



ACULYN™ 33 Rheology Modifier/Stabilizer

A cost-effective thickener for formulations containing polar solvents

This bulletin focuses on our ACULYN™ 33 Rheology Modifier Stabilizer, a cost-effective thickener and particulate suspending agent, particularly suited for formulations containing polar solvents and to stabilize suspensions. Our ACULYN rheology modifiers find utility in an ever-increasing breadth of personal care applications because of their unique ease of use, wide compatibility, cost effectiveness and favorable balance of rheological properties.

Dow is committed to providing technology enhancement to the personal care industry. To learn how our expertise in polymers and preservatives can spark your own creativity, please contact us.

CTFA/INCI Name: Acrylates Copolymer

Description

ACULYN™ 33 Rheology Modifier/Stabilizer is an alkali-swellable anionic acrylic polymer emulsion (ASE) that is lightly crosslinked to impart a short pseudoplastic flow. It is a liquid, cold-processable product that instantaneously thickens upon neutralization providing ease of handling and increased manufacturing efficiency. This thickener is offered at 28% solids and is compatible with peroxide and other oxidizing agents, electrolytes, polar solvents and zinc pyrithione. The polymer has a well-established toxicological profile and is safe in normal use.

Features

- Stable in highly alkaline systems
- Particulate suspension
- Polar solvent compatibility
- Instant neutralization/thickening
- Short flow
- Cold-processable/Liquid
- Yields clear gels
- Divalent ion tolerance
- Excellent viscosity stability
- Peroxide compatible
- Flat pH/viscosity response
- Lack of odor
- Excellent high shear stability

Benefits

- Easy to handle
- Formulations exhibit little viscosity drift
- No preparation necessary
- Compatible with nonionic and anionic surfactants
- Non hygroscopic
- Thickens and stabilizes hydrogen peroxide
- Increased manufacturing efficiency
- No odor/color change in two-part peroxide formulations
- Allows for use of continuous production processes with use of in-line static mixers
- Permits stable formulations with particulates
- Can be processed with membrane pumps and, when diluted, with turbine mixers and high speed propellers
- Ability to stabilize suspensions
- Less sensitive to water hardness
- Able to formulate clear products
- Does not promote or support contamination, unlike natural thickeners
- Mild, soft, non-greasy, non-sticky
- No watery feel upon skin contact
- Flexibility in choice of preservative system
- Improved pickup properties
- Supported by comprehensive environmental, health and safety data
- Formulation of spreadable lotion products that flow readily from the container
- Allows for stable, viscous formulations in polar solvents

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ACULYN™ 33 Rheology Modifier/Stabilizer

Applications

- Alcohol and glycol-containing formulations
 - Astringents
 - Cleansers
- Depilatories
- Hand Soaps
- Lotions
 - Body
 - Cleaning lotions
 - Hand
- Make-up creams and lotions
- Opaque and pearlescent shampoos
- Peroxide-containing formulations
 - Hair dyes
 - Hand disinfectants
 - Permanent wave neutralizers
- Solvent gels

Physical Properties

The following are typical properties of ACULYN™ 33 Rheology Modifier/Stabilizer; **they are not to be considered product specifications.**

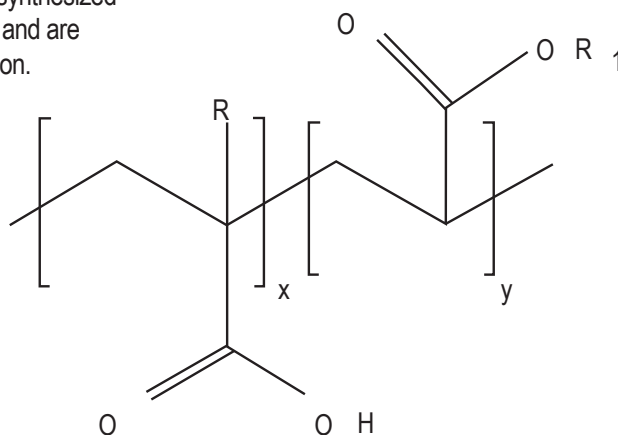
Chemistry: ASE polymer
Association: None
Ionic nature: Anionic
Appearance: Milky liquid
Solvent: Water
Solids, %: 28
pH (as supplied): 3.0
Density: 1.05
Equivalent weight*: 218
Rheology: Short, buttery
Shear thinning: Moderate
Viscosity, mPa s (as supplied): 10
Pseudoplastic index: 5.0
(viscosity @ 6 rpm/viscosity @ 60 rpm): (2% solids in water)

*grams of dry polymer neutralized by 1 equivalent (40 grams) of NaOH.

ACULYN™ 33 Rheology Modifier/ Stabilizer Chemistry

ACULYN 33 is an anionic Alkali-Soluble polymer Emulsion (ASE). ASE polymers are synthesized from acid and acrylate comonomers and are made through emulsion polymerization.

Structure



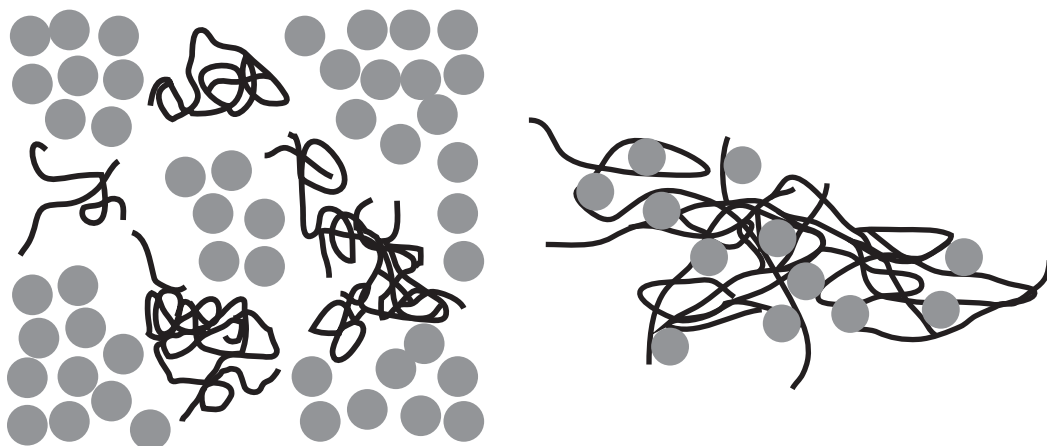
Mechanism of Action

ACULYN™ ASE polymers thicken via a non-associative mechanism. Non-associative rheology modifiers do not interact with surfactant structures, particulates or insoluble emulsion droplets.

Non-associative polymers thicken by structuring the continuous phase and through chain entanglement. This can stabilize pre-dispersed insolubles by significantly slowing their motion.

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ACULYN™ 33 Rheology Modifier/Stabilizer



Features of ASE Rheology Modifiers

The chart to the right shows features indicative of the behavior of ASE rheology modifiers under different conditions. Please note that these behaviors may vary to some extent according to specific formulations.

All ACULYN™ rheology modifiers are easy to formulate, have good to excellent salt tolerance, compatibility with anionics and nonionics and low odor. ASE polymers have excellent solvent stability and excellent stability in two part peroxide systems. Blending of the ASE and HASE chemistries can offer further enhancements and synergies.

Ease of formulation:	Excellent
Associative:	No
Salt tolerance	
NaCl:	Good
Di/trivalent ions:	Good
Shear thinning behavior:	Good
Solvent compatibility:	Excellent
Low pH compatibility (< pH 6:	No
Anionic surfactant compatibility:	Excellent
Nonionic surfactant compatibility:	Excellent
Cationic surfactant compatibility:	No
Peroxide stability	
1 part system:	No
2 part system:	Excellent
Lack of odor:	Excellent

ACULYN™ 33 Rheology Modifier/Stabilizer Behavior Profile

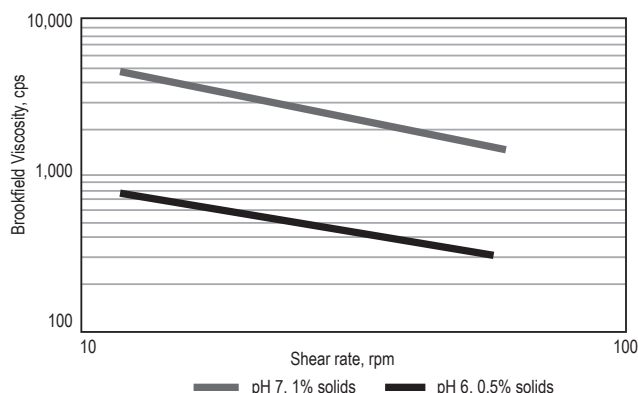
Rheology

ACULYN™ 33 Rheology Modifier/Stabilizer possesses many properties that make this polymer highly desirable for use in personal care applications, as shown in the data presented below.

Shear Thinning

Solutions incorporating ACULYN™ 33 Rheology Modifier/Stabilizer exhibit shear thinning properties with a short flow.

Effect of Shear Rate on Viscosity of Sodium Salt of ACULYN™ 33 Rheology Modifier/Stabilizer



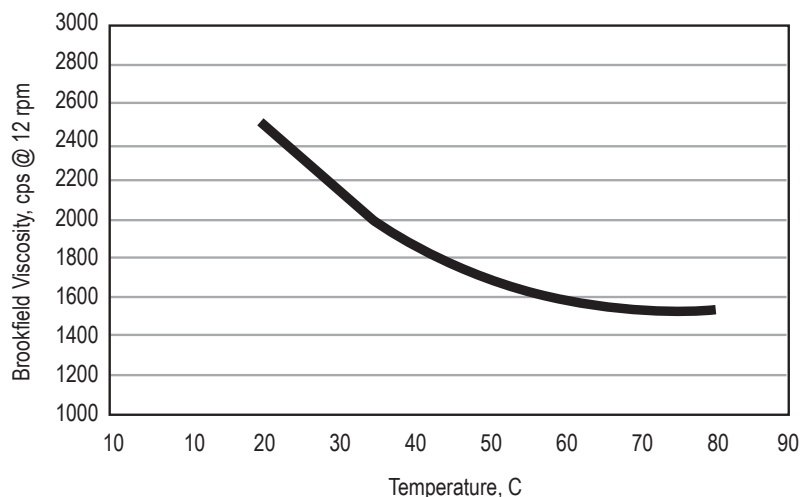
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Temperature Sensitivity

The relative degree of the shear thinning nature of these solutions is closely related to that of the cellulosic thickeners. Thickening undergoes a modest decrease throughout a temperature range from 20°C to 75°C.

Effect of Temperature on Viscosity of Sodium Salt of ACULYN™ 33 Rheology Modifier/Stabilizer (1% Polymer Solids)



Compatibility

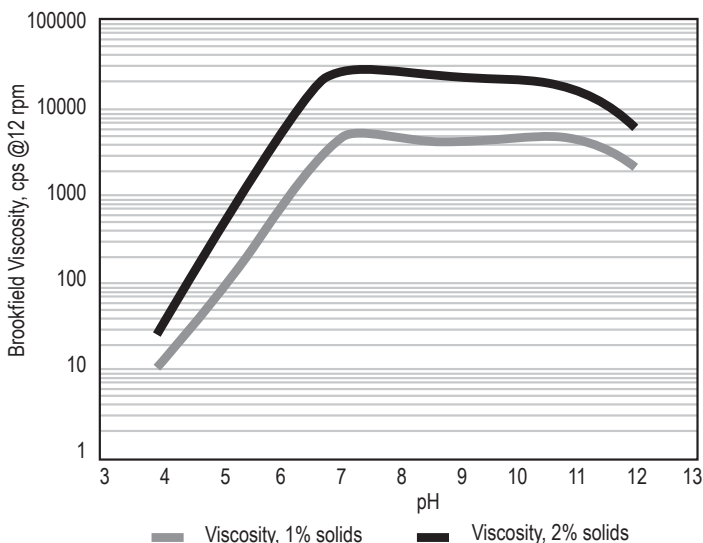
Cationic Compatibility

Polymeric cationics, as well as some large, bulky quaternary materials, can possibly be incorporated in formulations containing ACULYN™ 33 Rheology Modifier/Stabilizer. The optimum order of addition in these instances generally requires the ACULYN 33 to be neutralized with a base prior to the addition of any cationics.

pH Tolerance

ACULYN 33 is an effective stabilizer/thickener over the pH range of 6.0 to 12.5.

ACULYN™ 33 Rheology Modifier/Stabilizer and pH Change Upon Neutralization with NaOH



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Peroxide Stability

ACULYN™ 33 Rheology Modifier/Stabilizer is stable in systems containing hydrogen peroxide. Because hydrogen peroxide is only stable under acidic conditions and is most often supplied at a pH of 4, and ACULYN 33 does not thicken until neutralized (pH > 6.5), the use of ACULYN 33 in peroxide-containing formulas is restricted to two-part systems.

Peroxide and ACULYN 33 can be mixed together forming a stable mixture (part A), with alkali and any other component forming part B. When the two parts are mixed, thickening will occur instantaneously.

Peroxide Stability with ACULYN™ 33 Rheology Modifier/Stabilizer (3% Polymer Solids, pH 3.5)

Sample	Peroxide Retained, %	
	4 weeks at 25°C	4 weeks at 45°C
3% Hydrogen Peroxide + ACULYN 33	71.1	68.4
3% Hydrogen Peroxide (No polymer)	82.2	71.1
12% Hydrogen Peroxide + ACULYN 33	87.4	85.7
12% Hydrogen Peroxide (No polymer)	83.0	81.6

Performance

Film Formation

Films of neutralized ACULYN™ 33 Rheology Modifier/Stabilizer are clear and somewhat brittle. Soft flexible films can be prepared with the addition of glycols. Films cast from the ammonium or volatile amine salts are less sensitive to water than those prepared from sodium or potassium salts.

Particulate Suspension

Particulates can be stabilized by ACULYN 33. The table below illustrates stable kaolin clay slurries created with low levels of ACULYN 33. Formulators of liquid and cream-based makeup will find ACULYN 33 a valuable addition to their array of formulation aids. Formulations containing pigments difficult to suspend such as red iron oxide (Fe_2O_3) can be thickened/stabilized with ACULYN 33. And because of its ability to suspend particulates, ACULYN 33 can be employed to stabilize suspensions of zinc pyrithione in anti-dandruff shampoos.

ACULYN™ 33 Rheology Modifier/Stabilizer Stabilization of 30% Kaolin Clay Slurry

ACULYN 33 % solids	Viscosity 12 rpm
0.25	1,400
0.50	20,000
0.75	>100,000

ACULYN™ 33 Rheology Modifier/Stabilizer can also be used with titanium dioxide (TiO_2) in sunscreens to give an excellent feel with ample playtime. The polymer is also compatible with other inorganic UV absorbers.

Neutralization Options

ACULYN™ 33 Rheology Modifier/Stabilizer can be neutralized by a wide range of both inorganic and organic bases. Choice of base is dependent upon intended applications, specific ingredients and personal preference. In many simple aqueous systems the choice is often sodium hydroxide, potassium hydroxide, or ammonium hydroxide.

In emulsified lotions and creams, alkanol amines are often used. Typical choices include triethanolamine (TEA), diethanolamine (DEA), aminomethylpropanol (AMP) and aminomethylpropanediol (AMPD).

For products with high levels of organic solvents, the alkanol amines or higher molecular weight, more oil-soluble amines are preferred, such as Quadrol (tetrahydroxypropyl ethylenediamine) and Ethomeen C/-25 (PEG-15 cocoamine) supplied by Akzo Nobel.

Choice of amine can somewhat affect the formulated viscosity. The table below shows TEA to be slightly more efficient for ACULYN 33 in increasing viscosity of water. Subtle properties such as product feel can be altered by choice of amine.

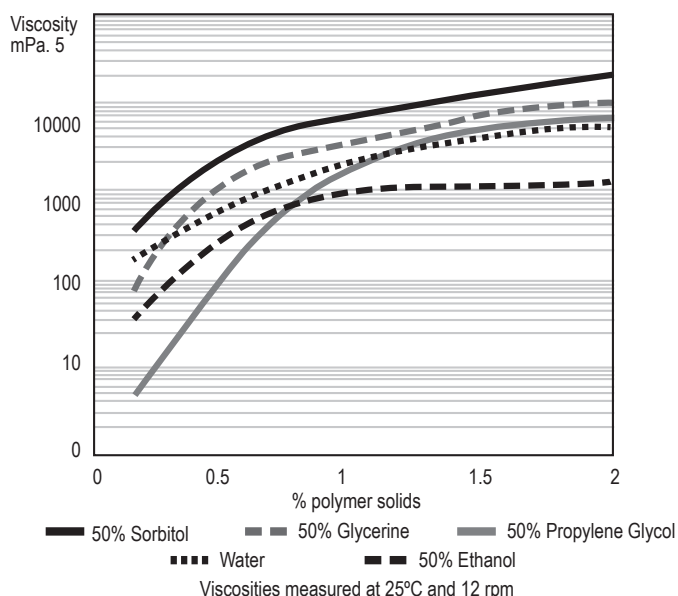
ACULYN™ 33 Rheology Modifier/Stabilizer Neutralization with Various Bases
(1% solids, Brookfield Viscosity (cps) @ 12 rpm)

Base	pH 7	pH 9
NH ₄ OH	3700	3200
TEA	5500	5500
KOH	3900	4300

Thickening of Polar Solvents

ACULYN™ 33 Rheology Modifier/Stabilizer is an effective thickener for a variety of alcoholic solutions. The thickening efficiency for the sodium form of ACULYN 33 in these polar solvents is shown in the table and graph below. Sodium hydroxide was used to neutralize ACULYN 33 in these solutions. More hydrophobic organic amines would be more appropriate for less polar solvents.

Thickening of Aqueous Solutions of Glycols and Glycerol with ACULYN™ 33 Rheology Modifier/Stabilizer

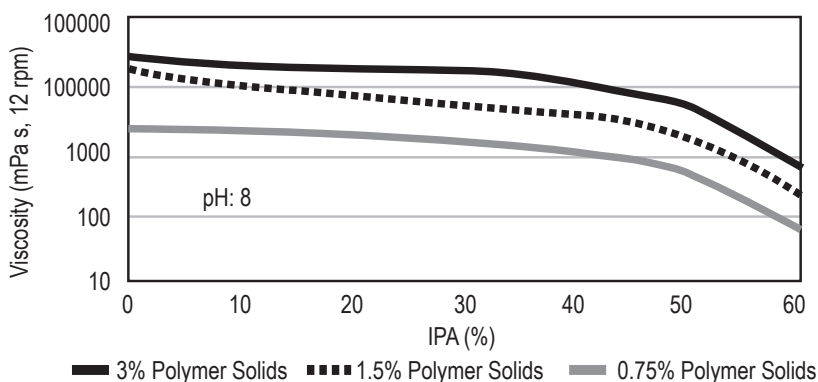


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ACULYN™ 33 Rheology Modifier/Stabilizer can be efficiently used to thicken up to 60% solutions of isopropyl alcohol. For optimum results when formulating with high levels of alcohols, it is recommended, if possible, to add approximately one-half of the required alkali for neutralization prior to the addition of the alcohol, followed by the balance of the alkali.

ACULYN™ 33 Rheology Modifier/Stabilizer Isopropyl Alcohol Compatibility



Formulations and Use Guidelines

ACULYN™ 33 Rheology Modifier/Stabilizer is compatible with surfactants, solvents, oils and salts commonly found in cosmetic and toiletry products. These products undergo instantaneous thickening when neutralized with base.

This product is supplied as a low viscosity emulsion and can be incorporated directly into formulations with none of the concerns about dissolution, particulate clumping or dusting problems that can be encountered with dry products. ACULYN 33 is also cold processable.

Because thickening occurs instantaneously upon neutralization with base, in-line mixing with static mixers is possible. Upon neutralization, the ACULYN 33 emulsion becomes a clear, highly viscous solution.

The preferred order of addition when using ACULYN™ 33 Rheology Modifier/Stabilizer in aqueous formulations is as follows:

1. Add ACULYN 33 to the water
2. Add other ingredients from the most acidic to the most alkaline
3. Add the neutralizing agent

If this sequence is not desirable, ACULYN ASE polymers can be added directly to an alkaline formulation after first diluting the ACULYN 33 product with two parts of water. Addition of the water prevents gel particles (small particles with neutralized swollen surfaces and unneutralized cores that will take considerable time to completely dissolve).

If ACULYN 33 is being used in an emulsion formulation, the general order of addition is as follows:

1. Add ACULYN 33 to the water phase at temperature
2. Add the other water phase ingredients
3. Mix separately the oil phase ingredients at temperature
4. Mix the oil phase into the water phase maintaining temperature
5. Neutralize the ACULYN 33 polymer
6. Cool the mixture with constant stirring
7. Add the preservative (if any) at a safe temperature

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Toxicity

For product safety information, refer to Safety Data Sheet (SDS).

**Handling
Precautions**

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

Storage

Store products in tightly closed original containers at temperatures recommended on the product label.

**Disposal
Considerations**

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow Technical Representative for more information.

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Stewardship**

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