

AEROSOL® EF-810 Surfactant

A Versatile Surfactant for “APE” Free Formulations

Type: Anionic/nonionic liquid
Chemical: Proprietary sulfosuccinate surfactant

AEROSOL EF-810 surfactant is a new, versatile, alkylphenol (APE) free surfactant designed for use as a primary emulsifier for acrylic, vinyl-acrylic, styrene-acrylic and styrene-butadiene latex systems. This water-soluble and highly effective surfactant ensures compliance with increasingly stringent alkylphenol regulations and yields high performance latex systems.

AEROSOL EF-810 surfactant can be used alone or in combination with other surfactants allowing optimization of latex formulations for desired solids content, particle size and viscosity. The product imparts outstanding pre-emulsion stability, yields robust reaction kinetics, high conversions and minimizes final latex grit and coagulum, thus improving overall operational efficiencies. AEROSOL EF-810 surfactant is biodegradable and has a favorable toxicological and regulatory profile.

Physical and Chemical Properties:

Appearance at 25°C	colorless to yellow viscous liquid
Solids, % by weight	28.0-33.0
Solvent	water
Specific gravity g/cc	~1.19
Freezing point, °C	ca.0
Flashpoint, °C	>93
(ASTM D93, PMCC)	
pH	5.0 -7.0

Acid Number	6
(as is, maximum)	
Iodine Value	0.5
(as is, maximum)	
Solubility in water	infinite

Surface Active Properties

Critical Micelle Concentration (CMC), % by weight	0.01-0.03
Surface Tension mN/M (at CMC)	32

Emulsion Polymer Applications

AEROSOL EF-810 surfactant is designed for use as an emulsifier in acrylic, vinyl-acrylic, styrene-acrylic and styrene-butadiene latexes. The product's high tolerance to water-sensitive monomers (i.e. CYLINK® NMA Monomer) facilitates easy development of high performance systems. Typical applications for AEROSOL EF-810 surfactant based products include:

- Adhesives & Sealants
- Paint binders
- Textile binders
- Paper coatings
- Non-woven binders
- Building and Construction coatings

Table 1: Features and Benefits of AEROSOL EF-810 Surfactant in Emulsion Polymerizations

Feature	Benefit
Alkylphenol free material (APE Free)	Ensures compliance with increasingly stringent alkylphenol regulatory requirements
Water-soluble	Easily formulated into acrylic, vinyl-acrylic, styrene-acrylic and styrene-butadiene latex systems
Versatile emulsifier	Functional alone or in combination with other anionic and nonionic surfactants
Excellent pre-emulsion stabilizer	Increases manufacturing flexibility
Highly effective	Functional at low concentrations (i.e. 1 to 2%)
Enhances latex properties	Can achieve high solids (i.e. >60%) content and excellent mechanical stability
Yields high conversion and low coagulum and grit	Increases operational efficiencies
High compatibility	Latex films exhibit high optical clarity and excellent heat stability

AEROSOL EF-810 Surfactant Foaming Performance

Figure 1 demonstrates that AEROSOL EF-810 surfactant exhibits a slightly lower tendency to foam than other AEROSOL monoester sulfosuccinate surfactants. Additionally, since

initial foam values are slightly lower, foam is dissipated more quickly. This lower foaming tendency can be beneficial and may offer greater operational flexibility and improved efficiency.

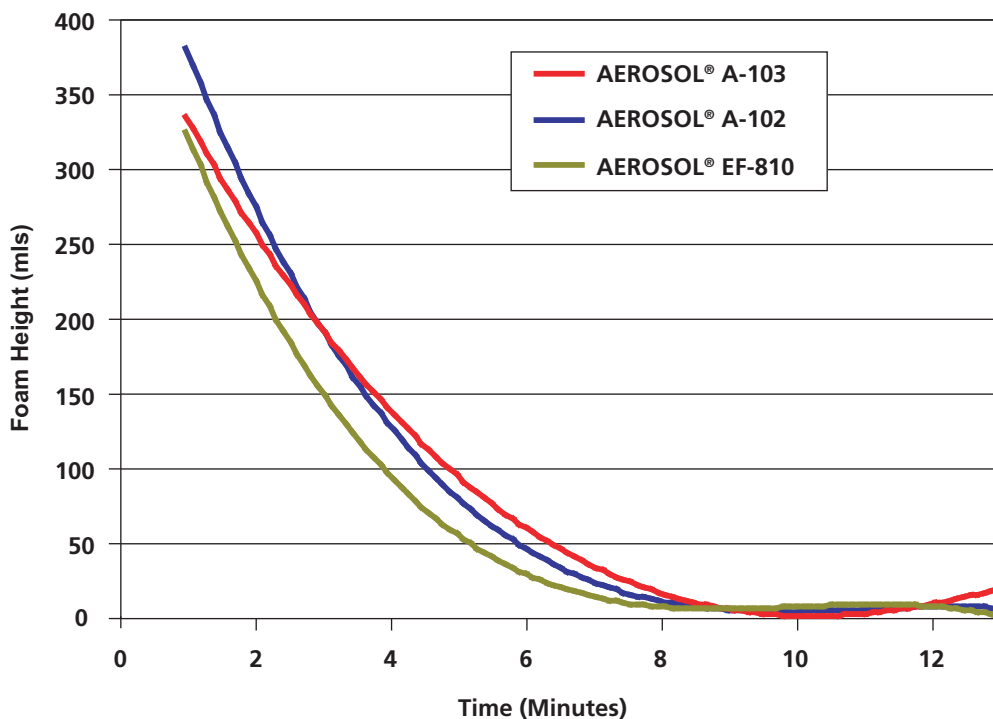
Figure 1: Foaming Characteristics of AEROSOL EF-810 Surfactant

Table 2: Pre-Emulsion Stability with AEROSOL EF-810 Surfactant

Sample	AEROSOL EF-810	AEROSOL A-103	Sodium Lauryl Sulfate
Pre-emulsion, 0 Hours	Stable	Unstable (Separation)	Unstable (Separation)
Pre-emulsion, 4 Hours	Stable	Unstable (Separation)	Unstable (Separation)

Pre-Emulsion Stability with AEROSOL EF-810 Surfactant

Table 2 demonstrates the excellent pre-emulsion stability achievable with the AEROSOL EF-810 surfactant in comparison with AEROSOL A-103 surfactant and Sodium Lauryl Sulfate (SLS). This enhanced pre-emulsion stability increases manufacturing flexibility and operational efficiency as emulsions can be prepared, stored and charged over a wide processing time.

Pre-emulsion formulation:

Monomer Ratio - 39.2% Butyl Acrylate/26.8 Ethyl Acrylate/34% Methyl Methacrylate

Surfactant Level - 1.3 phm (0.8 phm Anionic and 0.5 phm Nonionic Tridecyl Alcohol Ethoxylate)

Typical Acrylic Latexes Prepared with AEROSOL EF-810 Surfactant

Table 3 on page 4 presents a summary of the results obtained from some typical acrylic latexes prepared with concentrations of AEROSOL EF-810 surfactant that ranged from 0.6 to 2.0%. The synthesized latexes represent a range of end-use

applications. In some of the formulations, additional anionic sulfosuccinate and nonionic ethoxylated surfactants were also used to optimize latex properties. Each latex was analyzed for solids, conversion, particle sizes (seed and final), surface tension, viscosity and coagulum. On select latexes, mechanical stability and film optical properties were also assessed.

It is noted that for select recipes, AEROSOL EF-810 surfactant performance was benchmarked against other surfactants at similar concentrations. Competitive surfactants used in the benchmarking study included AEROSOL A-103 surfactant (an APE anionic sulfosuccinate), Sodium Lauryl Sulfate (SLS), Sodium Lauryl Ether Sulfate (SLES), Sodium Dodecyl Benzene Sulfonate (DDBS), AEROSOL NPES 930 surfactant (Ammonium Nonyl Phenol Ether Sulfate) and AEROSOL DPOS-45 surfactant (Sodium Diphenyl Oxide Disulfonate). The data from the benchmarking studies is available upon request.

Table 3 – Typical Acrylic Latexes Prepared with AEROSOL EF-810 Surfactant

Monomers ¹	EA/BA MMA/NMA	BA/HEMA/ AA	STY/BA/MMA HEMA/MAA	VA/VEOVA	MMA/BA/MAA
Composition	26/38/33/3	97/2/1	80/13/4/2/1	71/29	47/52/1
Application	Nonwoven	Acrylic PSA	Styrene/Acrylic Paint	VA/VEOVA Paint	All Acrylic
Polymerization Procedure	Pre-emulsion	Pre-emulsion	Pre-emulsion	Monomer feed	Pre-emulsion
AEROSOL EF-810 (phm)	1.6*	0.6	0.6*	1.0*	1.5
Co-Surfactants FAE 13-20 AEROSOL 22 AEROSOL MA-80 AEROSOL TR-70	3.1	0	0.6 0.5	1.9 0.5	0
Latex Properties Solids, %	42.7	55.3	51.0	52.1	48.3
Conversion, %	>99	>99	>99	>99	>99
Particle Size, nm Seed Final	60 (19) 144 (41)	86 (21) 205 (49)	103 (12)	50 (19) 162 (23)	74 (16) 192 (49)
Surface Tension (mN/M)	44	49	55	40	50
Viscosity ³ , cps	985	408	1975	344	60
Coagulum ² , % Total Latex	<0.01 0.05	<0.1 0.10	<0.01 <0.01	<0.01 0.10	<0.01 0.05
Mechanical Stability (5 min. @ 12K rpm)	Failed	Passed	Passed	Failed	Passed
Film Quality	Clear & Continuous	Clear & Continuous	No film formation ⁴	Clear & Continuous	Hazy & Continuous

*Denotes addition of co-surfactant to formulation. Co-surfactants were either anionic sulfosuccinate (AEROSOL MA-80 surfactant and AEROSOL TR-70 surfactant) or sulfosuccinamates (AEROSOL 22 surfactant) or nonionic ethoxylated surfactants (FAE 13-20, 20 moles ethoxylated isotridecanol).

¹ Monomers: BA – Butyl Acrylate
MMA – Methyl Methacrylate
MAA – Methyl Acrylate
EA – Ethyl Acrylate
HEMA – Hydroxyl Ethyl Methacrylate
VA – Vinyl Acetate
NMA – CYLINK® NMA monomer
AA – Acrylic Acid
STY – Styrene
VEOVA® – Vinyl Ester of Versatic Acid 10
(manufactured by Hexion)

² Coagulum: Percent was measured by weighing the total amount of wall and latex coagulum filtered out on a tandem combination of 60 and 150 mesh nylon screens. The coagulum was washed and dried at 100°C. Latex coagulum was the part retained on the 200 mesh screen.

³ Measured with a Brookfield LVT Viscometer, No. 2 spindle at 60 rpm, 25°C.

⁴ This is high Tg high gloss paint latex so no film formation without coalescing agent.

Example formulations for various latex systems are available upon request.

Typical Recipe and Procedure for Evaluation of AEROSOL EF-810 Surfactant in Latex Binders

The following recipe and procedure illustrates how the AEROSOL EF-810 surfactant was evaluated for its performance in latex binders.

Solids: 42.7%. Ratio: 26/38/33/3

0. Application:

All acrylic APE free soft feel non woven recipe.

I. Recipe:

A) <u>Kettle charge:</u>	<u>parts per weight</u>
D. Water	300
AEROSOL EF-810 (32.0%)	8.50
NaHCO ₃	0.48
Ammonium persulfate	1.92
D. water	20
B) <u>Pre-emulsion charge:</u>	
D. water	100
AEROSOL EF-810 (32.0%)	12.7
FAE 13-20	12.8
EA	104
BA	152
MMA	132
C) <u>Flush:</u>	
D. water	26
D) <u>Delayed charge:</u>	
D. Water	24
CYLINK® NMA	25
E) <u>Catalyst charge:</u>	
D. water	70
SMBS	0.8

II. Glass Transition Temperature:

T_g is calculated as -5.0°C.

III. Procedure:

A) Preparation of kettle charge:

Add 8.5 parts of AEROSOL EF-810 Surfactant and 0.48 parts of sodium bicarbonate to 300 parts of de-ionized water. Purge the solution with nitrogen while stirring and heat to 65°C.

A solution of 1.92 parts ammonium persulfate in 20 parts de-ionized water is placed aside for initiation.

B) Preparation of monomer pre-emulsion charge:

Stir 12.7 parts AEROSOL EF-810 Surfactant and 12.8 parts FAE 13-20 (20 moles ethoxylated isotridecanol) into 100 parts de-ionized water. Mix 132 parts methyl methacrylate, 152 parts butyl acrylate and 104 parts ethyl acrylate in a separate vessel. Slowly add the monomer solution into the sufficiently stirred aqueous solution.

C) Preparation of delayed charge:

Dissolve 25 parts CYLINK NMA 48% Monomer in 24 parts de-ionized water and place aside.

D) Preparation of catalyst charge:

Dissolve 0.8 parts sodium metabisulphite in 70 parts de-ionized water and set aside for gradual feeds.

E) Addition of monomer to polymerization flask:

Reduce the nitrogen flow to a minimum when the reaction kettle content reaches 62°C. Add 10% of the pre-emulsion and the initial catalyst shot. After an exotherm is observed (approx. 10 mins) the delayed charge is added to the pre-emulsion and the addition of monomer is started at a rate of 2.2 parts per minute. The addition of catalyst is started at a rate of 0.4 parts per minutes, with 15 minutes delay. Total addition time requires about 3 hours for both additions.

Once the feeds are complete, flush the emulsion vessel and lines with 26 parts of de-ionized water. Hold the batch for 1 hour at 65°C. Cool the reaction to room temperature and filter the latex into a suitable container.

Health and Safety Information

Before handling this material, read the corresponding Cytec Industries Inc. Material Safety Data Sheet for safety, health and environmental data.

Storage and Handling

Handling and storage information on this product can be found on the corresponding Cytec Industries Inc. Material Safety Data Sheet. Stainless steel, aluminum and Monel alloy are recommended for reaction and storage vessels; glass and rubber are suitable lining materials.

The efficacy of AEROSOL EF-810 surfactant is not impaired by freezing or thawing. However, if a freeze-thaw cycle occurs, it is recommended that the entire contents of the container be agitated prior to use.

Regulatory Information

All components of this product are included on the Toxic Substances Control Act (TSCA), European Inventory of Existing Chemical Substances (EINICS), the Korea Inventory (ECL), the China Inventory and the Japan Inventory (MITI).

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