Technical Data Sheet

ACULYN™ U Rheology Modifier

INCI Name: Acrylates/Beheneth-25 Methacrylate Copolymer

A very efficient thickener for a wide array of personal care formulations, designed for unique ease of use, wide compatibility, cost effectiveness and favorable balance of rheological properties.

Features & Benefits

- High thickening efficiency
- High shear-thinning rheology
- Able to formulate clear products
- Polymeric emulsifier
- Salt tolerance
- Compatible with common-used personal care ingredients
- No sensorial negatives on formulation
- Cold-processable
- Ideal for sulfate-free formulations
- Allows for use of continuous production processes with use of in-line static mixers

Applications

- Crystal clear gels
- Emulsifier free formulations (e.g. gel creams, lotions)
- Hand and body lotions
- Serums
- Make-up creams, lotions and foundations
- Sunscreens (e.g. sprays, lotions)
- Liquid hand soaps
- Facial cleansers
- Body washes and shower gels
- Shampoos
- Haircare leave-on and rinse-off conditioners
- Hair styling gels
- Two component hair dye systems (hair dye developers, perm neutralizers)

Typical Properties

Specification Writers: These values are not intended for use in preparing specifications.

Property	Unit	Result
Chemistry		HASE polymer
Association		Very high
Ionic nature		Anionic

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Typical Properties (Cont.)

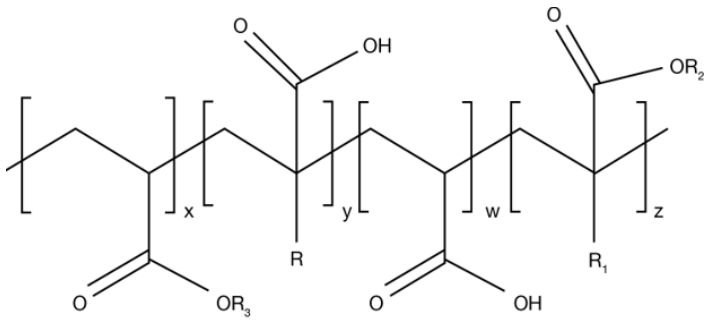
Property	Unit	Result
Appearance		Milky liquid
Solvent		Water
Solids	%	30
pH (as supplied)		4.3
Rheology		Short, non stringy
Shear thinning		Very high
Pseudoplastic index (viscosity @ 6 rpm/viscosity @ 60 rpm)		6 (0.5% solids in water)
Transparency (0.7% solids @ pH 8.5)		< 10 [NTU]
Viscosity, (as supplied)	mPa s	20
Viscosity of 1% solids solution (after 24 hrs @ pH 6.5, Brookfield RVT Spindle 7, 10 rpm)	cP	30,000–40,000
INCI name		Acrylates/beheneth-25 methacrylate copolymer

Description

ACULYN™ U Rheology Modifier is an anionic associative rheology modifier developed specifically for hair and skin care applications. This thickener is a hydrophobically modified alkali soluble polymer emulsion (HASE) with unusually high aqueous thickening and stabilizing efficiency. The polymer is a liquid, cold-processable product that instantaneously thickens upon neutralization, providing ease of handling and increased manufacturing efficiency.

ACULYN™ U Rheology Modifier Chemistry

ACULYN™ U Rheology Modifier is synthesized from acrylic acid, acrylate esters and a beheneth-20 methacrylate ester. The general structure for ACULYN™ U Rheology Modifier is shown in Figure 1.



Rx = Acyl chain from 1 to 22 carbons

Figure 1

Mechanism of Action

ACULYN™ HASE rheology modifiers are able to thicken by two mechanisms that can act simultaneously and are synergistic, i.e. by the effect of charge-induced polyelectrolytic chain extension and by association of hydrophobe groups.

When the acid groups present in the ACULYN™ HASE molecules are neutralized with inorganic bases or organic amines, they become anionically charged and water-soluble. ACULYN™ HASE rheology modifiers dissolve and swell due to charge-charge repulsion.

When ACULYN™ HASE polymers swell, the pendant hydrophobic groups are free to build associations with one another and with other hydrophobes available in the formulation, such as surfactants, particulates, emulsion droplets and dyes. This phenomenon creates a network structure that results in a significant viscosity build.

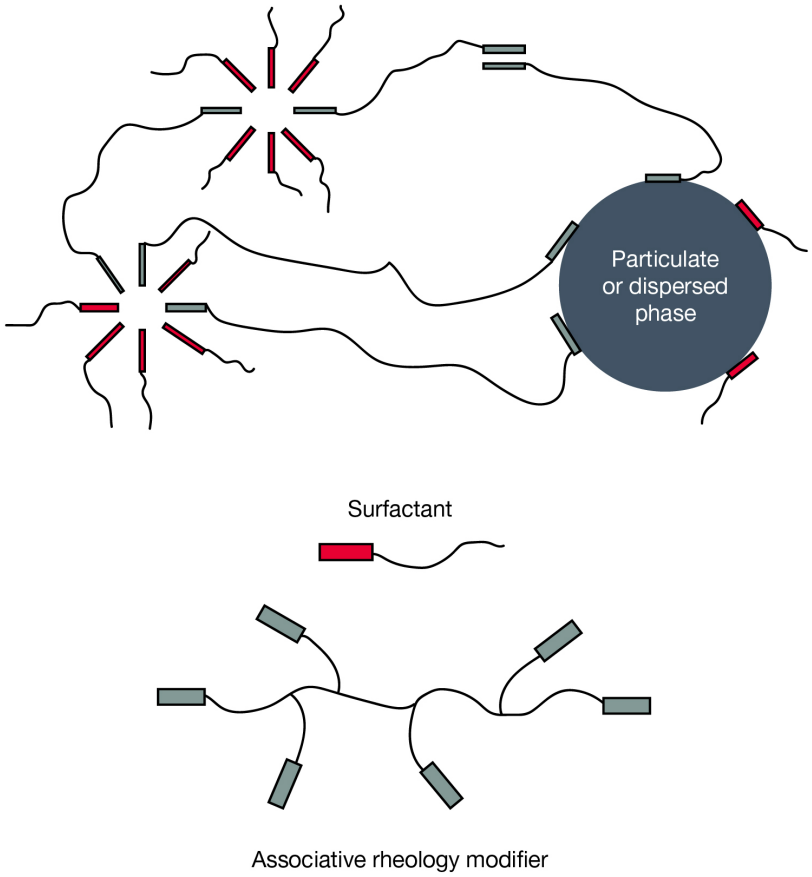


Figure 2

These associative structures can also act to stabilize and disperse particulates in a formulation.

Mechanism of Action (Cont.)

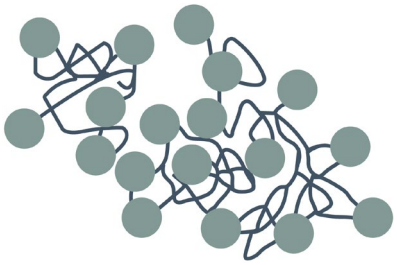


Figure 3

And because of the hydrophobic group on the rheology modifier, ACULYN™ U Rheology Modifier can also act as a primary emulsifier for some emulsion systems, such as gel creams, and emulsifier-free sunscreens, to minimize the level of surfactant or emulsifier.

Features of HASE Rheology Modifiers

The below chart features indicative of the behavior of HASE 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. HASE polymers have excellent shear thinning properties.

Ease of formulation	Excellent
Associative	Yes
Salt tolerance	
NaCl	Excellent
Di/trivalent ions	Good
Shear thinning behavior	Excellent
Solvent compatibility	Excellent
Anionic surfactant compatibility	Excellent
Nonionic surfactant compatibility	Excellent
Zwitterionic surfactant compatibility	Good
Cationic surfactant compatibility	Good
Lack of odor	Excellent

ACULYN™ U Rheology Modifier Behavior Profile

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

Rheology

The highly associative nature of ACULYN™ U Rheology Modifier has a significant effect on the viscosity of formulations, one that is much stronger than that created by the addition of electrolytes. The presence of the C_{22} hydrophobe causes solutions of ACULYN™ U Rheology Modifier to be very pseudoplastic with a high yield value, in general showing a high degree of shear thinning. The high yield value also allows the thickener to stabilize suspensions while still being pourable.

ACULYN™ U Rheology Modifier Behavior Profile (Cont.)

As shown in Figure 4, ACULYN™ U Rheology Modifier can provide a comparable thickening and shear-thinning performance as ACULYN™ 28 Rheology Modifier.

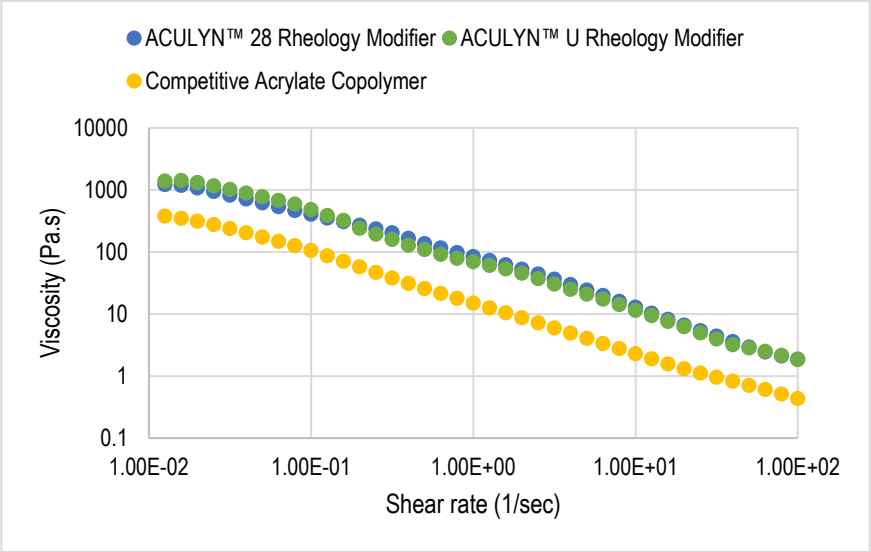


Figure 4: Shear-thinning profile of ACULYN™ U Rheology Modifier

Performance

Efficient Thickener

The viscosity of neutralized aqueous solutions of ACULYN™ U Rheology Modifier as a function of the concentration of solids is shown in the below graph (Figure 5).

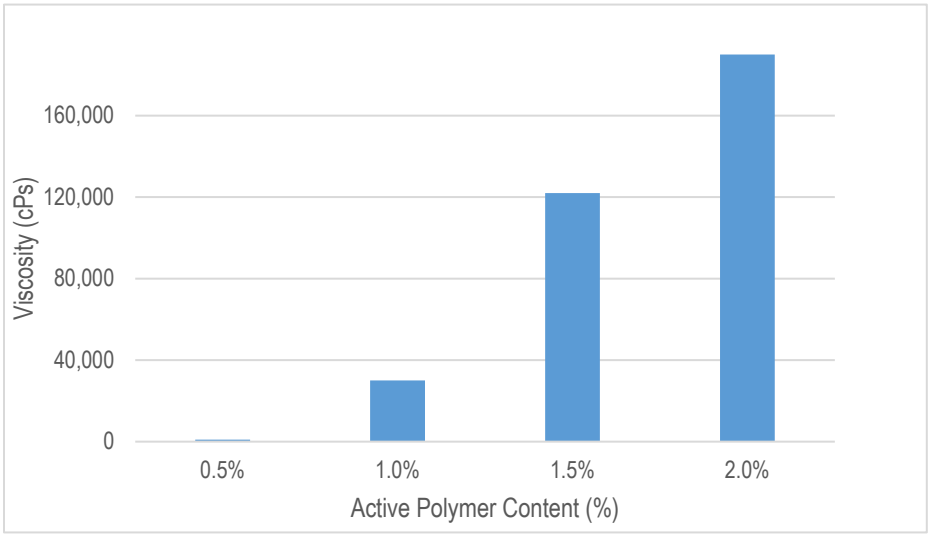


Figure 5: Viscosity of Neutralized ACULYN™ U Rheology Modifier (at pH6.5) with Increasing Concentration

Formulation and Use Guidelines

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

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Formulation and Use Guidelines (Cont.)

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™U Rheology Modifier is also cold processable.

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

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

1. Add other ingredients from the most acidic to the most alkaline to water
2. Add ACULYN™ U Rheology Modifier to the solution
3. Neutralize ACULYN™ U Rheology Modifier solution to pH 7.0-8.0 with NaOH or KOH or TEA solutions
4. Add other ingredients and adjust to the final desired pH

Preparation of Emulsions and Dispersions

If ACULYN™ U Rheology Modifier is being used in the emulsion formulation, the general order of addition is as follows:

1. Add ACULYN™ U Rheology Modifier to the water phase at room temperature
2. Neutralize ACULYN™ U Rheology Modifier solution to pH 7.0-8.0 with NaOH or KOH or TEA solutions
3. Add the other water phase ingredients
4. Mix the oil phase ingredients and add it to water phase
5. Adjust to the final desired pH
6. Measure the viscosity after 24 hours

Handling Precautions

PRODUCT SAFETY INFORMATION REQUIRED FOR SAFE USE IS NOT INCLUDED IN THIS DOCUMENT. BEFORE HANDLING, READ PRODUCT AND SAFETY DATA SHEETS AND CONTAINER LABELS FOR SAFE USE, PHYSICAL AND HEALTH HAZARD INFORMATION. THE SAFETY DATA SHEET IS AVAILABLE ON THE DOW WEBSITE AT DOW.COM, OR FROM YOUR DOW SALES APPLICATION ENGINEER, OR DISTRIBUTOR, OR BY CALLING DOW CUSTOMER SERVICE.

Usable Life and Storage

Keep from freezing; material may coagulate. The minimum recommended storage temperature for these materials is 1°C/34°F. The maximum recommended storage temperature is 49°C/120°F. These materials may coagulate if exposed to temperature outside this range. The coagulation process is irreversible.

Limitations

This product is neither tested nor represented as suitable for medical or pharmaceutical uses.

Health and Environmental Information

To support customers in their product safety needs, Dow has an extensive Product Stewardship organization and a team of product safety and regulatory compliance specialists available in each area.

For further information, please see our website, dow.com or consult your local Dow representative.

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.

Product Stewardship

Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products - from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

Dow strongly encourages its customers to review both their manufacturing processes and their applications of Dow products from the standpoint of human health and environmental quality to ensure that Dow products are not used in ways for which they are not intended or tested. Dow personnel are available to answer your questions and to provide reasonable technical support. Dow product literature, including safety data sheets, should be consulted prior to use of Dow products. Current safety data sheets are available from Dow.

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