BIG SUN CHEMICAL CORP.
旭懋化工實業有限公司

TERGITOL™ 15-S-9 Surfactant

Product Description

TERGITOL™ 15-S-9 Surfactant is a biodegradable, clear liquid that is ideally suited for applications requiring outstanding surface-chemical performance from a water soluble product. TERGITOL 15-S-9 Surfactant is a mixture of linear secondary alcohols reacted with ethylene oxide. As a nonionic surfactant it is chemically stable in the presence of dilute acids, bases, and salts, and it is compatible with anionic, cationic, and other nonionic surfactants. TERGITOL 15-S-9 Surfactant is soluble in water, chlorinated solvents, and most polar organic solvents.

Features and Benefits

The unique "T"-shaped molecular structure of TERGITOL™ 15-S-9 Surfactant, combined with the very low levels of unethoxylated secondary alcohols and low-mole adducts present, imparts highly desirable end-use features, including:

- Excellent detergency performance
- Outstanding wetting properties
- Excellent rinseability
- Low foam stabilities
- Versatile solubility characteristics
- Low pour point
- Low neat and aqueous viscosities
- Narrow aqueous gel range
- Rapid dissolution rates
- Low odor

UC-1443A

UNION CARBIDE Union Carbide Corporation • 39 Old Ridgebury Road • Danbury, CT 06817-0001

Chemical Structure

The CAS # is 84133-50-6, and the general structural formula is:

$$C_{12\text{-}14}H_{25\text{-}29}O[CH_2CH_2O]_xH$$

Applications

TERGITOL™ 15-S-9 Surfactant is one of the most versatile oil-soluble nonionic surfactants available. It is a proven performer in a myriad of industries, ranging from electronics to detergents. Specific end-uses for TERGITOL 15-S-9 Surfactant include:

- Household and industrial laundry detergents
- Hard-surface cleaners and degreasers
- Industrial and institutional cleaners
- Hydrocarbon and water-based laundry prespotters
- Power car washes and care products
- Paper deinking, rewetting, pulping, and deresinating
- Oil-in-water emulsions
- Textile wet processing
- Dye assist and leveling agents for carpets and textiles
- Wetting agent, coupling agent, and emulsifier for fiber lubricants
- Emulsifier for polyethylene textile softeners
- Dispersant, stabilizer, wetting agent for paints
- Agricultural dispersant and wetting agent
- Metal cleaners and acid-cleaning compounds
- Low-temperature soak-tank cleaning systems
- Oil field chemicals
- Water treatment operations
- Circuit board cleaners
- Leather soaking, tanning, and dyeing operations

Typical Properties*

Hydroxyl Number mg KOH/g	96
Molecular Weight (calculated from OH#)	584
Degree of Ethoxylation, mole/mole, avg	8.9
Degree of Ethoxylation, wt%	67
Actives Content, wt%	100
Water, wt%	0.03
Cloud Point (1% aqueous solution), °C (°F)	60 (140)
Pour Point, °C (°F)	9 (48)
pH at 25°C (1% aqueous solution)	7.1
Viscosity at 25°C, cP	60
Color, APHA (Pt-Co)	45
Appearance at 25°C	Clear liquid
Specific Gravity at 20/20°C	1.006
Flash Point, Pensky-Martens Closed Cup, ASTM D 93, °C, (°F)	193 (379)
HLB Number (calculated)	13.3
Surface Tension (1% aqueous solution), dynes/cm	30

* Determined on commercial material whose properties may vary within Union Carbide's specification limits. Values shown are not intended for specification process.

Performance Data

Physical property and performance data for a variety of nonionic surfactants are shown in Figures 1 through 6 and Table 1. TERGITOL™ 15-S-9 Surfactant is water soluble, has a cloud point of 60°C, and is compared to commercially available products with similar properties. The products used in these tests are categorized as follows:

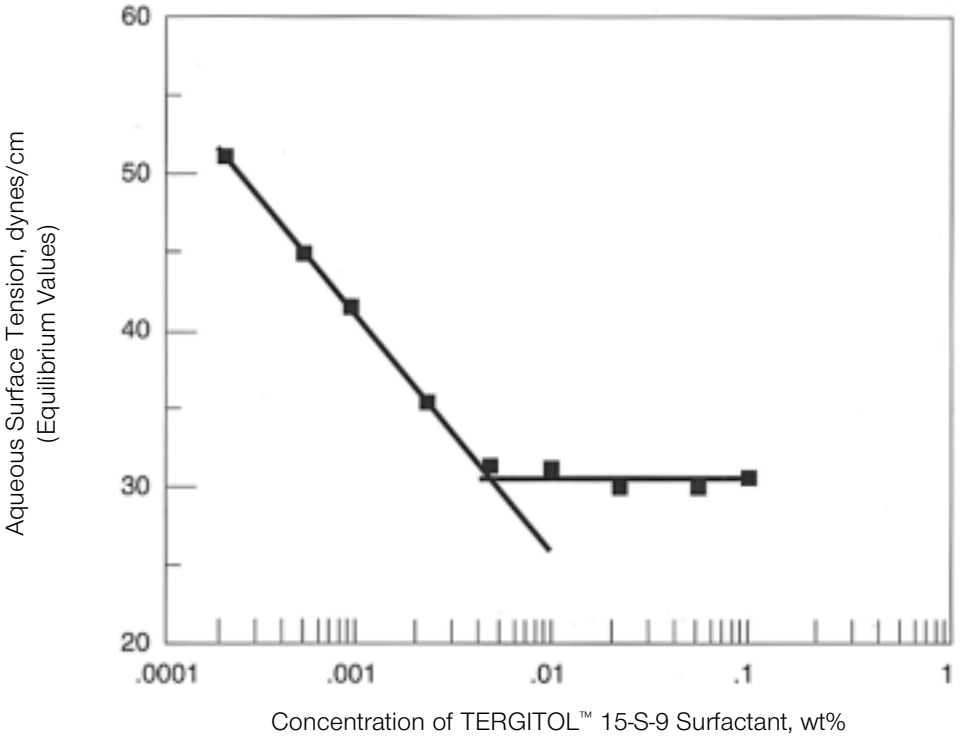
PAE — A primary alcohol ethoxylate with a 12-14 carbon chain length hydrophobe, 8.5 moles of ethylene oxide in a hydrophile, and a cloud point of 75°C. For certain of these tests, a primary alcohol ethoxylate with a shorter carbon chain length hydrophobe was used (**PAE-S**).

NPE — A nonylphenol ethoxylate with 10 moles of ethylene oxide in a hydrophile and a cloud point of 63°C.

Surface Tension Reduction

Perhaps the most universally recognized performance characteristic of a surfactant is its ability to reduce the surface tension of water. Figure 1 illustrates the dependence of aqueous surface tension on surfactant concentration for TERGITOL™ 15-S-9 Surfactant. Surface tension decreases rapidly with concentration until the critical micelle concentration (cmc) is attained at 0.0056 weight percent. Above the cmc, surface tension remains relatively constant at approximately 30 dynes/cm, and the average area per molecule at the air/water interface, calculated from the Gibbs Equation, is 62 square Angstroms. The low cmc of TERGITOL 15-S-9 Surfactant and its ability to reduce the surface tension of water to a very low value are fundamental characteristics that result in highly efficient and effective performance in a wide variety of applications.

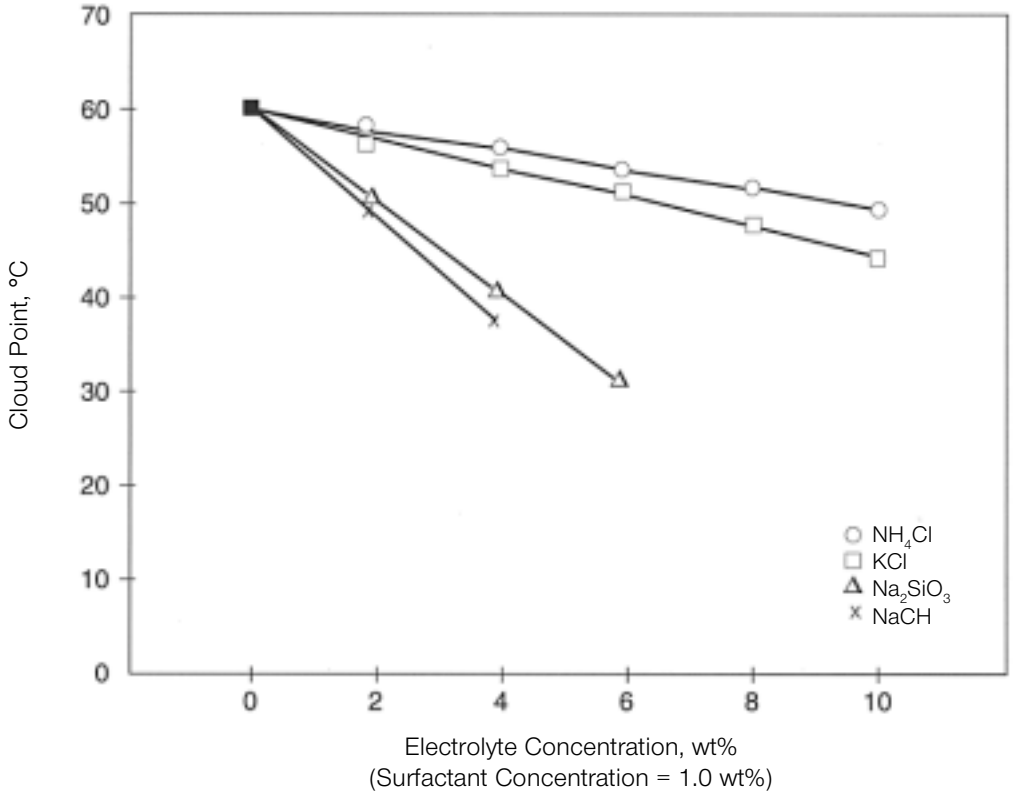
Figure 1 • Aqueous Surface Tension vs Concentration at 25°C for TERGITOL™ 15-S-9 Surfactant



Effect of Electrolytes on Cloud Point

Electrolyte sources, such as sodium hydroxide and potassium chloride, are sometimes utilized in end-use formulations and can affect the cloud point of nonionic surfactants. As illustrated in Figure 2, TERGITOL™ 15-S-9 Surfactant exhibits a cloud point depression in the presence of significant concentrations of most electrolytes. Since solubility is related to alkalinity, sodium hydroxide has a much greater effect on solubility than do more neutral salts such as sodium carbonate and sodium chloride. This "salting out" effect is generally attributed to the dehydration of the ethylene oxide chains, thereby resulting in the disruption of the hydrogen bonding forces responsible for maintaining water solubility. The amount of salt that can be tolerated by a nonionic surfactant is proportional to the number of sites available for hydrogen bonding along the chain, and this in turn is dependent upon the degree of ethoxylation. TERGITOL 15-S-9 Surfactant is typical of detergent-range alcohol ethoxylates in its ability to tolerate strong electrolytes. The characteristic cloud point reduction in the presence of electrolytes is sometimes utilized to increase the low-temperature surface activity of TERGITOL 15-S-9 Surfactant, and it is also useful when an application requires the surfactant to be above its cloud point such as in some textile scouring operations. Consequently TERGITOL 15-S-9 Surfactant is well suited for applications requiring high surface activity at moderate temperatures in the presence of low levels of electrolytes.

Figure 2 • Effect of Electrolytes on Cloud Point for TERGITOL™ 15-S-9 Surfactant

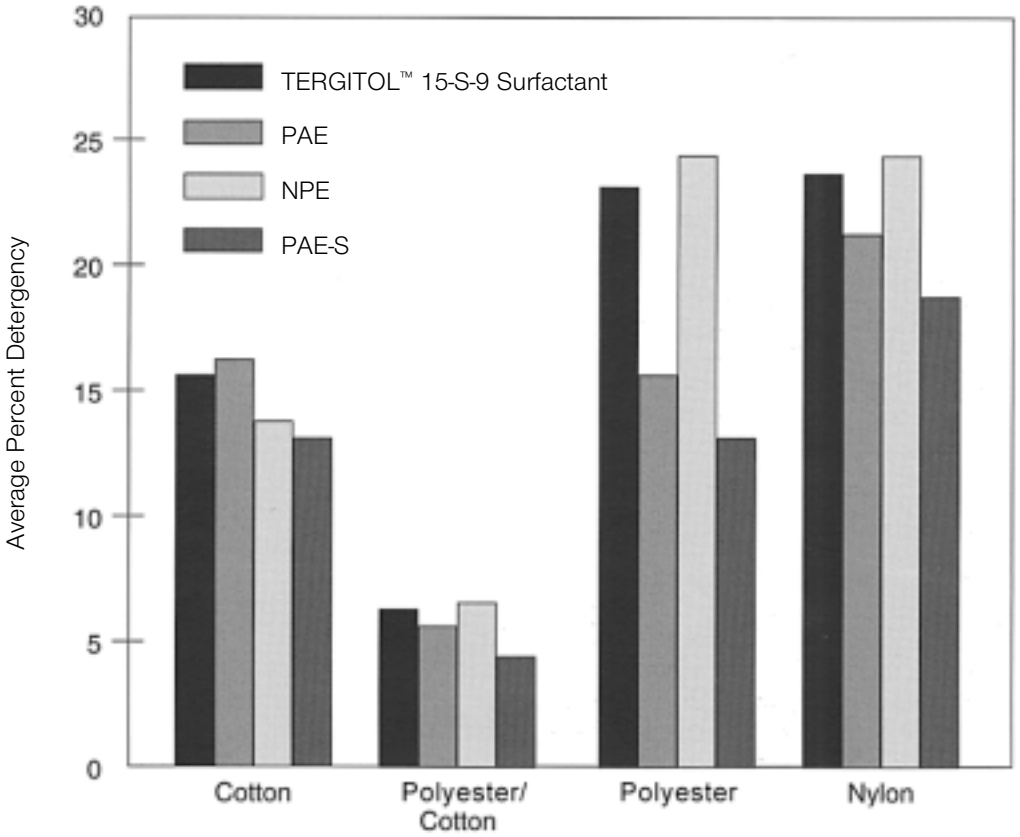


Detergency Performance

TERGITOL™ 15-S-9 Surfactant provides excellent cleaning of hard and soft surfaces. TERGITOL 15-S-9 Surfactant meets or exceeds competitive ethoxylate surfactants in hard-surface cleaning tests. The outstanding formulating and handling characteristics of TERGITOL 15-S-9 Surfactant, combined with its excellent performance, make it a surfactant of choice for hard-surface cleaner products.

Figure 3 demonstrates the outstanding detergency performance of TERGITOL 15-S-9 Surfactant Surfactant on nonpolar oily soils. Detergency values for a mineral oil/carbon black standard soil cloth available from Testfabrics Inc. were determined for TERGITOL 15-S-9 Surfactant and the competitive ethoxylates. All of the nonionic surfactants perform well, but even among these tough competitors TERGITOL 15-S-9 Surfactant exhibits excellent performance. The outstanding cleaning properties of this surfactant, combined with its desirable formulating and handling characteristics, low odor, and biodegradability, make TERGITOL 15-S-9 Surfactant an ideal surfactant for high-performance detergent products.

Figure 3 • Detergency Performance* on Carbon Black/Mineral Oil Soil

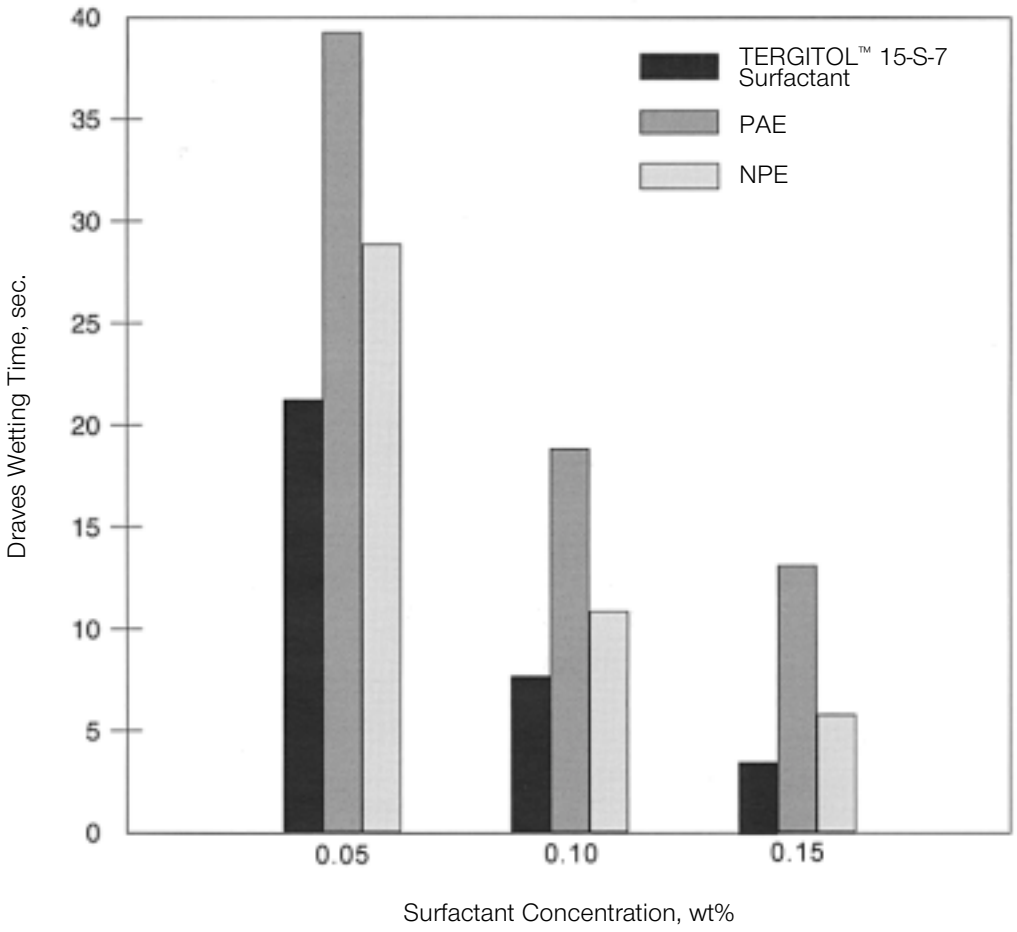


*"Terg-O-Tometer" Testing, 35°C, 150 ppm Hardness, 0.05% Surfactant
10-min wash, 2-min rinse
Reflectance Method

Draves Wetting

The ability of a surfactant to wet textile substrates rapidly is a key performance property in many applications. The Draves Wetting test is a widely regarded laboratory procedure for ranking the relative wetting efficiencies of surfactants. This test is a timed determination for the wetting of a cotton skein by dilute surfactant solutions, where short wetting times are indicative of excellent wetting efficiencies. Shown in Figure 4 are Draves Wetting times for TERGITOL™ 15-S-9 Surfactant and the competitive ethoxylates. All of these surfactants are excellent wetting agents, but TERGITOL 15-S-9 Surfactant has a clear advantage at all of the concentrations tested. TERGITOL 15-S-9 Surfactant is similarly very effective in wetting other substrates such as polyester, nylon, and polyethylene.

Figure 4 • Draves* Wetting Times

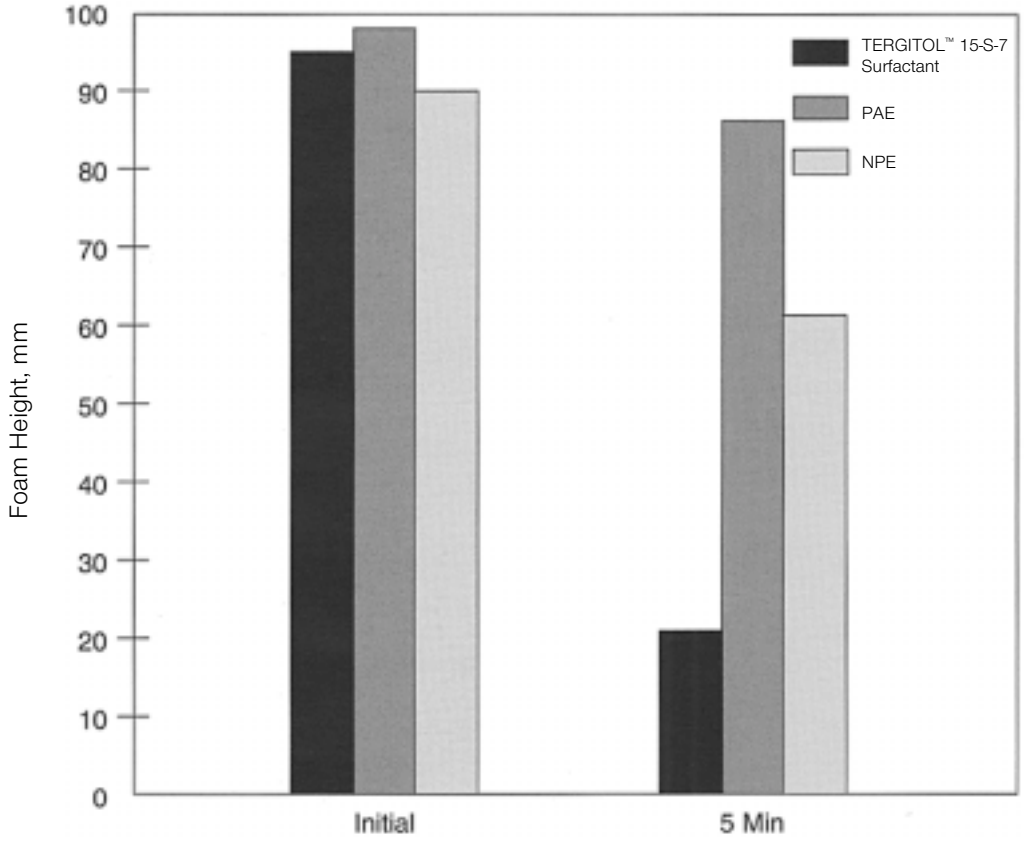


*AATCC 17, 25°C, distilled water, 5 g hook, 3 g cotton skein

Ross-Miles Foaming

In many industrial applications, excessive foaming can lead to reduced operating efficiencies and/or added expenses for foam-control agents. Like all nonionic surfactants, TERGITOL™ 15-S-9 Surfactant has lower foaming tendencies than most ionic surfactants. However, because of the unique "T"-shaped molecular structure of TERGITOL 15-S-9 Surfactant, it tends to produce less stable foams than many competitive ethoxylates. This feature is illustrated in Figure 5, which shows initial and five-minute Ross Miles foam heights for TERGITOL 15-S-9 Surfactant and the competitive ethoxylates. While all three surfactants generate significant foam initially, the foam produced by TERGITOL 15-S-9 Surfactant dissipates faster than that produced by the competitive products. This trend is noted over a broad concentration range, and it is maintained up to the cloud point of the surfactant.

Figure 5 • Ross-Miles* Foam Heights

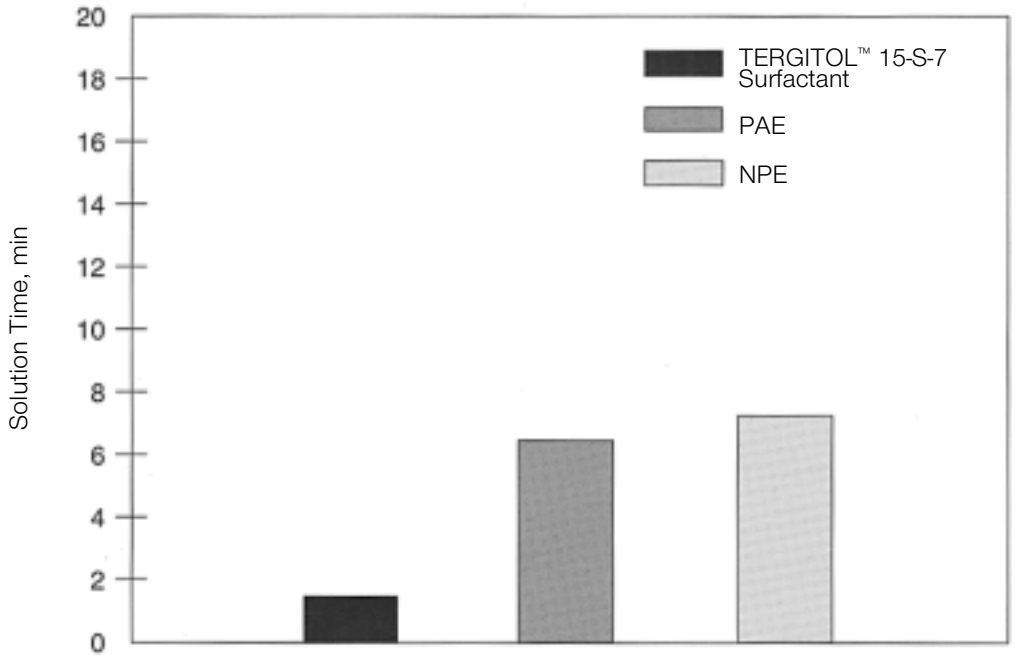


ASTM D1173, distilled water, 1.0 wt% solutions

Dissolution Rate

In formulating a product containing a nonionic surfactant, the rate of dissolution is often an important factor affecting the final cost of the formulation. A slower dissolution rate not only reduces production efficiency, but can also lead to increased raw material costs resulting from the need to use hydrotropes and coupling agents. TERGITOL™ 15-S-9 Surfactant, because of its unique "T"-shaped molecular structure, undergoes rapid dissolution in water, as illustrated in Figure 6. Here, the rate of issolution is compared for TERGITOL 15-S-9 Surfactant and the competitive ethoxylates in this laboratory screening procedure, 50 mL of distilled water was placed in a flat-bottomed glass tube, and the system was agitated at 800+/–25 rpm with a 1.5x0.5 cm stirring bar. With a 1-cc syringe equipped with a 4-in, 16-gauge blunt-tip needle, 0.2 mL of surfactant was injected below the surface of the liquid. Time zero was taken at the time of injection, and the solution time was recorded when the surfactant was totally dissolved. TERGITOL 15-S-9 Surfactant dissolves much faster than the PAE in this laboratory screening test, and this observation is generally upheld in practical applications. The differences in dissolution rates are expected to be even more pronounced in cold water and/or in highly concentrated systems, making TERGITOL 15-S-9 Surfactant the preferred surfactant in numerous applications.

Figure 6 • Solution Times at 25°C



Aqueous Viscosity

When formulating products with high levels of nonionic surfactant, hydrotropes must often be added to reduce viscosity and/or prevent gelling. Table 1 reveals that TERGITOL™ 15-S-9 Surfactant builds viscosity at a much slower rate than the competitive ethoxylates. In addition, TERGITOL 15-S-9 Surfactant forms gels over a much more narrow concentration range than most nonionic surfactants. Thus, TERGITOL 15-S-9 Surfactant can often be formulated into concentrated products with a minimal amount of hydrotrope, thereby reducing the final cost of the formulation.

Table 1 • Aqueous Solution Viscosities at 25°C

Surfactant Concentration, wt%	Aqueous Viscosity, cSt		
	TERGITOL™ 15-S-9 Surfactant	PAE	NPE
10	2	2	3
20	6	6	26
30	34	51	312
40	214	Gel	Gel
50	Gel	Gel	Gel
60	260	Gel	2055
70	154	Gel	Gel
80	129	Gel	602
90	96	104	307

Regulatory Status

FDA and EPA Status

Regulation	Permitted Uses
FDA 21 CFR 173.315	Surface active agent in **flume water for washing sugar beets** prior to the slicing operation at a level not to exceed 3 ppm.
FDA 21 CFR 178.3400	**Emulsifier and/or surface active agent** in the manufacture of articles or components of articles intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, or holding food.
FDA 21 CFR 181.30	Manufacture of **paper or paperboard** products for use in food packaging (if the surfactant would not reasonably be expected to migrate to food under conditions of normal use).
EPA 40 CFR 180.1001(c) FDA 21 CFR 182.99	Inert ingredient for use in **pesticide formulations** applied to growing crops or to raw agricultural commodities after harvest.
EPA 40 CFR 180.1001(e)	Inert ingredient for use in **pesticide formulations** applied to animals.

Shipping Data*

Weight per Gallon at 20°C, lb	8.37
Δlb per gallon/Δt per °C	0.00646
Coefficient of Expansion, per °C	
at 20°C	0.00077
at 55°C	0.00079
Flash Point, Pensky-Martens Closed Cup, ASTM D 93, °C (°F)	193 (225)
Net Contents	
Steel drum, 55-gal tight, DOT 17E, unlined, lb	460
DOT Label Required	None
DOT Hazard Classification	Not Regulated
DOT Shipping Name	None
Resample Time, months (estimated)	24

* For typical commercial material

Storage and Handling

TERGITOL™ Specialty Surfactants are stable, high flash point products manufactured to meet exacting standards of quality. They must be handled and stored properly to prevent degradation or contamination and to ensure maximum performance in your application.

Storage

Under anhydrous conditions, store in carbon steel, baked phenolic-lined steel, fiberglass-reinforced polyester, tinned iron, or polyethylene. To avoid discoloration, do not use copper, copper alloys (brass, bronze), zinc, or galvanized iron.

When water is added, the resulting product is more corrosive to commonly used metals and should be stored in stainless steel (type 304 or 316), baked phenolic-lined steel, fiberglass-reinforced polyester, polyethylene or polypropylene.

Store under nitrogen to avoid degradation which causes undesirable color and odor.

Store under air (without nitrogen blanket) only for short-term storage, when temperature is less than 90˚F. Slow degradation will occur under air storage. A desiccant unit may be installed in the vent line to dry incoming air.

Handling

TERGITOL 15-S-9 Surfactant has a typical pour point of 9˚C (48˚F) and is a low-viscosity liquid at room temperature (60 cP at 25˚C). While it is unlikely that heated storage and handling facilities will be required for the neat surfactant, some formulations containing TERGITOL 15-S-9 Surfactant may require heat to maintain adequate handling and/or stability.

Use mild heating, preferably with circulation or agitation, since surfactants are subject to discoloration when overheated. Heat with warm water or low watt-density electrical heating tape, so that the container temperature will not exceed 50˚C (122˚F). Low-pressure steam is acceptable, as long as circulation or agitation is provided.

Avoid bayonet heaters because high temperatures can be generated on their heating surfaces.

Standard all-iron valves and centrifugal pumps are commonly used for product transfer service. Ball valves with “Teflon” seals can be used for “on-off” valves.

Product Safety

When considering the use of any Union Carbide products in a particular application, you should review our latest Material Safety Data Sheets and ensure that the use you intend can be accomplished safely. For Material Safety Data Sheets and other product safety information, contact the Union Carbide sales office nearest you. Before handling any other products mentioned in the text, you should obtain available product safety information and take necessary steps to ensure safety of use.

No chemical should be used as or in a food, drug, medical device, or cosmetic, or in a product or process in which it may contact a food, drug, medical device, or cosmetic until the user has determined the suitability and legality of the use. Since government regulations and use conditions are subject to change, it is the user's responsibility to determine that this information is appropriate and suitable under current, applicable laws and regulations.

Union Carbide requests that the customer read, understand, and comply with the information contained in this publication and the current Material Safety Data Sheet(s). The customer should furnish the information in this publication to its employees, contractors, and customers, or any other users of the product(s), and request that they do the same.

SALES OFFICES

See More Information in Main Menu

BIGSUN CHEMICAL CORPORATION

TEL: 886-2-25253688

FAX: 886-2-25253677

P.O. BOX 68-733 TAIPEI ,TAIPEI CITY, TAIWAN, R.O.C.