

SILSOFT* AX-E PMF

conditioning agent

SPECIALTY FLUIDS - PERSONAL CARE



Proposed INCI: *Bis-Cetearyl Amodimethicone (and) Ceteareth-7 (and) Ceteareth-25*

Silsoft AX-E PMF conditioning agent is a 40% active emulsion of an alkyl modified amino fluid. The combination of both pendant amino and terminal alkyl groups on the silicone structure help provide enhanced thermal protection, smoothness, shine, softness and manageability for dry hair.

This easy to formulate emulsion, produced without the use of parabens, offers the opportunity to create a multitude of hair care applications.

Key Features and Typical Benefits

- Thermal protection
- Excellent smoothness
 - not sticky or greasy
- Shine without greasiness
- Superior conditioning and manageability
 - excellent for straight, sleek look
- Color retention
- Hair strengthening
- Ease of formulation
- Produced without the use of paraben
- Good deposition in conditioning shampoo

Potential Applications

Hair Care

- Products for thermal protection
- Products to smooth hair:
 - leave-on conditioners
 - shampoos
 - rinse-off conditioners
 - serum
- Shine spray
- Ethnic hair care
- Products for color protection

Other

- Body wash
- Liquid hand soap
- Bar soap

Typical Physical Properties⁽¹⁾

Appearance	Milky white liquid
Viscosity at 25 °C, cP	Maximum 400
Solid Content, %	48 max
Silicone Content, %	40
pH	5-6
Emulsifier	Nonionic
Particle Size	Submicron

(1) Typical data are average data. The actual data may vary.
Product specifications for specific applications need to be agreed upon individually.

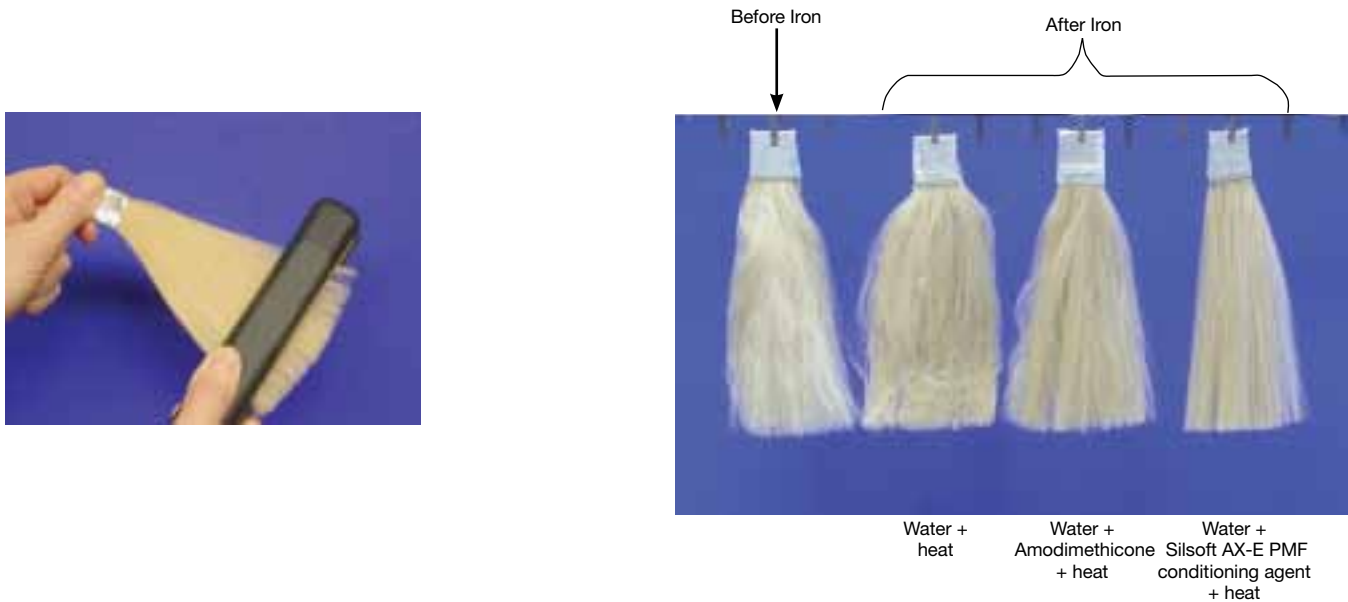
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Performance Data

1 - Severe straightening test

Damp Hair with Flat Iron. Daily styling practices can cause extensive damage to the cuticle, causing it to crack, buckle and lift. Damaged cuticles cause the hair to look dull, lifeless and frizzy.

In a severe straightening test, heat was applied to damp hair with a flat iron until dry in order to distinguish differences between thermal protection ingredients. The photographs of the straightened tresses correlate with the SEM images in section 2 below and illustrate the film forming effects of Silsoft AX-E PMF conditioning agent and the cuticle protection that it provided.

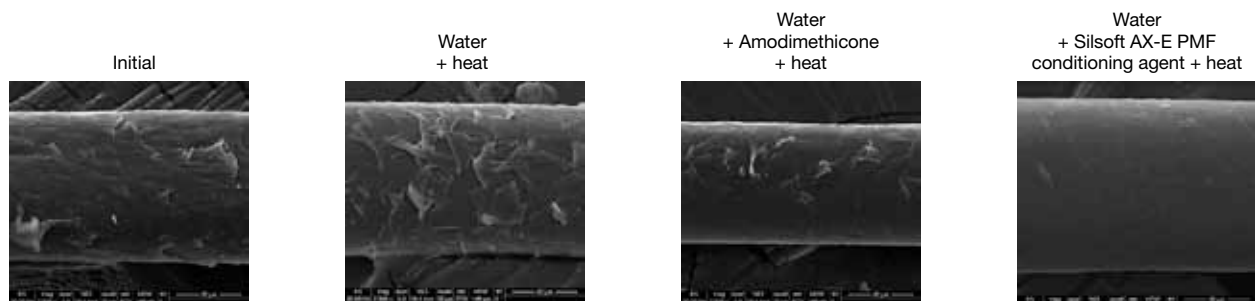


Protocol:

1. Frizziness process: Platinum bleached tress dipped for 1 min in 0.5% NaOH bath, rinsed, blown dry
2. Protection treatment: Dipped 1 min in 1% active silicone dispersion in water, prepared from Silsoft AX-E PMF conditioning agent. Squeeze excess liquid, iron
3. With iron at medium heat (130 °C), pass hair through iron several times until dry (5-7 min)

Silsoft AX-E PMF conditioning agent helped protect hair from heat damage in the presence of water and reduced frizz.

2 - SEM imaging for bleached hair



Silsoft AX-E PMF conditioning agent helped prevent cuticle lift by forming a protective film.

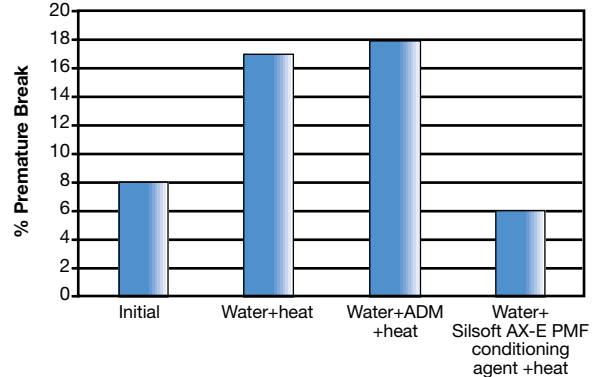
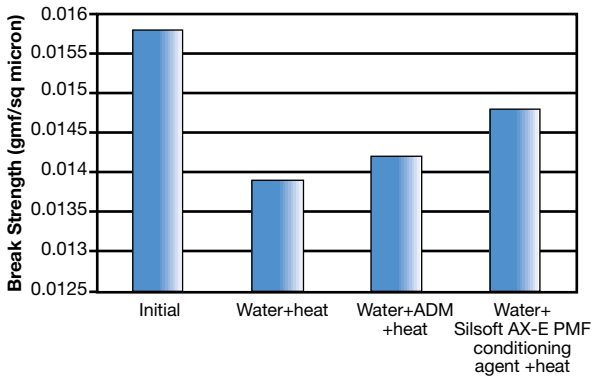
Note: Test results. Actual results may vary.

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Performance Data (continued)

3 - Tensile test on damaged hair

Among the byproducts of hair damage is the loss of elasticity; the degree to which hair is damaged correlates to the force needed to break the hair fiber. The tensile property of hair is used to measure the extent of thermal damage. The same overworked tresses that were exposed to the severe hair straightening protocol detailed in section 2 above were evaluated to determine if there was any loss of strength and if a treatment could prevent the damage from occurring.



ADM = amodimethicone

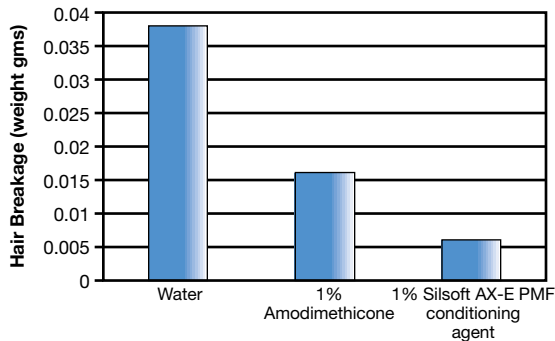
These graphs demonstrated trending that indicated that Silsoft AX-E PMF conditioning agent reduced premature breaking and break strength loss generated by the ironing process.

4 - Breakage test

Simple brushing and combing can cause significant breakage of damaged hair. Used prior to heat styling, Silsoft AX-E PMF conditioning agent helped protect the hair from heat damage and reduced the force required to comb the hair.

Protocol:

- 4g Platinum bleached tresses were treated with 0.5% NaOH for 1 minute, rinsed and blown dry.
- Tresses were dipped for 1 minute in 1% active silicone dispersion of Silsoft AX-E PMF conditioning agent, and excess liquid was squeezed out.
- Tresses were ironed at constant speed and constant pressure at temperature 125 °C until almost dry.
- After ironing, tresses were left at room temperature overnight. Tress was held vertically and combed manually with a coarse comb 5 times each side. Broken fibers were collected on an aluminum foil below the tress. Total weight of broken fibers was recorded on a precision balance.



Reduction of hair breakage observed with Silsoft AX-E PMF conditioning agent treatment was likely due to the protected cuticle layer and lowered friction.

5 - Hydrophobicity test

Healthy undamaged hair is hydrophobic. When it is damaged it becomes hydrophilic. If a product can restore hair to a more hydrophobic state, it is often concluded that hair is healthier. A simple wicking test was used to measure hydrophobicity before and after treatments and the change in wicking time is represented in the figure below. The surface hydrophobicity of the bleached hair fibers was improved after treatment with Silsoft AX-E PMF conditioning agent, restoring damaged bleached hair to what appears to be a more natural or healthy state.

Protocol:

- A bleached hair tress was dipped in a silicone dispersion prepared from Silsoft AX-E PMF conditioning agent. The tress was dried, washed with a 10% SLES solution and dried again.
- Several deionized water droplets were deposited on a bleached hair tress held flat and taut in a clamp.
- A record was kept of the time required for the droplets to wick into the hair tress.

	Treatment concentration of silicone	Wicking time after 1 wash (s)
No silicone	0	<10
Amodimethicone	0.3%	120
Silsoft AX-E PMF conditioning agent	0.3%	>300



The excellent thermal performance effect of Silsoft AX-E PMF conditioning agent could be due to its very good spreading and lubricating properties, and also to its ability to form a very hydrophobic film.

Note: Test data. Actual results may vary.

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6 - Curly hair ironing: fiber alignment enhancement test

Protocol:

Undamaged Latin curly hair was treated with an aqueous dispersion of Silsoft AX-E PMF conditioning agent, dried, equilibrated at 90% RH, then ironed for 5 passes at 154 °C (hair temperature). The contact force and the iron speed were controlled in the automated apparatus shown below. After ironing, the tress was washed with a 10% SLES solution, rinsed, dried. This iron treatment cycle was repeated 2 more times before pictures were taken. The pictures were taken after storage of the tress in a 90% RH chamber for 30 minutes.

Apparatus



Initial



No Silicone

**0.5% Silsoft AX-E PMF
conditioning agent**

Silicone treatment enhanced straightening due to fiber alignment.

Note: Test results. Actual results may vary.

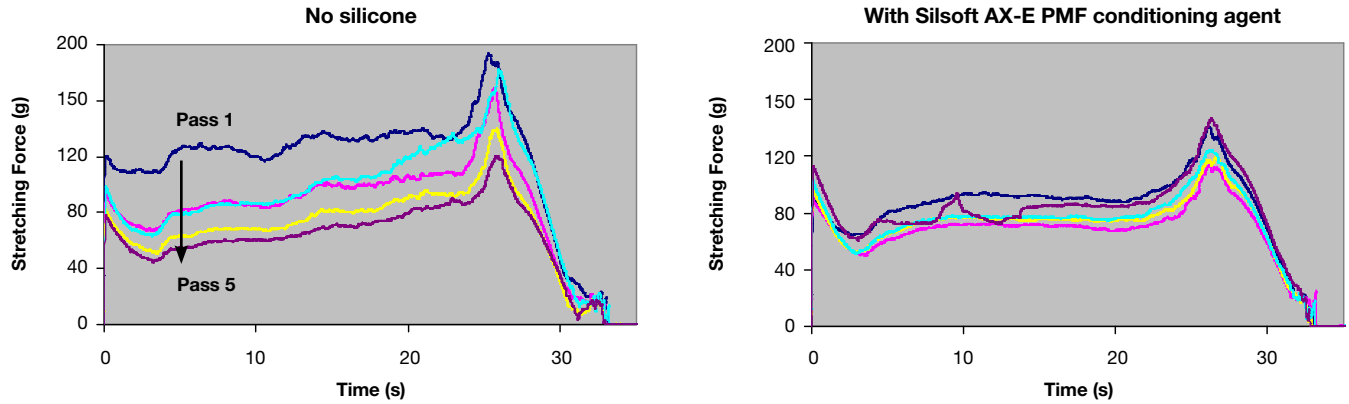
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7 - Iron gliding test

Protocol:

The undamaged curly hair tress was dipped in an aqueous dispersion of Silsoft AX-E PMF conditioning agent for 1 minute, dried and placed for 30 minutes in a humidity chamber at 90% RH. The hair was ironed at 175 °C for 5 passes. The tress was pulled at a constant speed of 15 mm/s by the vertical motorized stage of a Texture Analyzer. The Texture Analyzer load cell measured the stretching force exerted on the hair tress during ironing.



Control



0.5% Silsoft AX-E PMF conditioning agent



Silsoft AX-E PMF conditioning agent enhanced fiber alignment and lowered iron gliding force.

Note: Test results. Actual results may vary.

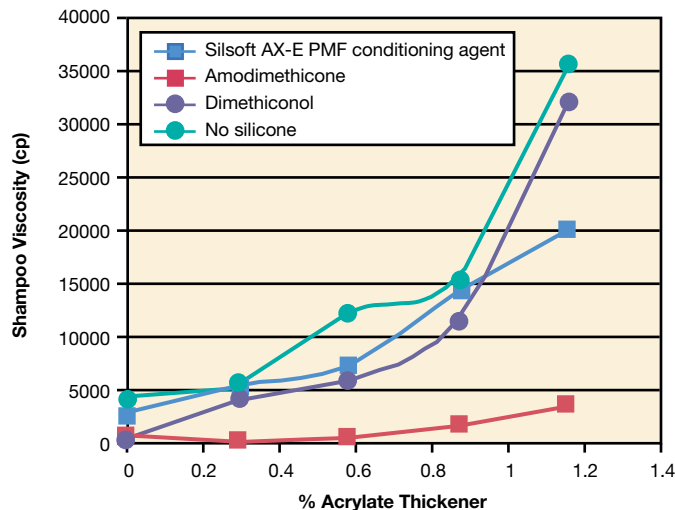
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8 - Conditioning shampoo tests

A. Structure

Protocol:

1. A SLES/CAPB shampoo base shown in the table below was prepared with different silicone emulsions or no silicone.
2. The dosage of acrylate thickener was varied from 0 to 1.17%.
3. The viscosity of the final shampoo was taken with a Brookfield viscometer at 10 rpm.



Ingredient Name	Shampoo % Active
Sodium Lauryl Ether Sulfate	12
Cocamidopropyl Betaine	3
Cocamide Monoethanolamide	1
Ethylene Glycol Distearate	1
Silsoft AX-E PMF conditioning agent	1
Acrylate Thickener ⁽¹⁾	0-1.17
Polyquaternium-6	0.06
Water	q.s.p. 100

(1) Acrylate thickener
Acrylates/Vinyl Neodecanoate Crosspolymer

With Silsoft AX-E PMF conditioning agent, stable salt-free pearlescent shampoos can be obtained. Generally, unlike conventional amodimethicone emulsion, Silsoft AX-E PMF conditioning agent allowed incorporation of acrylated thickeners to adjust the shampoo viscosity.

Product formulations are included as illustrative examples only. Momentive makes no representation or warranty of any kind with respect to any such formulations, including, without limitation, concerning the efficacy or safety of any product manufactured using such formulations.

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8 - Conditioning shampoo tests (continued)

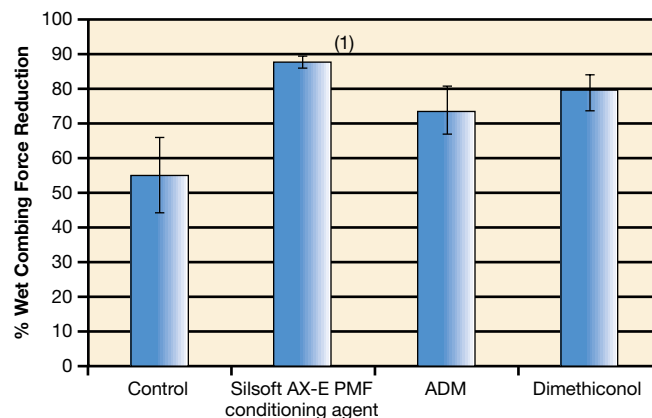
B. Performance

Protocol:

1. 4g undamaged tresses (International Hair Importers) were placed in 2 successive 6% hydrogen peroxide baths (pH 9-10) for 25 minutes each. Tresses were rinsed under running water for 30 seconds.
2. Tresses were washed with 1mL of 10% SLES solution per 4g hair (20 rubs: 10 rubs per side) and rinsed under running water for 30 seconds. The wash protocol was repeated 3 times for each tress before measurement was taken.
3. Formulation is shown in table below. Level of thickener was adjusted to obtain similar viscosity.
4. Wet combing force was measured with a Diastron apparatus. Each tress washed with a 10% SLES solution was measured to obtain the tress baseline value. The control is the tress treated with the shampoo base without silicone. Each datum is an average of 3 tresses.

Wet and dry friction were measured with a Texture Analyzer. Each datum is an average of 3 tresses.

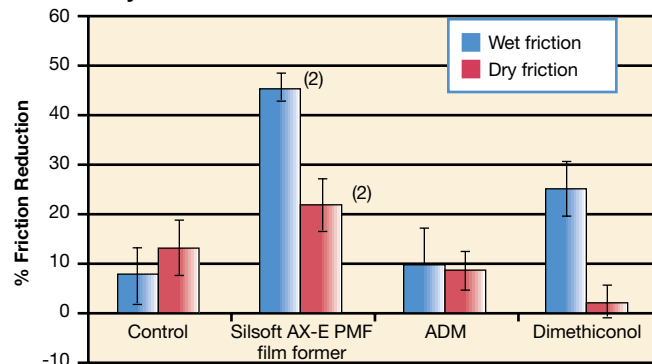
Wet Combing



ADM = amodimethicone

(1) Statistically better than ADM (p-value<0.05)

Wet and Dry Friction



ADM = amodimethicone

(2) Statistically better than ADM and dimethiconol (p-value<0.05)

Silsoft AX-E PMF conditioning agent improved conditioning properties such as wet and dry friction over shampoo formulations, that contained amodimethicone and dimethiconol or did not contain amodimethicone and dimethiconol.

Sample Shampoo Formulations

Ingredients	Control	Silsoft AX-E PMF conditioning agent	ADM	Dimethiconol
	% Active			
DI Water	83	79	70	79
Sodium Lauryl Ether Sulfate	12	12	12	12
Cocamidopropyl Betaine	3	3	3	3
Cocamide Monoethanolamide	1	1	1	1
Ethylene Glycol Distearate	1	1	1	1
Acrylates/Vinyl Neodecanoate Crosspolymer (diluted to 10% active)		3	12	3
Silsoft AX-E PMF conditioning agent		1		
Amodimethicone Emulsion			1	
Dimethiconol Emulsion				1
Polyquaternium-6 (40% active)	0.15	0.15	0.15	0.15
Viscosity (cp)	4425	5150	3875	4200

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Note: Test data. Actual results may vary.

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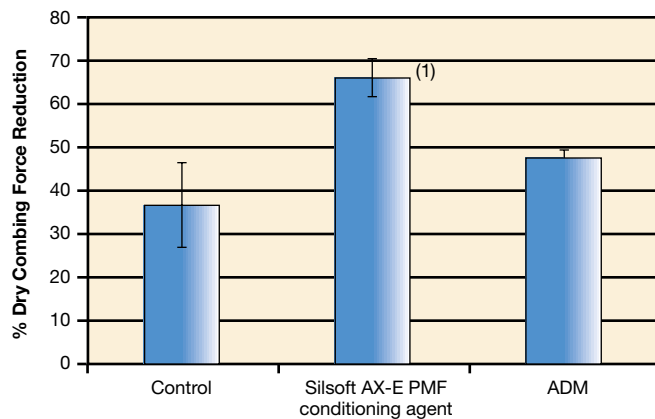
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9 - Rinse-off conditioner test

Protocol:

1. 4g single bleached tresses were subjected to a 0.5% NaOH bath for 2 min. Tresses were rinsed under running water for 30 seconds.
2. Tresses were washed with 1mL of 10% SLES solution per 4g hair (20 rubs: 10 rubs per side). Tresses were rinsed under running water for 30 seconds and then blow dried. 1mL of conditioner was applied per 4g hair (20 rubs: 10 rubs per side). Tresses were rinsed under running water for 30 seconds and then blown dry.
3. Dry combing force was measured with a Diastron apparatus. Each tress washed with a 10% SLES solution was measured to obtain the tress baseline value after overnight conditioning at 50%RH, 25 °C. Treatment measurements were taken after overnight conditioning at 50% RH, 25 °C. The control is the tress treated with conditioner base without silicone. Each data is an average of 3 tresses.

Conditioner formulation with 1% silicone polymer is shown on page 10.



ADM = amodimehicone

(1) Statistically better than ADM and control (p -value<0.05)

Silsoft AX-E PMF conditioning agent, when used in rinse-off conditioner, significantly improved dry combing of damaged hair.

Note: Test results. Actual results may vary.

SILSOFT* AX-E PMF Conditioning Agent

10 - Formulation examples

Sample Salt-Free Pearlescent Conditioning Shampoo Formulation

Ingredients	% w/w
DI Water	39.85
Polyquaternium-6 (40%)	0.15
Cocamidopropyl Betaine (35%)	9
Sodium Lauryl Ether Sulfate (27%)	44
Cocamide Monoethanolamide	1
Ethylene Glycol Distearate	1
Acrylates/Vinyl Neodecanoate Crosspolymer (diluted to 10% active)	3
Silsoft AX-E PMF conditioning agent	2.5

Product formulations are included as illustrative examples only. Momentive makes no representation or warranty of any kind with respect to any such formulations, including, without limitation, concerning the efficacy or safety of any product manufactured using such formulations.

Typical Properties

Appearance	<i>Pearlescent white viscous liquid</i>
pH	<i>6.0</i>
Viscosity	<i>5000 cp (Brookfield DV-III Ultra, 10 RPM)</i>
Stability	<i>Passed 1 month @ 50°C</i>

Ingredient Information

Polyquaternium-6, *Merquat 100*, Lubrizol
Cocamidopropyl Betaine, *Velvetex BA-35*, Cognis
Sodium Lauryl Ether Sulfate, *Jeelate ES-2*, Jeen
Cocamide Monoethanolamide, *Comperlan 100*, Cognis
Ethylene Glycol Distearate, *Cutina AGS*, Cognis
Acrylates/Vinyl Neodecanoate Crosspolymer, *Aculyn 38*,
Dow Chemical (30%)

Procedure

1. Mix DI water and polyquaternium-6 at room temperature.
2. Add cocamidopropyl betaine at room temperature and mix until uniform.
3. Add sodium lauryl ether sulfate at room temperature. Mixture will become cloudy.
4. Once mixture is homogeneous, heat to 70-75 °C.
5. Melt in cocamide monoethanolamide and ethylene glycol distearate individually while mixing.
6. Cool down to 40-45 °C. Add pre-diluted thickener and mix for 20 minutes.
7. Add Silsoft AX-E PMF conditioning agent and mix until uniform.
8. Allow shampoo to cool down to room temperature.

Note: Test data. Actual results may vary.

SILSOFT* AX-E PMF Conditioning Agent

10 - Formulation examples (continued)

Sample Sulfate-Free Pearlescent Conditioning Shampoo

Ingredients	% w/w
DI Water	39.85
Polyquaternium-10	0.15
Sodium Lauryl Sulfoacetate (and) Disodium Laureth Sulfosuccinate (24%)	44
Cocamide Monoethanolamide	1.5
Cetyl Betaine (37%)	9
Ethylene Glycol Distearate	1.5
Hydroxypropyl Methylcellulose	1.5
Silsoft AX-E PMF conditioning agent	2.5

Product formulations are included as illustrative examples only. Momentive makes no representation or warranty of any kind with respect to any such formulations, including, without limitation, concerning the efficacy or safety of any product manufactured using such formulations.

Typical Properties

Appearance	<i>Pearlescent white viscous liquid</i>
pH	<i>4.5-5.5</i>
Viscosity	<i>15000 cp (Brookfield DV-III Ultra, 10 RPM)</i>
Stability	<i>Passed 1 month @ 50°C</i>

Ingredient Information

Polyquaternium-10, *Ucare PolymerJR-30M*, Dow Chemical
Sodium Lauryl Sulfoacetate AND Disodium Laureth Sulfosuccinate, *Stepan-Mild LSB*, Stepan
Cocamide Monoethanolamide, *Comperlan 100*, Cognis
Cetyl Betaine, *Amphosol CDB Special*, Stepan
Ethylene Glycol Distearate, *Cutina AGS*, Cognis
Hydroxypropyl Methylcellulose, *Methocel E4M Premium AMC*, Dow Chemical

Procedure

1. Mix DI water and polyquaternium-10 at room temperature for 15 minutes.
2. Heat to 70-75 °C.
3. Add in surfactants and waxes one by one in the order listed and mix until uniform.
4. Add hydroxypropyl methylcellulose slowly to vortex and hydrate for 20 minutes.
5. Cool down to 40-45 °C. Add Silsoft AX-E PMF conditioning agent and mix until uniform.
6. Allow shampoo to cool down to room temperature.

Sample Rinse-Off Cationic Conditioner Formulation

Ingredients	% w/w
DI Water	90.3
Lactic Acid	0.6
Behenamidopropyl Dimethylamine	2.2
Cetearyl Alcohol	4.4
Silsoft AX-E PMF conditioning agent	2.5

Product formulations are included as illustrative examples only. Momentive makes no representation or warranty of any kind with respect to any such formulations, including, without limitation, concerning the efficacy or safety of any product manufactured using such formulations.

Typical Properties

Appearance	<i>White emulsion</i>
pH	<i>6.0</i>
Viscosity	<i>18000 cp (Brookfield DV-III Ultra, 10 RPM)</i>
Stability	<i>Passed 1 month @ 50°C</i>

Ingredient Information

Lactic Acid, *Purac Powder 60*, Purac
Behenamidopropyl dimethylamine, *Amidet APA-22*, Kao
Cetearyl Alcohol, *Kalcol 6850*, Kao

Procedure

1. Heat water and lactic acid to 75 °C.
2. Add behenamidopropyl dimethylamine and mix until homogeneous.
3. Add cetearyl alcohol and mix until homogeneous.
4. Cool down to room temperature with continued agitation, increasing speed as conditioner thickens.
5. Add Silsoft AX-E PMF conditioning agent and mix until uniform.

SILSOFT* AX-E PMF Conditioning Agent

Patent Status

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Limitations

Customers must evaluate Momentive Performance Materials products and make their own determination as to fitness of use in their particular applications.

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