevated temperatures, storage next to a heat source and exposure to direct sunlight should be avoided.

8. Specification Data/ Food Contact Status

The specification data and further general description can be obtained from the corresponding product data sheet.

Regulations on food contact status (FDA) as well as BfR recommendations are subject to change. We recommend periodic review of these products, so that suitability for a particular application may be verified.

9. Safety Data Sheets

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

Source reference

Cover: Dreamstime/Nurbek Sagynbaev, Dreamstime/Chrisharvey, Sasol Germany GmbH, Dreamstime/Deg, p. 3: Sasol Ltd., p. 4: ©Victoria - stock.adobe.com, p. 9: Dreamstime/Mack2happy

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
oliver.groegor@de.sasol.com
Telephone +34 934 676 902
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 5836 5602

Japan
yoshihiro.ito@jp.sasol.com
Telephone +81 3 3248 6711
Fax +81 21 221 80 506

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

www.sasol.com

LIPOXOL 08/18 US