Today’s successful cosmetics products need the right rheological properties. And the correct choice of rheological additive enhances the product in production, storage stability and application. ELEMENTIS Specialties rheological additives for aqueous and non-aqueous formulations are valuable and proven tools for you to use. Personal care, skin care, sun care and decorative cosmetics; single-phase, suspension or emulsion; all can benefit from ELEMENTIS Specialties rheological additives.
Rheology is the science of flow. Every time a lotion is poured, a cream squeezed from a tube or a lipstick applied, rheology is involved. Even when products are at rest, it plays an important part in controlling stability and suspension.

Understanding a formulation’s rheological needs enables you to create the best possible products.

The way the viscosity changes at varying shear rates greatly influences the overall product stability and performance. A material which maintains a constant viscosity, regardless of shear rate, has Newtonian flow (Fig. 2). Dilatant flow (Fig. 2) is a form where viscosity increases with shear, sometimes encountered in highly pigmented/filled systems.

Pseudoplastic flow (Fig. 4), also known as shear thinning behaviour, and typical of many commercial systems, is when viscosity decreases with increasing shear rate.

Flow may require a specific stress to be initiated. This particular stress value is known as the yield point. A system having both shear thinning flow and a yield point can be described as having plastic flow.

The rate of recovery of a system when stress is removed is also very important. When a shear thinning system shows delayed viscosity recovery, it is described as thixotropic (Fig. 3). This is one of the most important types of flow in cosmetics. Controlling the degree of thixotropy enhances the application of a cream, eliminates dripping of a roll-on antiperspirant or allows brushmarks in a coat of nail lacquer to disappear, leaving a smooth film.

Viscosity can be temperature dependent. Correct choice of rheological additive allows you to create the ideal flow characteristics (Fig. 1) and also achieve thermostable rheology.
ELEMENTIS Specialties Rheological Additives for Cosmetics

Improving aqueous, anhydrous and emulsion-based products

ELEMENTIS Specialties rheological additives can be broadly divided between aqueous-phase thickeners and non-aqueous-phase thickeners. But it is important to remember the advantages of oil-phase viscosity modification that can greatly improve emulsion-based products.

ELEMENTIS Specialties additives for cosmetics are based on naturally occurring materials: highly refined and beneficiated hectorite clay or castor oil derivatives.

### Aqueous-Phase Additives

#### Rheoluxe

**RHEOLUXE® Associative Thickeners**

The RHEOLUXE® family of rheology modifiers are non-ionic polymeric thickeners designed specifically for the personal care market. RHEOLUXE® consists of Urethane based and Polyether Polyol based associative thickeners with superior performance in difficult systems such as those containing high salt levels or with extremes in pH. Due to its structure, RHEOLUXE® is soluble in water, but associates with lipophilic materials to build viscosity.

**Associative thickeners – mechanism of action**

Associative thickeners increase the viscosity of aqueous systems through a system of molecular associations and interactions. The thickeners consist of water soluble polymeric chains modified with hydrophobic caps. The hydrophobic caps of the polymer associate, that is build a structured network with other hydrophobes in the formula. This results in micelle type structures that form a network resulting in significant viscosity build.

**Rheoluxe structure**

- **Hydrophobic Cap**
- **Hydrophilic Chain**
- **Hydrophobic Cap**

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**INCI Name** | Typical use level: | Chemistry
--- | --- | ---
RHEOLUXE® 812 | Bis-Lauryl Cocamidopropylamine/10G/PEG-100 Copolymer (and) Butylene Glycol 1.0 – 3.0% Polyurethane | Polyurethane
RHEOLUXE® 880 | Bis-C16-20 Isoalkoxy TMMDI/PEG-90 Copolymer 1.0 – 3.0% Polyurethane | Polyurethane
RHEOLUXE® 8015 | PEG/PPG-45/50 Trimethylolpropane Coder (and) Ether 0.5 – 5.0% Polyether Polyol | Polyether Polyol

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**The Rheoluxe range of products provides viscosity control in all types of emulsion systems, creating an exceptional sensory profile. Supplied as easy to handle solutions, Rheoluxe can be added at any point in the production process. Rheoluxe is heat stable, although cold process systems are possible.**
BENTONE® rheological additives are non-abrasive. The skin feel imparted by BENTONE® hydrophilic clays is a pleasant silkiness, quite different to that associated with the majority of cellulose, polymer and polysaccharide-based thickeners. Furthermore, as hectorite itself is insensitive to temperature variations, the BENTONE® products impart a thermostable viscosity control.

Surfactants can influence the rheological behaviour of hydrophilic clays. Non-ionic surfactants, if they are highly ethoxylated, can adsorb onto the clay surface. This rarely causes problems either in flow control or activity of the formulation. Anionic surfactants can act as dispersing agents and weaken the gel structure. Alternatives that eliminate or minimize any problems can normally be found. However, cationic surfactants interact strongly and should be avoided.

Organic and silicone-based liquids used in oil and wax-based cosmetics, and as the non-aqueous-phase in emulsions, benefit greatly from ELEMENTIS Specialties rheological additives. Outstanding rheological properties are developed using BENTONE® organoclay rheological additives in their powder form or, even better, with BENTONE GEL® additives, their predispersed forms.

The benefits gained are:

- thermostable viscosity control
- thixotropic flow
- suspension control of pigments and actives
- emulsion stabilisation
- silky skin feel
BENTONE® additives need to be efficiently dispersed using high-shear equipment and then to be activated with the optimum level of a chemical activator, such as propylene carbonate.

BENTONE® organoclays form thixotropic gels by developing hydrogen bond bridges between the edges of adjacent platelets as shown in Figure 7.

**BENTONE GEL®**

BENTONE GEL® additives are optimally dispersed and activated predispersions of ELEMENTIS Specialties organoclays.

Benefits include:
- optimally dispersed
- high-shear dispersion not necessary
- no polar activation required
- easy to handle and use
- can be added at any appropriate and convenient stage in manufacture

A wide range of gels made from various cosmetics oils, esters and solvents are available.

The use of a BENTONE GEL® enables you, the formulator, to achieve the maximum efficiency from the organoclay without the need for careful shearing and activation. On the production scale, time is saved and the highest degree of reproducibility attained, leading to potential cost savings.

**INCORPORATION**

BENTONE GEL® additives can be added at any convenient suitable stage in the manufacturing cycle. BENTONE GEL® additives are very high-viscosity, shear thinning products. To ensure good homogeneous mixing is achieved, care must be taken to overcome large viscosity differentials existing between the BENTONE GEL® and the other lower-viscosity components. Choice of mixing equipment and the configuration within the mixing vessels are critical factors in developing the optimum performance of the BENTONE GEL® additive. The use of medium- to high-shear mixing equipment is recommended.

For additional guidance see page 14

**Batch Processing**

- Single-Phase Systems
  Always add the BENTONE GEL®, under shear, to a portion of the organic component or solvent with which it is most compatible. Mix until homogeneous before adding the other ingredients.

- Multi-Phase Systems (e.g. emulsions)
  As for the single phase, but always ensure the BENTONE GEL® additive is thoroughly mixed in before the emulsification stage.

**Continuous processing**

The BENTONE GEL® should be added to the oil phase at any convenient point that meets the above guidelines for the batch processing. In multi-manifold systems, a flowable pre-mix of the BENTONE GEL® with a compatible oil or solvent should be made in a side pot.

Where only lower-shear mixing equipment is available, stir the BENTONE GEL® alone, in a small mixing vessel, if necessary, and then slowly add the most compatible component by portions, always ensuring the mixture is homogeneous at each stage.
**ThIXCIN® R Rheological Additive**

For the highest degree of thixotropy in aliphatic liquids, ThIXCIN® R additive is the product to use. In addition to its effective rheological properties, it gives water repellency, stabilises emulsions and acts as a stiffening agent in lipsticks and ointments. It can also be used as a dry binder in pressed powder systems.

(Where high-temperature resistance is needed, BENTONE® or BENTONE GEL® additives are recommended).

ThIXCIN® R is a castor oil derivative. It requires temperature-controlled activation within the range 55-60°C (130-140°F) and high-shear mixing to develop its full structure.

ThIXCIN® R is in compliance with ECOCERT; The ecological and organic cosmetics standards.

**INCORPORATION THIXCIN® R additive**

**Wetting**
High-shear mixing
Add ThIXCIN® R to oil
Disperse to deagglomerate

**Heat**
Temperature range 55-60°C (130-140°F)

**Shear**
Shear for 20 minutes within this temperature range to activate

**Cool**
Maintain shear to below 35°C (95°F) when cooling

For additional guidance see page 15

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**Product Application and Selection**

Choosing the right rheological additive

Cosmetic products range from pressed dry powders to suspensions in liquids; from single-phase solid or liquid formulations to emulsions. The choice of rheological additive and level of use depends on the system and the desired performance criteria (Table pages 20/21).

The properties imparted by the rheological additive benefit different cosmetics in different ways. The advantages of using ELEMENTIS Specialties rheological additives are not always only the obvious ones, for instance:

**Stick products (lipstick and antiperspirant)**
- maintain homogeneity in molten and setting stages
- gain improved pay-out
- increase high-temperature integrity
- eliminate oil migration
- reduce “creasing” around lips and eyes

**Mascara**
- improve film-build
- increase water-resistance
- eliminate oil migration

**Emulsions**
- elevate drop-point temperature of water-in-oil creams
- eliminate syneresis
- improve emulsion stability
- enable cold-process emulsification
- create novel viscosity effects

**UV Sunscreen**
- eliminate ultrafine TiO2 skin-whitening problems
- enhance sun protection factor (SPF)
- optimise use of sunscreen actives
- reduce separation and settlement

**Antiperspirant Aerosols**
- uniform distribution of active ingredients
- soft and dry skin feel
- significant less whitening
- reduced separation and settlement
Incorporation & Equipment Guideline

**Conditions**

**BENTONE® MA, BENTONE® EW and BENTONE® LT additives – powders needing high-energy mixing**

<table>
<thead>
<tr>
<th>Shear Development</th>
<th>Low</th>
<th>Low</th>
<th>Medium</th>
<th>Med-high</th>
<th>Med-high</th>
<th>Very high</th>
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<tbody>
<tr>
<td>Generic Type</td>
<td>Paddle</td>
<td>Propeller</td>
<td>Planetary</td>
<td>Rotor/stator</td>
<td>Impeller</td>
<td>Homogeniser</td>
</tr>
</tbody>
</table>

**Special factors**

- Ensure full wetting achieved before activation.
- Avoid the presence of surfactants or electrolytes until dispersion completed.

**BENTONE® GEL® additives – optimally dispersed and activated gels**

- Use maximum speed and disperse gel stepwise under shear.
- Use highest speeds and carefully observe optimum mixer/vessel configuration.
- Add gel to vessel, apply shear prior to adding other ingredients by increments.

**Order of addition**

- Gel first, then oil or solvent if needed, only after dispersion completed.
- Add defoamers, if needed, only after dispersion completed.

**Special factors**

- Ensure mixture is homogeneous at each dilution stage.
- Particulate materials, such as antiperspirant salts will assist in the dispersion in low-viscosity media.

**INCI References**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>INCI Name</th>
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</thead>
<tbody>
<tr>
<td>RHEOLOGICAL MODIFIERS FOR AQUEOUS-PHASE</td>
<td></td>
</tr>
<tr>
<td>BENTONE® EW</td>
<td>Hectorite</td>
</tr>
<tr>
<td>BENTONE® EW CE</td>
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<tr>
<td>BENTONE® LT</td>
<td>Hectorite, Hydrosilica Gel</td>
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<td>BENTONE® MA</td>
<td>Hectorite</td>
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<tr>
<td>RHEOLATE® FX 1100</td>
<td>Steareth-100/PEG-136/HD Copolymer</td>
</tr>
<tr>
<td>NEW! RHEOLUX® 880</td>
<td>Bio-C16-20 lauropyridyl TMHD/PEG-90 Copolymer</td>
</tr>
<tr>
<td>NEW! RHEOLUX® 812</td>
<td>Bio-Lauryl Cocosaminopropylmine/NDI/PEG-100 Copolymer, Butyloxy-Glycol</td>
</tr>
<tr>
<td>NEW! RHEOLUX® 8015</td>
<td>PEG/PPG-450/50 Trimethylolpropane Dodecyl Ether</td>
</tr>
</tbody>
</table>

**RHEOLOGICAL MODIFIERS FOR NONAQUEOUS-PHASE**

| BENTONE® 27V | Stearalkonium Hectorite |
| BENTONE® 27V CG | Stearalkonium Hectorite |
| BENTONE® 38V | Distearalkonium Hectorite |
| BENTONE® 38V LT | Distearalkonium Hectorite |
| TRICOP® R | Trihydroxystearin |

**NEW! RHEOLOGICAL MODIFIERS FOR NONAQUEOUS-PHASE**

<table>
<thead>
<tr>
<th>BENTONE GEL®</th>
<th>INCI Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BENTONE GEL® 100XV</td>
<td>Cyclopentaisoxane, Distearalkonium Hectorite, Propylene Carbonate</td>
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<tr>
<td>BENTONE GEL® 102XV</td>
<td>Crambe Abyssinica Seed Oil, Stearalkonium Hectorite, Propylene Carbonate</td>
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<tr>
<td>BENTONE GEL® 104XV</td>
<td>Ricinus Communis, Stearalkonium Hectorite, Propylene Carbonate</td>
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<tr>
<td>BENTONE GEL® 106XV</td>
<td>Octyldodecanol, Distearalkonium Hectorite, Propylene Carbonate</td>
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<tr>
<td>BENTONE GEL® 108XV</td>
<td>Caprylyl/Capril Glyceryl, Stearalkonium Hectorite, Propylene Carbonate</td>
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<tr>
<td>BENTONE GEL® 110V</td>
<td>Helianthus Annuus (Sunflower) Seed Oil, Distearalkonium Hectorite, Propylene Carbonate</td>
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<td>BENTONE GEL® 114V</td>
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<td>Linum Alba (Meadowfoam) Seed Oil, Distearalkonium Hectorite, Propylene Carbonate</td>
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<tr>
<td>BENTONE GEL® 121V</td>
<td>Neopentyl Glycol, Dihexanolate, Distearalkonium Hectorite, Propylene Carbonate</td>
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<tr>
<td>NEW! BENTONE GEL® 122V</td>
<td>Olia Europae (Olive) Fruit Oil, Stearalkonium Hectorite, Propylene Carbonate</td>
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<tr>
<td>BENTONE GEL® 123V</td>
<td>C11-12 Isopropylphenyl</td>
</tr>
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</table>
Before using any of our products please consult our Safety Data Sheets.

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