ACULYN™ 44 Rheology Modifier/Stabilizer

Description

ACULYN™ 44 Rheology Modifier/Stabilizer is a nonionic thickener based upon Hydrophobically-modified Ethoxylated UREthane (HEUR) chemistry designed for personal care applications. As with most other ACULYN rheology modifiers, the polymer is a liquid product for easier handling and manufacturing efficiency. ACULYN 44 is offered at 35% solids, is stable from pH 2 to 12 and compatible with peroxide and other oxidizing agents. The polymer has a well-established toxicological profile.

CTFA / INCI name: PEG-150/Decyl Alcohol/SMDI Copolymer

Features

- Highly associative
- Broad compatibility
- Near Newtonian rheology
- Nonionic
- Minimum shear dependence
- Stable in anionic, cationic and nonionic systems
- Cold-processable
- Stable pH/viscosity response
- Liquid
- Acid compatibility
- Salt tolerant
- Peroxide stable
- Lack of odor
- Particulate stabilizer

Applications

- Cationic silicone emulsions
- Creams
  - Non-medicated creams
  - Make-up
  - Mascara
- Hair products
  - Permanent waves
  - Hair rinse/conditioners
  - Particulate containing shampoos
  - 2 or 3 in ONE shampoos/conditioners
- Lotions
  - Deodorants
  - Astringents
- Peroxide-containing formulations
  - Hair bleaches/dyes
  - Hydrogen peroxide skin formulations

Benefits

- Easy to handle
- Stabilization of hydrophobic (low solubility) components
- No neutralization necessary
- No preparation necessary
- Compatible with nonionic, anionic, Zwitterionic and cationic surfactants
- Non-hygrosopic
- Increased manufacturing efficiency
- Stable in pH 2 to 12 formulations
- Allows for use of continuous production processes with use of in-line static mixers
- Effective in thickening acid media such as solutions of organic acids
- Can be processed with membrane pumps and, when diluted, with turbine mixers and high speed propellers
- Thickens and stabilizes oxidizing media
- Able to formulate clear products
- Flexibility in choice of preservative system
- Mild, soft, non-greasy, non-sticky, creamy
- Supported by comprehensive environmental, health and safety data
- Reproducible viscosity
- Can be used with electrolytes
- Cleared under CTFA/MITI/EINECS/TSCA/AICS/Canada
- Ability to stabilize suspensions
**Physical Properties**

The following are typical properties of ACULYN™ 44 Rheology Modifier/Stabilizer; they are not to be considered product specifications.

- **Chemistry:** HEUR polymer
- **Association:** Very high
- **Ionic nature:** Nonionic
- **Appearance:** Hazy liquid
- **Solvent:** 60/40 propylene glycol/water
- **Solids, %:** 35
- **pH (as supplied):** 8 to 9
- **Density:** 1.0 - 1.2
- **Rheology:** Stringy, tacky
- **Shear thinning:** Near Newtonian
- **Viscosity, mPa s (as supplied):** 11,000
- **Pseudoplastic index:** 1.0 (2% polymer solids in water)
- **INCI Name:** PEG-150/Decyl Alcohol/SMDI Copolymer

**Structure**

ACULYN™ 44 Rheology Modifier/Stabilizer is a Hydrophobically-modified Ethoxylated UREthane (HEUR) and is synthesized from decyl alcohol, a diisocyanate and a polyethylene glycol as shown above.

**Mechanism of Action**

ACULYN™ HEUR rheology modifiers thicken via an associative mechanism. The hydrophobic parts of HEUR polymers build up associations with other hydrophobes present in the formulation. However, because the ACULYN™ 44 Rheology Modifier/Stabilizer is nonionic in nature, no neutralization is needed and the polymer will function equivalently in a pH range from 2 through 12.

The pendant hydrophobic groups in ACULYN HEUR polymers 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.

These associative structures can also act to stabilize and disperse particulates in a formulation.
The chart below shows features indicative of the behavior of HEUR 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 anions and nonionics and low odor. HEUR polymers have excellent compatibility in low pH and cationic systems and excellent stability in one-part peroxide systems.

### ACULYN™ 44 Rheology Modifier/Stabilizer

ACULYN™ 44 Rheology Modifier/Stabilizer possesses many properties that make this polymer an excellent choice for use in personal care applications, as shown in the data presented below.

### Near-Newtonian Rheology

Formulations using ACULYN™ 44 Rheology Modifier/Stabilizer show a slight drop in viscosity between 0.5 and 1.5 rpm (very low shear rate). For higher shear rates, the viscosity is nearly Newtonian. This behavior allows the thickened product to flow easily from the container when poured.

### Effect of Shear Rate on Viscosity on ACULYN™ 44 Rheology Modifier/Stabilizer
ACULYN™ 44 Rheology Modifier/Stabilizer is supplied as a viscous liquid. To facilitate handling and dispersion the product can be heated up to 75°C, resulting in decreased viscosities with increasing temperatures.

The lowering of the viscosity by increasing the temperature also assists in the dispersion of ACULYN™ 44 Rheology Modifier/Stabilizer. Although the polymer will disperse at room temperature, a slight increase in the water temperature will facilitate the dispersion in a shorter period of time. Below is a graph that indicates the approximate time for dispersion of various levels of ACULYN 44 (on a product basis). This work was done with a 3 blade propeller turning at 1000 rpm and a blade diameter to vessel ratio of 1 to 8.

**Dispersion Time vs Concentration at Various Temperatures for ACULYN™ 44 Rheology Modifier/Stabilizer**
Compatibility

pH Tolerance

ACULYN™ 44 Rheology Modifier/Stabilizer has a constant pH response at very low or very high pH’s as shown below.

Effect of pH on Viscosity on ACULYN™ 44 Rheology Modifier/Stabilizer

Peroxide Compatibility

ACULYN 44 is compatible with peroxides and does not induce loss of active oxygen. To obtain significant viscosity and stability over time, an appropriate surfactant should be used in combination with ACULYN 44.

Hydrogen Peroxide Thickening with ACULYN™ 44 Rheology Modifier/Stabilizer

ACULYN 44 has good stability in hydrogen peroxide. The stability of the polymer can be improved by combining the polymer with a surfactant that will associate with the ACULYN 44.
Stability of ACULYN™ 44 Rheology Modifier/Stabilizer in Hydrogen Peroxide Solutions

### Viscosity, mPa s (12 rpm)

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>2 Weeks</th>
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</thead>
<tbody>
<tr>
<td>3% ACULYN™ 44 Rheology Modifier/Stabilizer</td>
<td>1525</td>
<td>1300</td>
</tr>
<tr>
<td>3% H₂O₂</td>
<td>1250</td>
<td>1070</td>
</tr>
<tr>
<td>6% H₂O₂</td>
<td>960</td>
<td>880</td>
</tr>
<tr>
<td>12% H₂O₂</td>
<td>565</td>
<td>450</td>
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### Surfactant Synergies

ACULYN™ 44 Rheology Modifier/Stabilizer works by association. This means that the hydrophobic parts of the HEUR polymer build up associations with other hydrophobes present in the formulation. This property allows ACULYN 44 to demonstrate a marked synergistic effect when used in conjunction with fatty surfactants, pigments, particulates, and dyes. The following graph shows the synergy of ACULYN 44 with dicetyl dimethyl ammonium chloride (DCDMAC).

Cationic used was a Dicetyl dimethyl ammonium chloride. Viscosities measured by a Brookfield RVT.
ACULYN™ 44 Rheology Modifier/Stabilizer is compatible with cationic surfactants, acids and peroxides as well as other ingredients commonly found in cosmetic and toiletry products.

ACULYN 44 is shipped in a water/propylene glycol solvent that thickens directly upon addition to a formulation. To facilitate handling and dispersion, the product can be heated up to 75°C, resulting in decreased viscosities.

ACULYN 44 should be added slowly and steadily near the periphery of the mixing tank. The rate of addition should be adjusted to allow uniform incorporation of the thickener. Rapid addition may cause excessive thickening or gelling due to highly localized thickener concentrations.

To facilitate optimum performance of the ACULYN 44, the following procedure is recommended:

1. Introduce most of the formulation water into the reactor.
2. Add ACULYN 44 polymer and stir vigorously for a minimum of 5 minutes (see note).
3. Add the most hydrophilic (high HLB) surfactants and ingredients and stir for a minimum of 5 minutes.
4. Add the remaining components, saving the most hydrophobic component for last.

Note: If the formulation does not contain a surfactant that helps dispersion, Step 2 should be extended to a minimum of 40 minutes. Either low speed paddle stirrers or high spin turbines are suitable.

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

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.

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

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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