Q. How would you describe the new Sensomer™ CT-250 and CT-400 polymers?

A. Sensomer™ CT-250 and CT-400 polymers are cationic derivatives of cassia gum. Cassia gum is a member of the galactomannan family. Galactomannans are natural, vegetable-based carbohydrates based on mannose and galactose sugars. Sensomer™ CT polymers are derived from the seeds of Cassia Obtusifolia and Cassia Tora plants, which grow wild in tropical zones and regenerate on an annual basis. Cassia has a long history of use in Ayurvedic medicine for the treatment of a wide variety of ailments such as pain, indigestion, high cholesterol, and skin conditions.

Q. Why did Lubrizol decide to develop and introduce cationic polymers based on cassia gum?

A. The conditioning polymers market is a large and very attractive category, with well articulated unmet and under-served needs. With the development of cationic cassia polymers and the acquisition of the Merquat® and Sensomer™ CI polymer product lines from Nalco, Lubrizol is well positioned to participate in this attractive market space. Conditioning polymers align well with our strategy to drive innovation in claims-driving and enabling technologies.

Sensomer™ CT-250 and CT-400 polymers are derived from cassia gum, which is a galactomannan. Other galactomannans have different ratios of galactose to mannose. Guar gum is commonly used in the personal care industry and has a ratio of one galactose unit to every two mannose units. Tara gum and locust bean gum have ratios of three to one and four to one galactose units to mannose, respectively. The ratio of mannose units to galactose units in cassia gum is five to one. The unique structure of cassia gum provides more sites for substitution on the mannose backbone of the polymer, providing differentiated performance for Sensomer™ CT-250 and CT-400 polymers.

Q. What are the primary benefits of Sensomer™ CT-250 and CT-400 polymers?

A. When used in surfactant cleansing formulations, Sensomer™ CT-250 and CT-400 polymers provide efficient silicone deposition, enhanced conditioning in both the wet and dry stages, frizz control and distinctive sensory. While the polymers exhibit several similar benefits, there are some key performance differences.

The higher cationic charge (3.0 meq/g) of Sensomer™ CT-400 polymer enables the polymer to generate higher levels of coacervate, deposit more silicone and have greater substantivity to the hair. The unique design of the polymer also enables the creation of surfactant cleansing products with medium clarity that generate rich, creamy foam during use.
Hair treated with shampoo containing Sensomer™ CT-400 polymer will feel clean and fresh in the wet stage and will have a soft, cushiony feel after drying.

The cationic charge (1.86 meq/g) of Sensomer™ CT-250 polymer is lower. This polymer is able to generate a higher level of coacervate, deposit more silicone and have greater hair substantivity than cationic guar or Polyquaternium-10, traditional polymers which are commonly used in cleansing systems that promote conditioning properties. The unique design of Sensomer™ CT-250 polymer enables the creation of cleansing products with medium to high clarity that generate rich foam during use. Hair treated with shampoo containing Sensomer™ CT-250 polymer will feel lubricious in the wet stage and will have a smooth feel after drying.

Due to the high charge density of Sensomer™ CT-250 and CT-400 polymers, best results are obtained where surfactant concentration is >12%.

Q. What applications are well suited for the use of Sensomer™ CT-250 and CT-400 polymers?

A. Cationic cassia polymers are well suited for use in conditioning shampoos, smoothing shampoos, hair conditioners, hair treatments, body washes and facial cleansers. Due to the high charge density of Sensomer™ CT-250 and CT-400 polymers, best results are obtained where surfactant concentration is >12%.

Q. What are the differences between Sensomer™ CT-400 polymer and Sensomer™ CT-250 polymer?

A. Both Sensomer™ CT-250 and CT-400 polymers provide enhanced conditioning, increased deposition and distinctive sensory. A summary of differences in typical properties is provided below:

Table 1: Typical Properties

<table>
<thead>
<tr>
<th></th>
<th>Sensomer™ CT-250 Polymer</th>
<th>Sensomer™ CT-400 Polymer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge Density (meq/g)</td>
<td>1.86</td>
<td>3.00</td>
</tr>
<tr>
<td>Dispersion Viscosity (mPa·s)</td>
<td>300 - 2,000</td>
<td>100 - 750</td>
</tr>
<tr>
<td>Clarity in Surfactant Chassis</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Deposition Capability</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Feel in Wet Stage</td>
<td>Lubricious</td>
<td>Clean</td>
</tr>
<tr>
<td>Feel in Dry Stage</td>
<td>Smooth</td>
<td>Soft</td>
</tr>
</tbody>
</table>
Sensomer™ CT-250 and CT-400 Polymers

Frequently Asked Questions (FAQs)

Q. Can Sensomer™ CT-250 and CT-400 polymers be used with Carbopol® polymers to formulate conditioning shampoos? If so, how?

A. Yes, Carbopol® polymers can be used to formulate conditioning shampoos with cationic cassia polymers. Cationic cassia polymers are best suited for use with powdered versions of Carbopol® polymers like Carbopol® 980 polymer and Carbopol® Ultrez 20 polymer. Please refer to the formulation recommendations in the training presentation.

Q. What is the potential for build-up with repeated use of products formulated with Sensomer™ CT-250 and CT-400 polymers?

A. Repeat use studies suggest that silicone deposition levels out after five uses. The efficiency of cationic cassia polymers allows formulators to reduce the amount of cationic conditioning polymer and silicone to impart conditioning performance.

Q. How well do Sensomer™ CT-250 and CT-400 polymers condition damaged hair?

A. Conditioning studies on European brown hair bleached for one hour and treated twice with shampoos formulated with Sensomer™ CT-250 and CT-400 polymers showed advantages in combing and feel in both the wet and dry stages versus shampoos based on cationic guar or Polyquaternium-10.

While none of the shampoos deposited significant amounts of silicone on bleached hair, the shampoos formulated with Sensomer™ CT-250 and CT-400 polymers and the shampoo based on cationic guar showed comparable silicone deposition and wet combing improvements while the shampoo based on Polyquaternium-10 provided little conditioning.

Q. What new claims are possible for shampoos formulated with Sensomer™ CT-250 and CT-400 polymers?

A. Depending on the formulation composition, Sensomer™ CT-250 and CT-400 polymers offer enhanced deposition and improved conditioning performance. Test data suggest that it is possible to deposit larger amounts of polymer and silicone to provide improved smoothing benefits and deliver greater conditioning benefits than typical conditioning shampoos.
Q. **What percentage of the content of Sensomer™ CT-250 and CT-400 polymers is natural?**

A. Over 50% of each polymer is based on cassia gum. The exact % of natural content for the respective polymers is considered proprietary.

Q. **Are Sensomer™ CT-250 and CT-400 polymers biodegradable?**

A. Testing conducted with a polymer representative of Sensomer™ CT-400 polymer showed limited biodegradation based on an actual OECD 301 type test. 1-10% of the components of Sensomer™ CT-400 polymer display no potential to bioconcentrate. To date, biodegradation testing has not been completed with Sensomer™ CT-250 polymer. We would, however, expect that Sensomer™ CT-250 polymer has a similar profile to Sensomer™ CT-400 polymer.

Q. **Are Sensomer™ CT-250 and CT-400 polymers more sustainable than cationic guar products?**

A. Assessment of the level of sustainability associated with different classes of chemicals is a source of active debate around the world.

Both cassia gum and guar gum are annual plants. Cassia gum plants grow to heights of three to six feet before they are annually harvested in India. The plants are easily recognized by their unique pale yellow flowers and characteristic smell. The smell of the plants has been described as “fresh” and has been compared to the smell of a green cornfield. Cassia gum grows wild and is believed to be free of pesticide or fertilizer.

As the plant is harvested, seeds from the plant’s seed pods fall onto the ground, laying the foundation for the following year’s harvest. The entire seed is consumed in the production of Sensomer™ CT-polymers: during processing, the endosperm of the seed is separated from the husk to make the Sensomer™ CT-polymers, while the husk is converted into animal feed.

Q. **Where are Sensomer™ CT-250 and CT-400 polymers produced?**

A. Sensomer™ CT-250 and CT-400 polymers are produced in Vadodara, India. The manufacturing facility has earned ISO 9001: 2008 certification.
Q. Shampoos shared in the presentation are based on 14-15 wt% TS total surfactant actives. Can Sensomer™ CT-250 and CT-400 polymers be used in cleansing formulations with lower total surfactant active levels?

A. Lower levels of surfactant actives can be used to formulate cleansing products using Sensomer™ CT-250 and CT-400 polymers. Due to the high cationic charge of the polymers, nonionic and amphoteric surfactants and salt levels or other structuring ingredients may need to be adjusted to improve compatibility and formulation stability.

Q. How does the use of Sensomer™ CT-250 and CT-400 polymers impact the foam quality of surfactant cleansing formulations?

A. Foam studies of shampoos formulated with Sensomer™ CT-250 and CT-400 polymers suggest that use of the polymers enhances foam volume and richness versus shampoo formulated without cationic polymer or shampoos based on cationic guar or Polyquaternium-10.

Q. How does the use of Sensomer™ CT-250 and CT-400 polymers impact the viscosity of surfactant cleansing formulations?

A. The use of Sensomer™ CT-250 polymer has little impact on the viscosity of surfactant-based cleansing formulations while the use of Sensomer™ CT-400 polymer can increase the viscosity of conditioning shampoos.

Q. What conditioning properties are provided by Sensomer™ CT-250 and CT-400 polymers?

A. Sensomer™ CT-250 and CT-400 polymers can enhance wet and dry combing force reduction, improve frizz control and increase the deposition characteristics of traditional conditioning shampoos while delivering distinctive, soft sensory appeal on a wide variety of hair types.

Q. What sensory properties are provided by Sensomer™ CT-250 and CT-400 polymers?

A. Hair treated with shampoo containing Sensomer™ CT-250 polymer will feel lubricious in the wet stage and will have a smooth feel after drying. Hair treated with shampoo containing Sensomer™ CT-400 polymer will feel clean and fresh in the wet stage and will have a soft, cushiony feel after drying.
Q. Which silicones are best suited for use with Sensomer™ CT-250 and CT-400 polymers?

A. Sensomer™ CT-250 and CT-400 polymers are well suited for use with both small and large particle size silicones. When formulating conditioning shampoos, optimum conditioning performance is achieved through the use of Sensomer™ CT-250 and CT-400 polymers with small particle size silicone.

Q. How easy is it to disperse Sensomer™ CT-250 and CT-400 polymers?

A. Sensomer™ CT-250 and CT-400 polymers are easily dispersed in water, comparable to other commercially available cationic polymers. They can be easily dispersed in water with high agitation by slowly sprinkling the product into the low viscosity mixture. When using higher dispersion concentrations (2 wt% or more), the use of citric acid or carrier such as glycerin or betaine will help in reducing the hydration time.

Q. What ingredients are incompatible with Sensomer™ CT-250 and CT-400 polymers?

A. In general, highly anionic polymers will form complexes with cationic cassia polymers due to the high cationic charge of the polymers.

Sensomer™ CT-250 and CT-400 polymers are compatible with other hydrocolloids.

Q. What use level of Sensomer™ CT-250 and CT-400 polymers are required in shampoo formulations in order to deposit silicone on hair?

A. Typical use levels of Sensomer™ CT-250 and CT-400 polymers to deposit silicone on hair can range from 0.1 to 0.5 wt% depending on the shampoo formulation used.

Q. What is the shelf life of Sensomer™ CT-250 and CT-400 polymers?

A. The shelf life for Sensomer™ CT-400 polymers is two years from date of manufacture while the shelf life of Sensomer™ CT-250 polymer is one year from date of manufacturing. It is anticipated the shelf life for Sensomer™ CT-250 polymer may be extended to two years after additional production history is generated. For best results, keep bags of cationic cassia polymers sealed until needed and store open bags of product in a humidity controlled environment to minimize moisture uptake.
Q. Is a preservative added to Sensomer™ CT-250 and CT-400 polymers prior to shipment?

A. No. Sensomer™ CT-250 and CT-400 polymers are shipped preservative free. The maximum limit for Total Aerobic Plate Count for both polymers is 1,000.

Q. Are Sensomer™ CT-250 and CT-400 polymers freeze/thaw stable?

A. Yes. Sensomer™ CT-250 and CT-400 polymers are freeze/thaw stable.

Q. What is the shelf stability of products formulated with Sensomer™ CT-250 and CT-400 polymers?

A. Two prototype formulations developed using Sensomer™ CT-250 and CT-400 polymers have maintained stability for two months at 45°C and have passed three freeze/thaw cycles. Formulators should conduct their own stability testing on formulations they develop, consistent with good formulating practices.

Q. The pricing for Sensomer™ CT-250 and CT-400 polymers seems high. Why should I invest time to evaluate the use of these polymers?

A. While the pricing of Sensomer™ CT-250 and CT-400 polymers is higher on a per kg basis compared to some other cationic conditioning polymers, formulators may be able to realize savings on a cost-in-use (in formulation) basis by taking advantage of the increased efficiency of cationic cassia polymers and by reducing the amount of silicone and cationic polymer used in formulation. Conditioning shampoo formulations containing 50% less silicone and 60% less Sensomer™ CT-250 and CT-400 polymers have demonstrated increased silicone deposition, comparable wet combing reduction, and improved sensory performance versus formulations based on cationic guar or Polyquaternium-10.