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HOUSEHOLD
INSTITUTIONAL
& INDUSTRIAL
CLEANERS


AKZO NOBEL

Introduction

AKZO NOBEL IS A LEADER IN THE PRODUCTION OF SAFE, EFFECTIVE, ENVIRONMENTALLY FRIENDLY, WATER BASED CLEANERS FOR HOUSEHOLD, INDUSTRIAL AND INSTITUTIONAL APPLICATIONS. WITH RESEARCH LABORATORIES AND MANUFACTURING SITES AROUND THE WORLD, AKZO NOBEL STANDS READY TO HELP YOU ACHIEVE YOUR ENVIRONMENTAL, COST AND PERFORMANCE GOALS THROUGH OUR FOCUS ON QUALITY, SERVICE AND PRODUCT DEVELOPMENT.

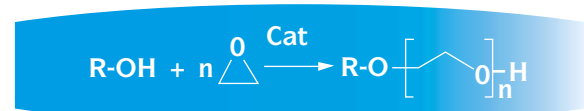
THIS PRODUCT GUIDE WILL FAMILIARIZE YOU WITH AKZO NOBEL CLEANING PRODUCTS AND THEIR APPLICATIONS.

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ETHOXYLATED ALCOHOLS

Akzo Nobel offers a range of ethoxylated alcohols for cleaning applications. Narrow range ethoxylated alcohols are the foundation of our product line.



ETHOXYLATION

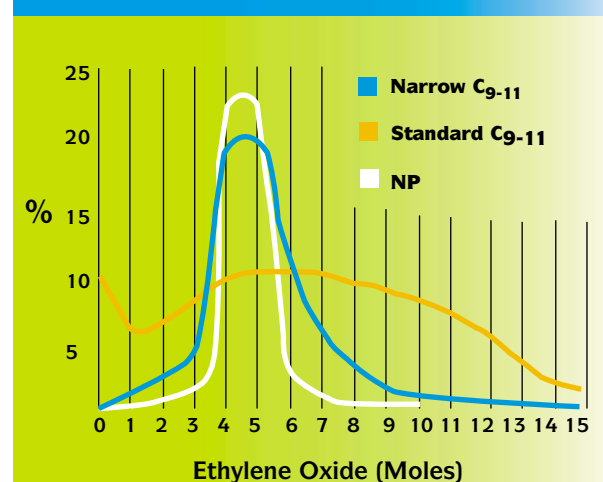
Ethoxylation can be achieved by the reaction of an alcohol with ethylene oxide. The ethoxylation distribution can be influenced by the catalyst (Cat) and by the choice of the alkyl group (R) of the alcohol.

A narrow range ethoxylated alcohol, also called peaked ethoxylated alcohol, has an ethoxylation distribution curve that is narrower than the equivalent standard alcohol ethoxylate and contains considerably lower free alcohol. This gives the non-ionic surfactant focused properties and a very low odor especially when derived from the short chain alcohol.

When phenol or alkyl phenol is ethoxylated the ethoxylation distribution is narrow compared to the broad distribution obtained with fatty alcohols such as C₉₋₁₁ alcohol. By using a special catalyst, a narrow distribution similar to that observed with phenols can be achieved for fatty alcohols.

Generally, lower degrees of ethoxylation give higher amounts of free alcohol in the product. BeroI® 840, BeroI® 260 and BeroI® 266 all contain less than 1% free alcohol resulting in low odor and improved performance.

Ethoxylation Distribution Comparisons



Narrow range nonionics are unique surfactants offered by Akzo Nobel.

Alcohol Ethoxylates Narrow Range

Product Name	Chemical Description	Cloud pt (°C)	Appearance @ 25°C	% Active	Properties	Main Applications
BeroI® 260	Narrow Range C ₉₋₁₁ Alcohol with 4EO	58 ^a	Liquid	100	Degreaser Low Foaming	Waterbased Degreasing Vehicle & Engine Cleaners Hard Surface & All Purpose Cleaners
BeroI® 266	Narrow Range C ₉₋₁₁ Alcohol with 5.5EO	26 ^b and 58 ^b	Liquid	100	Degreaser Low Foaming Dispersions Two Cloud Points*	Waterbased Degreasing Vehicle & Engine Cleaners Hard Surface & All Purpose Cleaners Liquid Detergents (including textiles)
BeroI® 840	Narrow Range Ethoxylated Alcohol	52 ^a	Liquid	100	Extremely Low Foaming Defoaming Wetting	Low Foam Cleaners (e.g. Metal Cleaners & CIP) Waterbased Alkaline Cleaners Automatic Dishwashing Hard Surface Cleaners

Cloud Point (C°) of:
^a5g product 25ml 25% butyl diglycol solution
^b1% product in water

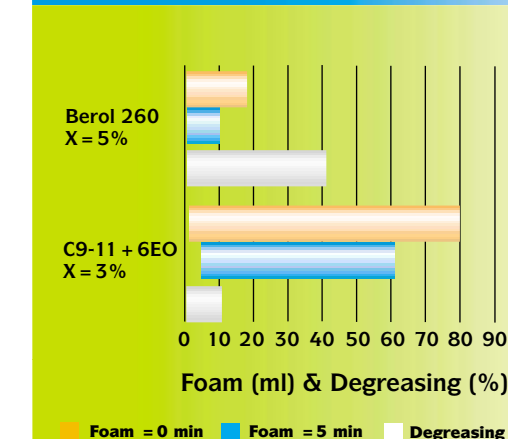
*This product shows two distinct cloud points across a temperature gradient in water.

EFFICIENCY

Use of a short chain alcohol ethoxylate with a narrow distribution of ethoxylation results in faster soil penetration, improved cleaning and lower foam properties.

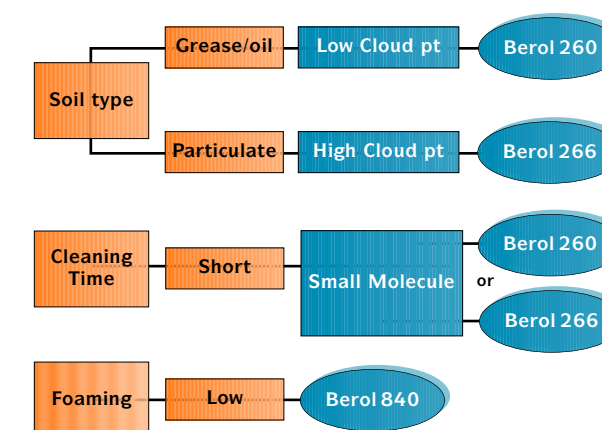
Comparison of BeroI® 260 with a standard alcohol ethoxylate, for example C₉₋₁₁ alcohol + 6 EO, shows reduced foam and improved degreasing.

BeroI 260 vs. Standard Ethoxylated Alcohol Product



Formula:
8% Nonionic + 7% TKPP + X% SXS 10g/l Dilution

How to choose the Right Nonionic Surfactant





Akzo Nobel offers Hydrotropic co-surfactants that can be selected for either low foam or high foam cleaning applications.

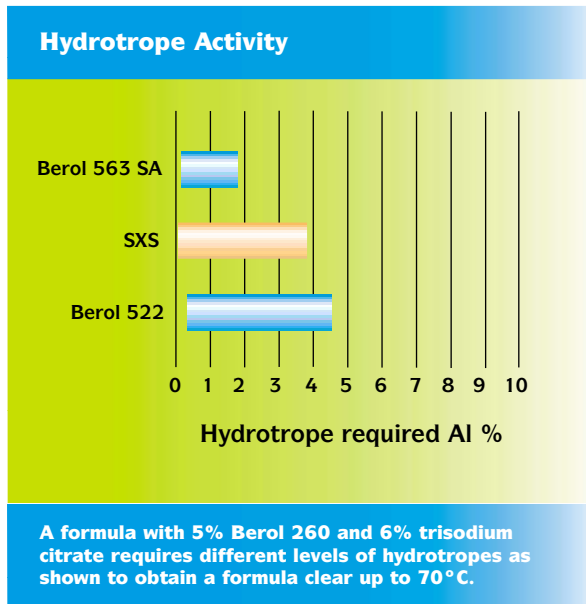
Hydrotropic Co-surfactants

HYDROTROPES

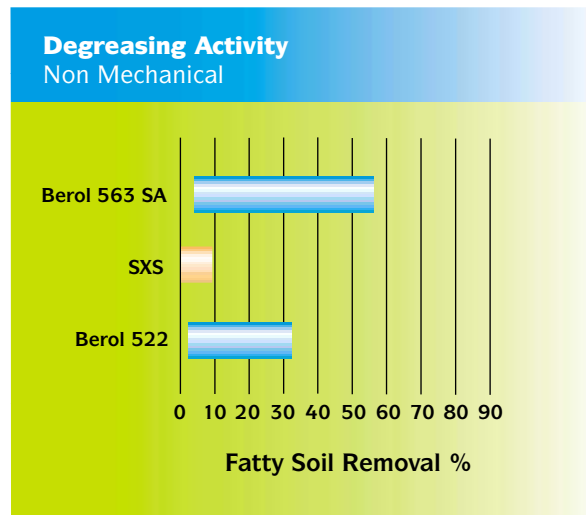
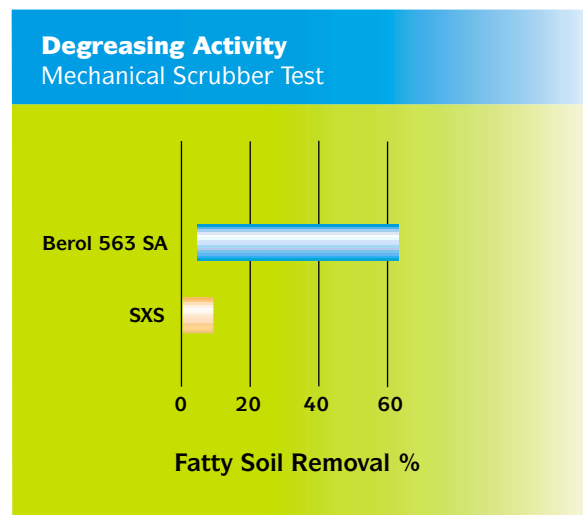
A hydrotrope is a substance that increases the solubility of an ingredient that is slightly soluble in water. In cleaning formulations the nonionic surfactant can be insoluble in the presence of electrolytes, such as chelates and builders. Therefore, the addition of a hydrotrope is required to develop a shelf stable cleaning formulation.

Many surfactants can serve as hydrotropes while at the same time bringing additional functions such as corrosion protection, boosted cleaning, low foaming, etc. Choosing the right hydrotropic co-surfactant is critical to the development of extremely effective water-based cleaning formulations.

As shown graphically, the amount of hydrotrope needed to obtain a formulation that is clear up to 70°C depends upon the choice of hydrotrope.



Dilution of these formulations [1:50 with hard water (200 ppm WHO)] results in differentiated cleaning performances under both mechanical and non-mechanical conditions. Selection of Berol® 563 SA as the hydrotrope results in a boost of cleaning compared to the formula using SXS or Berol® 522.



Hydrophilic Quaternary Ammonium Compounds

Product Name	Chemical Description	Appearance @ 25°C	% Active	Properties	Main Applications
Berol® 563 MC	Proprietary Cationic	Liquid	100	Hydrotrope Dispersing Medium Foaming	Waterbased Degreasing (Acid or Alkaline) Vehicle Cleaners & All Purpose Cleaners (Inert listed)
Berol® 563 SA	Proprietary Cationic	Liquid	100	Hydrotrope Dispersing	Waterbased Degreasing Vehicle Cleaners Hard Surface & All Purpose Cleaners

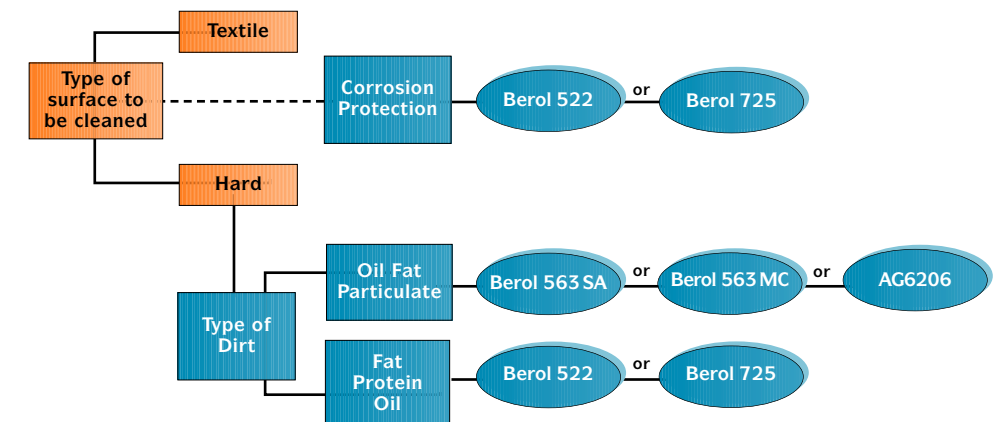
Alkylpolyglucosides

AG™ 6202	Alkyl Polyglucoside	Liquid	65	Low Foaming Hydrotrope Dispersing Good Wetting Demulsification	Low Foam Cleaners (e.g. Metal Cleaners & CIP) Waterbased High Alkaline Cleaners High Caustic Cleaners
AG™ 6206	Alkyl Polyglucoside	Liquid	75	Low Foaming Hydrotrope Dispersing Good Wetting	Low Foam Cleaners (e.g. Metal Cleaners & CIP) Waterbased High Alkaline Cleaners High Caustic & Concentrated Cleaners

Phosphate Esters

Berol® 522	Phosphate Ester	Liquid	43	Medium Foaming Hydrotrope Solubilizer Protein Removal Corrosion Protection	Liquid Alkaline Cleaners Liquid Detergents Hard Surface Cleaners Metal Cleaning
Berol® 725	Phosphate Ester	Liquid	65	Low Foaming Hydrotrope Solubilizer Protein Removal Corrosion Protection	Liquid Alkaline Cleaners Metal Cleaning Hard Surface Cleaners

Choice of Hydrotropic Co-surfactants for Liquid Cleaners





Optimized surfactant blends from Akzo Nobel are used in various applications, including car-wash cleaners.

Specialty Blends

SPECIALTY BLENDS

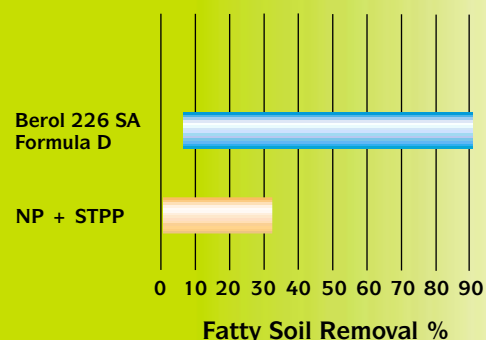
Berol® 226 SA is a surfactant blend optimized for use in water-based degreasing and cleaning formulations. It combines the benefits of ease of formulating and excellent degreasing.

Berol® 226 SA is highly effective in the removal of organic soils such as greases, fats and oils. Degreaser formulations based on Berol® 226 SA offer excellent cleaning performance for use on vehicles, engines, and metal parts. Berol® 226 SA is suitable for use in alkaline, acid and neutral cleaners.

COMPARISON WITH NP-9

Comparison of Formulation D (containing 9% Berol® 226 SA) to a formulation with 9% NP-9 reveals that Berol® 226 SA gives a three-fold boost in degreasing performance compared to the NP-9 formulation.

Degreasing Activity Mechanical Scrubber Test

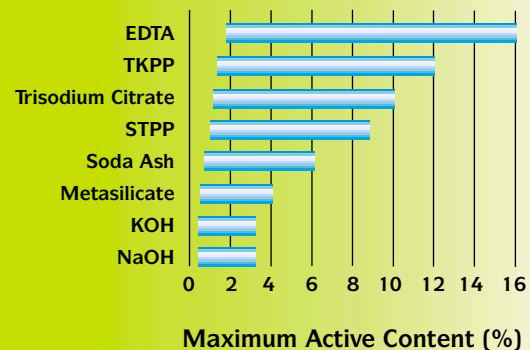


9% Berol 226 SA + 4% TKPP + 3.5% EDTA
9% NP-9 + 4.5% STPP

BEROL® 226 SA AND BUILDERS

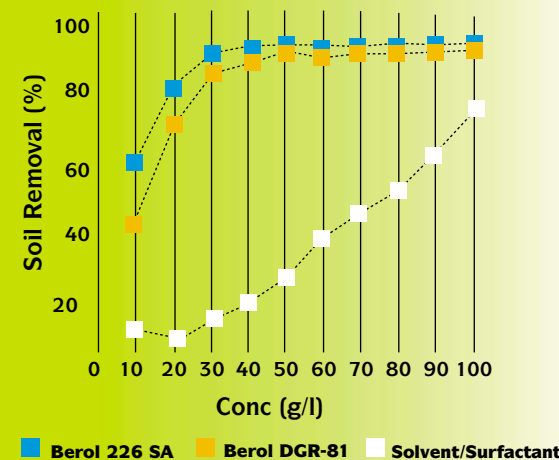
As illustrated in the graph, Berol® 226 SA is compatible with various builders and chelating agents.

Stability of 9% Berol 226 SA with Various Builders & Chelating Agents



Product Name	Chemical Description	Appearance @ 25°C	% Active	Properties	Main Applications
Berol® 226 SA	Nonionic/Cationic	Liquid	100	Degreasing Dispersing Medium Foaming	Waterbased Alkaline Degreasing Acid Cleaners, Vehicle Cleaners (including High Pressure Touchless Equipment) Hard Surface & All Purpose Cleaners (inerts listed)
Berol® TFR	Nonionic/ Cationic	Liquid	100	Degreasing Dispersing Medium Foaming Good Oil-Separation in Waste Water	Waterbased Alkaline Degreasing Acid Cleaners, Vehicle Cleaners (optimized for High Pressure Touchless Equipment), Hard Surface Cleaners & All Purpose Cleaners
Berol® DGR-81	Nonionic Blend	Liquid	100	Degreasing Medium Foaming Good Oil-Separation in Waste Water	Waterbased Alkaline Degreasing Acid Cleaners, Vehicle Cleaners Hard Surface Cleaners, All Purpose Cleaners, High Caustic & Concentrated Cleaners
Berol® LFG-61	Nonionic Blend	Liquid	100	Degreasing Low Foaming Defoaming	Low Foam Cleaners (e.g. Metal Cleaners & CIP) Waterbased High Alkaline Cleaners High Caustic & Concentrated Cleaners

Degreasing Ability of Berol Surfactants Compared with a Solvent Based System on Dilution



Formula:
9-10% Surfactant* + 6% TKPP + 4% Metasilicate
*replaced with 8% EB + 2% Surfactant

DILUTION OF OUR SPECIALTY BLENDS

When compared with solvent-based cleaning formulations, our specialty blends exhibit superior performance upon dilution. Systems containing solvents, such as 2-butoxyethanol (EB) for example, depend greatly on concentration in order to be effective and dilution significantly reduces their degreasing performance. Both Berol® 226 SA and Berol® DGR-81 are more resistant to loss of effectiveness upon dilution and decline in performance only after a dilution of 1:25 of the base formulation is used.

Typically, 1% Berol® 226 SA can replace at least 8% EB in a formulation without loss of performance.

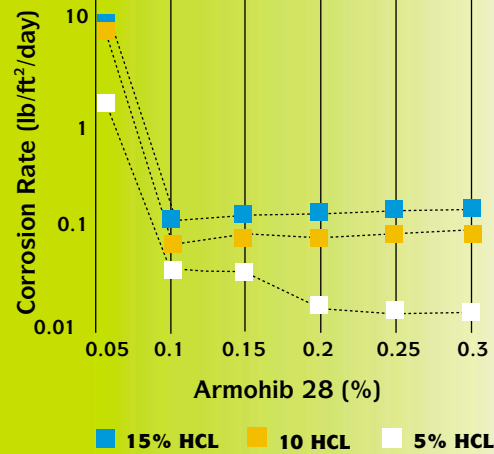


Akzo Nobel's Functional surfactants are used in specialty applications, such as corrosion protection.

Functional Surfactants

Product Name	Chemical	Appearance Description	% Active @ 25°C	Main Applications
Penetrating Agent				
Ethylan™ HB-4	Nonionic	Liquid	100	Vehicle Cleaning, Rig Cleaning Microemulsions Perfume solubizers
Corrosion Inhibitor				
Armohib® 28	Proprietary Blend	Liquid	100	Rust Removal in Metal Cleaners (Acid Pickling), Acid Corrosion, HCl or HCl/HF Mixtures
Armohib® 31	Proprietary Blend	Liquid	100	Rust Removal in Metal Cleaners (Acid Pickling), Acid Inhibitors for Sulphuric, Sulfamic, Citric & Phosphoric Acids
Chain Lubricant				
Armolube™ CL300	Cationic	Liquid	100	Track Lubricant, Car/Wax Polish, Corrosion inhibitor Car Undercoating & Sound Deadener
Softeners				
Arquad® HTL8 MS	Dialkyldimethyl Ammonium Methyl Sulphate	Liquid	83	Softening for Two in One Detergents or Clear Softeners Antistatic, Water Repellent
Arquad® 2HT-75	Dialkyldimethyl Ammonium Chloride	Paste	75	Softening, Antistatic Emulsifying, Thickener Water Repellent
Microemulsion Aids				
Berol® 239	Nonionic/Cationic	Liquid	100	Micro-emulsions Silicon Oil emulsions
Berol® 251	Nonionic Blend	Liquid	100	Solvent Free Micro-emulsions Solvent Free Degreasers

Corrosion Protection



Mild Steel in Hydrochloric Acid with Armohib 28 (6 hours at 200°F)

CORROSION INHIBITION

Armohib is a registered trademark for acid corrosion inhibitors developed by Akzo Nobel. These aliphatic nitrogen inhibitors retard the corrosive effects of acids on metals during pickling, on process equipment being cleaned, and in oil well acidizing operations. These products are formulated for use with specific acids. Armohib® 31 may be used with sulfuric, sulfamic, citric, and phosphoric acid. Armohib® 28 is used with hydrochloric acid and hydrochloric-hydrofluoric acid mixtures.

Armohib corrosion inhibitors offer low-cost, dependable protection over a wide range of temperatures. Acid attack on metals can be retarded by incorporating small amounts of Armohib® chemicals with the acid without affecting the cleaning action of the acid. Since Armohib® compounds are all liquid, readily soluble in acid, non-staining, and do not precipitate on standing, they are easy to use.

PLANT CLEANING

Inhibited acids are used extensively in plant cleaning, both pre-commission and periodic service cleaning. Although many plants, such as breweries, dairies and sugar refineries, use acid cleaning, the major use of acid cleaning is in power plants.

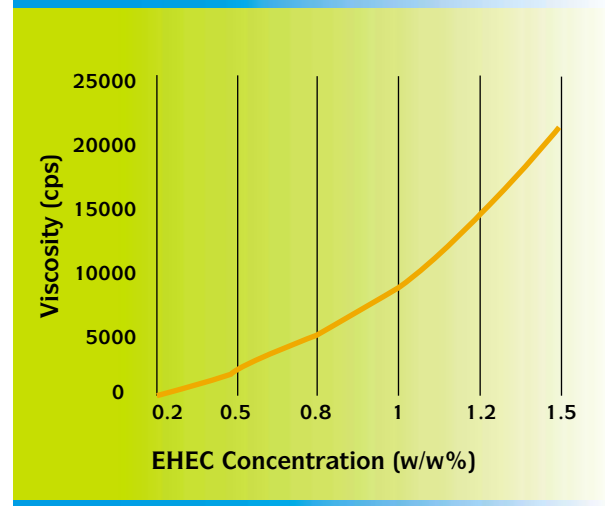


Rheology modifiers from Akzo Nobel provide unique value to cleaners and detergents.

POLYMERIC PRODUCTS

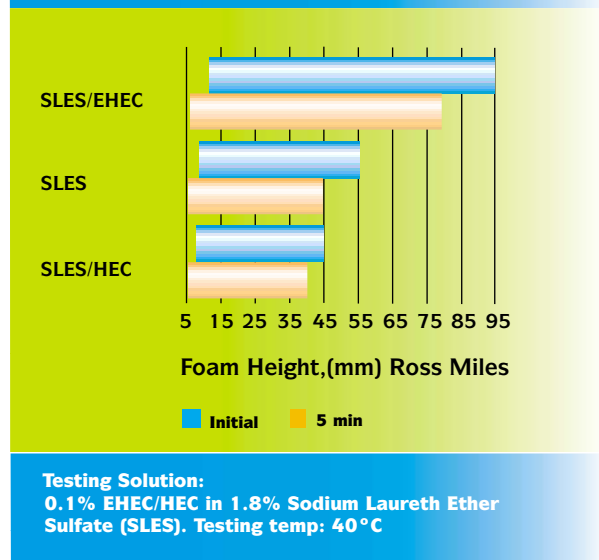
Elfacos® CD 481 is a uniquely modified, water soluble, nonionic cellulose ether with substantial surface and interfacial activity. These physiochemical properties and functions allow Elfacos® CD 481 to be used as a multifunctional ingredient for many cleaning formulations.

Viscosity of Elfacos CD 481 in Aqueous Solutions



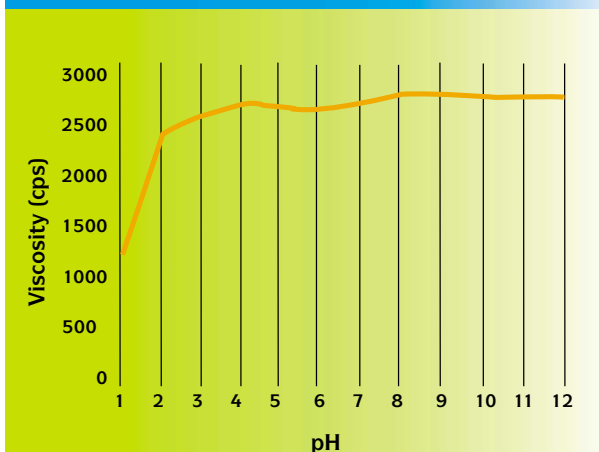
Brookfield RVDV-II, SPDL #5, 10 rpm

Foam Modification by Elfacos CD 481



Testing Solution: 0.1% EHEC/HEC in 1.8% Sodium Laureth Ether Sulfate (SLES). Testing temp: 40°C

pH Stability of Elfacos CD 481



0.8% EHEC in 3.0% Cetearyl Alcohol

Elfacos® CD 481 exhibits the following characteristics:

- Highly efficient thickener for aqueous systems
- Stabilizer/protective colloid foam modification
- Strong polymer-surfactant interaction to influence phase behavior and interfacial activity

Product Name	Chemical Description	Appearance @ 25°C	% Active	Main Applications/Functions
Surfactant				
Ethomeen® S/12	Ethoxylated Amine	Liquid	100	Metal Cleaning, Acid Cleaning, Solvent Based Cleaners, Emulsifier
Ethomeen® T/12	Ethoxylated Amine	Liquid	100	Metal Cleaning, Acid Cleaning, Solvent Based Cleaners, Emulsifier
Ethomeen® O/12	Ethoxylated Amine	Liquid	100	Metal Cleaning, Acid Cleaning, Solvent Based Cleaners, Emulsifier
Aromox® 14DW970	Amine Oxide	Liquid	25	Alkaline Cleaner, Hypochlorite Cleaners, Foam Booster
Aromox® T/12	Amine Oxide	Liquid	49	Alkaline Cleaners, Acid Cleaners
Arquad® T-50	Alkyl-trimethyl Ammonium Chloride	Liquid	50	Acid Cleaners, Hydrogen Peroxide Cleaners
Arquad® 16-29	Alkyl-trimethyl Ammonium Chloride	Liquid	29	Acid Cleaners, Hydrogen Peroxide Cleaners
Polymers				
Elfacos® CD 481	Ethyl Hydroxyethyl Cellulose	Powder	100	Aqueous Cleaners & Degreasers, Water Repellent, Gel Cleaners, Foam modifier, Emulsion Stabilizer

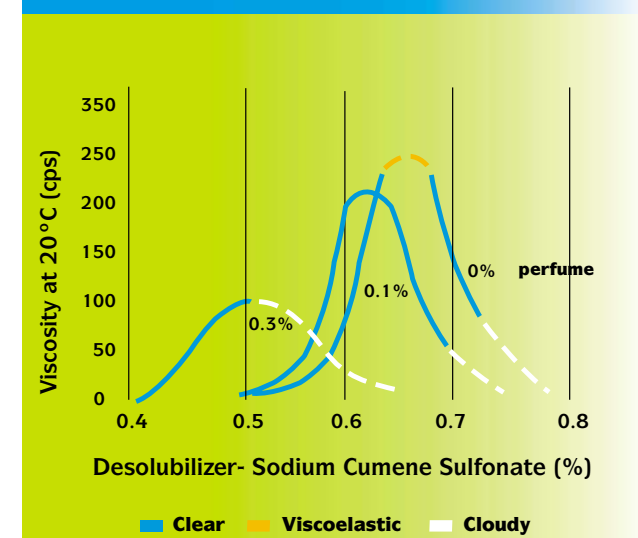
SURFACTANT

Akzo Nobel surfactants are versatile rheology modifiers as they can span the range of acidic to alkaline formulations.

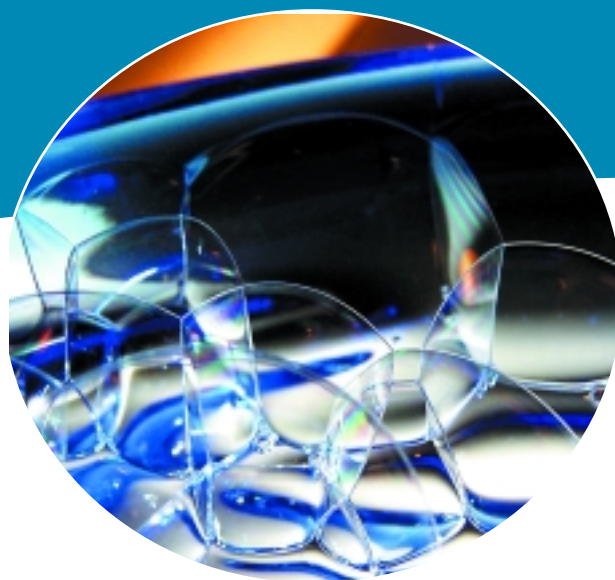
Amine oxides are useful in hypochlorite systems while Arquad®16-29 is useful in hydrogen peroxide formulations.

As shown in the accompanying graph, perfume can have a dramatic influence on the viscosity of the cleaning formulation.

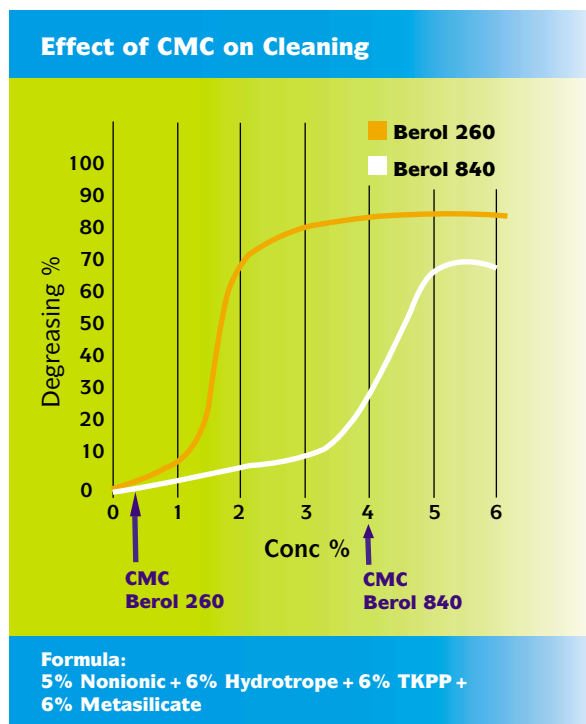
Fragrance and Viscosity



Formula: 5% Citric Acid Monohydrate + 1.25% Arquad 16-29 + 0-0.3% Methylsalicylate (Perfume) + x% Sodium Cumene Sulfonate



In building cleaning formulations, several factors are critical and need to be monitored. These include critical micelle concentration, cloud point, surface tension, HLB, wetting and foam.



CRITICAL MICELLE CONCENTRATION (CMC)

In order to maximize cleaning performance upon dilution, it is essential that the concentration of the primary surfactant be above its CMC. As shown in the graph, the optimal cleaning of both formulations is obtained above the CMC of the nonionic surfactant used.

CRITICAL SURFACE TENSION (CST)

To obtain good wetting of a surface, the surface tension of the liquid must be less than the critical surface tension. Critical surface tensions of some substances are shown below.

Surface	Dynes/cm
Glass	> 73
Polystyrene	32
Polypropylene	28
Teflon	18
Surface Tension	
Water	72

Product	Surfactant Type	~ Molecular Wt.	HLB	Foam (mm)	Viscosity (°C/Cps)	Cloud Pt (°C)	Surface Tension (dynes/cm)	CMC (g/l)	Wetting (sec.)
Nonionics									
Bero[®] 260	Alcohol Ethoxylate	336	10.5	20	20/50	58 ^a	27	0.04	11
Bero[®] 266	Alcohol Ethoxylate	402	12.1	70	20/50	26 & 58 ^b	27	0.03	15
Bero[®] 840	Alcohol Ethoxylate	307	11.5	5	20/50	52 ^a	32	4.5	90
AC[™] 6202	Alkylpolyglucoside	550-630	> 20	8	20/265	> 100	33.4	16	–
AC[™] 6206	Alkylpolyglucoside	520-600	–	0	20/775	–	34	20	–
Hydrotropes									
Bero[®] 563 MC	Hydrophilic Cationic	–	–	–	25/1150	75 ^c	41	–	–
Bero[®] 563 SA	Hydrophilic Cationic	–	–	110	25/940	–	39	0.04	> 600
Bero[®] 522	Phosphate Ester	314	–	80	20/300	–	24	NA	> 1000
Bero[®] 725	Phosphate Ester	497	–	5	20/470	–	55	NA	> 600
Blends									
Bero[®] 226 SA	Blend	NA	NA	110	20/140	> 100	27	0.04	15
Bero[®] TFR	Blend	NA	NA	115	20/120	> 100	27	NA	18
Bero[®] DGR-81	Blend	NA	NA	70	20/1600	26/61 ^d	27	0.5	20
Bero[®] LFG-61	Blend	NA	NA	20	20/1800	33/65 ^d	31	10	> 600

Foam

Ross-Miles immediate height at 50 °C at 0.05%

Viscosity

Brookfield DVII at 20/25 °C

Cloud Point

^a 5g product 25ml of 25% butyldiglycol solution

^b 1% product in water

^c 1g product in 100 ml 9% NaOH solution

^d 5 & 10% product in water

Surface Tension

Du Noüy or Whillemly Plate at 25 °C (DIN 53 914)

CMC

Critical Micelle Concentration determined using Surface Tension

Wetting

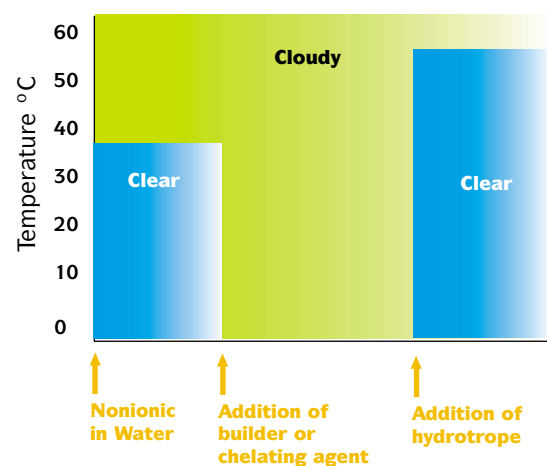
Draves, 25 °C, 0.1%

The most important factor in designing the right cleaner is to identify the main soil component and select surfactants that are optimal for these soils. Important elements to keep in mind are the cloud point of your nonionic, cloud point of your final formula, CMC, CST of your surface and surfactant compatibility.

CLOUD POINT - NONIONIC SURFACTANTS

The cloud point for a nonionic surfactant is the temperature at which the surfactant becomes insoluble in water. The solution will become heterogeneous and phase separation will occur upon further increase in temperature.

The optimal performance of a nonionic surfactant is obtained just below the cloud point temperature. As the temperature approaches the cloud point, the surfactant becomes increasingly insoluble and readily penetrates the oil phase. A higher percentage of surfactant molecules interact with the grease and higher cleaning efficiency is obtained.



Surfactant Type	Base Surfactant Nonionic			Hydrotropic Co-surfactant						Blends				
	Product Name	BEROL 260	BEROL 266	BEROL 840	APG AG 6202	AG 6206	Anionic BEROL 522	BEROL 725	Cationic BEROL 563 SA	BEROL 563 MC	BEROL 226 SA	BEROL TFR	BEROL DGR-81	BEROL LFG-61
Soil Type:														
Grease/Oil	****	***	***	**	**	***	***	****	****	****	***	***	****	**
Particle	**	****	**	**	**	**	*	****	****	***	****	***	***	**
Protein/Fat	**	**	**	**	***	****	****	**	**	***	***	**	**	**
Protein/Fat ¹	*	*	**	***	***	**	**	*	*	*	*	***	***	***
Grease/Particle	***	**	**	*	**	**	***	****	****	****	***	****	****	**
Mixed ²	**	**	**	***	***	**	**	***	***	***	**	***	***	**
Features:														
Low Foam	***	***	****	****	****	**	****	**	**	**	**	**	***	****
Hydrotrope Effect	-	-	-	*	****	***	***	****	****	****	Not Required			
Temporary Corrosion Protection (Residual)	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No	No
Acid Stable	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Hydrogen Peroxide Stable ³	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Caustic Compatible	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Suitable for Concentrated Formulations	No	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Soluble in High Caustic	No	No	No	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes
Self Splitting (Degreasing Formulations)	-	-	-	-	-	-	-	-	-	-	Yes	Yes	Yes	No
Elemental Phosphorous Content (%)	0	0	0	0	0	0	5	6	0	0	0	0	0	0

Key
 **** optimal surfactant
 *** good surfactant
 ** acceptable surfactant
 * poorest surfactant

¹ In a caustic base formula.
² A mixed soil of protein, oil/fat and particulate.
³ When formulated with a stabilized hydrogen peroxide system.

CLARITY INTERVAL

Addition of builders and/or chelating agents to a formulation reduces the cloud point of the nonionic surfactant. Addition of a hydrotrope improves the solubility on the nonionic thereby increasing the cloud point of the formulation. The clarity interval is the temperature range over which the formulation is stable and clear.

FINAL FORMULA CLOUD POINT

The cloud point of the final formulation is extremely important when removing soils heavy in greases and oils.

Particulate-based soils require dispersion, so the cloud point of the formulation is not as critical. For particulate-based soils the most important characteristics of the surfactant is its ability to disperse soil and prevent re-deposition.

