

Silsoft* CLX-E Conditioning Agent



MARKETING BULLETIN

SPECIALTY FLUIDS - PERSONAL CARE

INCI Name: *Dipropylene Glycol (and) Polysilicone-29*

Hair grown in youth is nearly flawless in design with a radiant appearance – full of life, body, shine and strength. Over time, hair is exposed to aggressors such as sunlight, pollution, chemical treatments or excessive heat that break down the bio-structural components of hair fiber, making it coarse, brittle, weaker and more vulnerable to split end formation. Momentive’s Silsoft CLX-E conditioning agent can help protect hair from these damage and aggressors and even restore damaged hair to a healthy, more youthful state that is comparable to the quality of hair at the root. These benefits may be achieved by Silsoft CLX-E conditioning agent’s ability to form a durable, crosslinked network on hair. This invaluable result can provide improved manageability along with a soft, radiant appearance without weighing down hair or leaving behind residue.

The versatile benefits of Silsoft CLX-E conditioning agent can also include excellent straightening with virtually no frizz when combined with heat. Silsoft CLX-E conditioning agent was formulated to be durable – with noticeable effects – lasting through multiple washes and has shown to improve the hydrophobicity of damaged hair through 30 washes. Silsoft CLX-E conditioning agent is a versatile candidate to consider for a broad range of hair care applications.

Key Features and Typical Benefits

- Offers superior conditioning and helps to reduce combing force
- Restores hydrophobicity to hair
- Can provide excellent anti-frizz capabilities
- Can provide durable effects that last through multiple washes
- Helps to repair split ends
- Aids in restoring manageability to hair
- Helps protect hair from thermal assaults
- Boosts the effects of daily conditioners
- Effective at low dosage levels
- Can reduce drying time of hair
- Dispersible in water without the need for surfactants
- Self-limiting deposition

Typical Physical Properties

	Silsoft CLX-E conditioning agent
Appearance	Clear to slightly hazy liquid
Silicone Content %	15
Viscosity (25 °C, cPs)	100 - 500
pH Range	4 - 6
Solubility	Easily dispersible in water
Residual Cyclic Content	<1000 ppm D4 or D5

Typical physical properties are average data and are not to be used as or to develop specifications.

Potential Applications

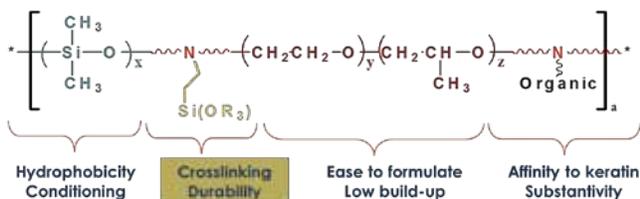
Hair Care

- Products to smooth and repair hair:
 - Leave-on and rinse-off conditioners
 - Shampoos
 - Serums
 - Treatment ampoules
 - Pre-treatment for hair dying
- Thermal hair straightening/curling products
- Color protection
- Thermal protection
- Shine spray
- Ethnic hair care

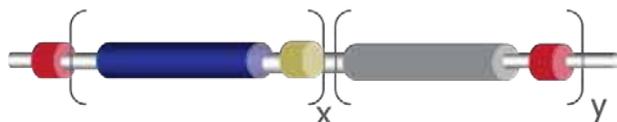
Other Applications

- Body wash
- Liquid hand soap

Chemistry



Generic structure of Silsoft CLX-E conditioning agent



Linear structures are favored for their sensory benefits. The silicone aligns itself to the hair shaft to help provide a smooth, soft, silky feel to hair, whereas the polyether portion provides better water dispersibility, and ease of formulation as well as improved adhesion to damaged hair. The non-reactive amine is substantive to keratinaceous substrates, such as hair to form a soft, flexible film. The reactive portion cross-links and provides prolonged effects that can endure through multiple washes while the polyether balances the hydrophilic/hydrophobic balance leading to self-limiting deposition.

Test Performance Data

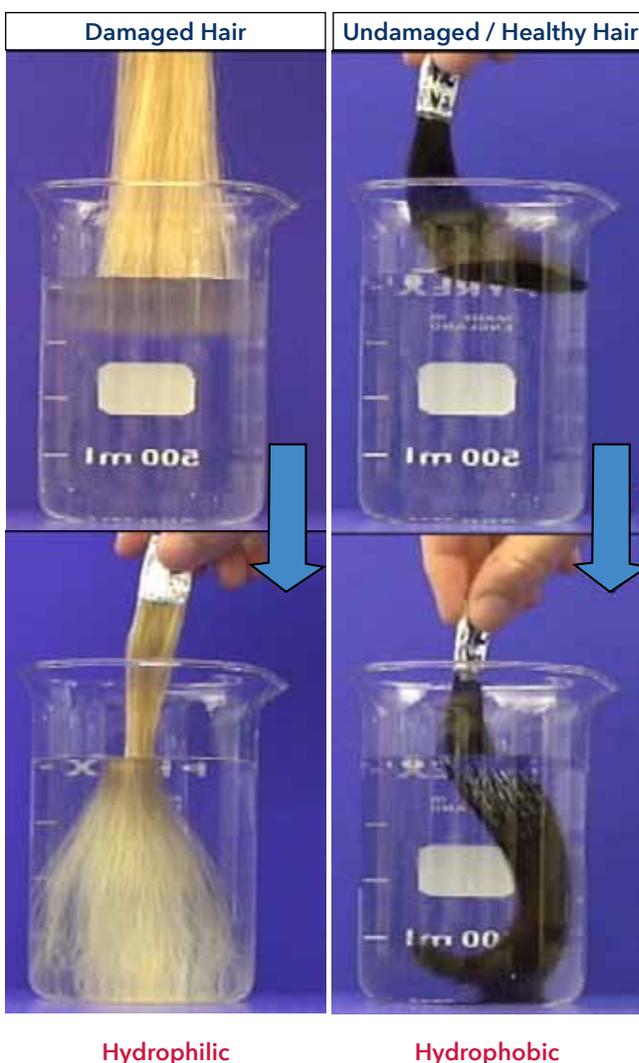
1. Hydrophobicity Restoration

Hydrophobicity is a key measure for determining the amount of damage hair has undergone. Silsoft CLX-E conditioning agent was tested to show its ability to drastically improve the hydrophobicity of damaged hair, which is generally more hydrophilic.

Immersion Test

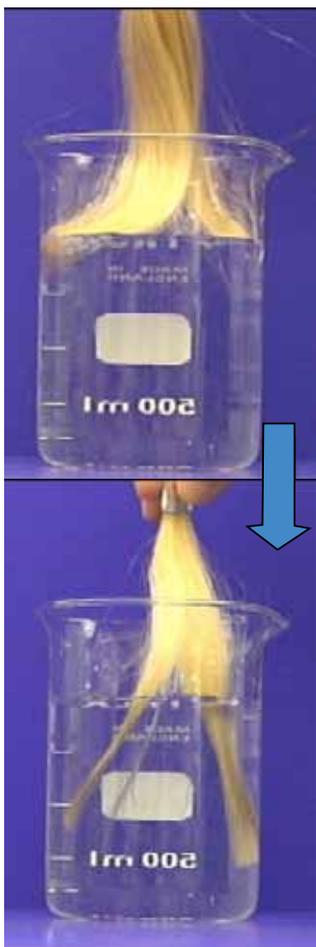
When the hair tress was immersed in water, the fibers of undamaged hair gathered together to repel the water, whereas hydrophilic hair spread out and absorbed water.

Figure 1:



Hair was dipped in a 1% active (6.5% as supplied) solution of Silsoft CLX-E conditioning agent and dried. The fibers of the treated hair tress gathered together to repel the water, indicating that the hair surface hydrophobicity was similar to that of undamaged hair.

Figure 2:

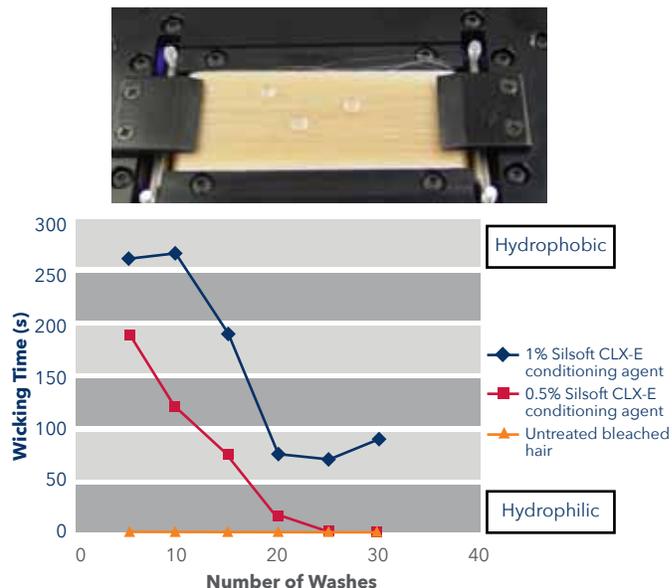


Note: Test results. Actual results may vary.

Wicking Test

Hair tresses were dipped in a 0.5 - 1% active solution of Silsoft CLX-E conditioning agent and left to dry overnight. These tresses were then washed ten times with a 10% solution of sodium lauryl ether sulfate solution. Once thoroughly washed, a wicking test was performed to measure the hydrophobicity of the hair tresses, as seen in Figure 3.

Figure 3: Wicking Time as Function of Number of Wash Cycles

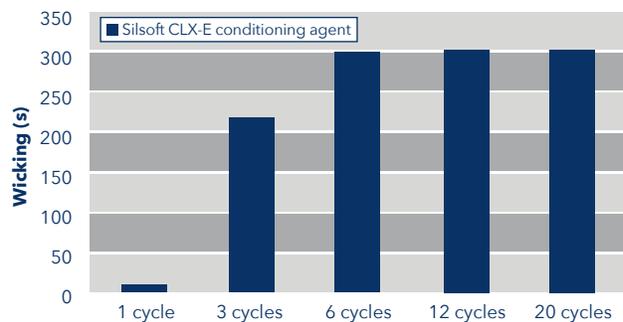


Note: Test conducted on bleached damaged hair. Test data. Actual results may vary.

Damaged hair treated with Silsoft CLX-E conditioning agent was able to maintain hydrophobicity through 30 washes.

When Silsoft CLX-E conditioning agent was used at a 1.7% use level (0.25% active), hydrophobicity was fully restored in damaged hair after the fifth treatment in a rinse-off application.

Figure 4: Wicking Time as Function of Wash Cycles



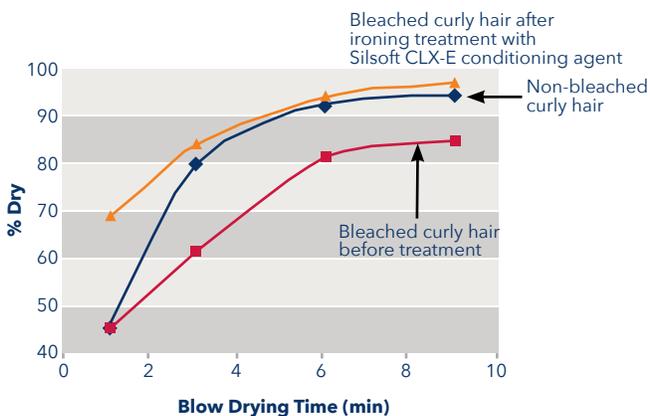
Note: Test results. Actual results may vary.

Faster Drying Time Test

With schedules becoming busier and multi-tasking at an all-time high, reducing the time required to blow dry hair is becoming a very desirable claim. In addition to the time savings, reducing the time hair is exposed to the heat of the blow-dryer is beneficial to the overall health of hair.

Latin curly hair was damaged with bleach and treated with a 1% active solution of Silsoft CLX-E conditioning agent (dipping method) then blow dried, passed through a flat iron 6 times (234 °C) and washed 10 times.

Figure 5: Blow Drying Time of Bleached Curly Hair Ironed and Treated with Silsoft CLX-E conditioning agent



Note: Test data. Actual results may vary.

The damaged hair treated with Silsoft CLX-E conditioning agent showed significant reduction in drying time compared to the untreated damaged hair.

Repairing Properties on Relaxed Hair

Ethnic hair is elliptical shaped and therefore has very tight curls and can be extremely difficult to manage. In response to poor manageability, it is common to chemically “relax” or straighten such hair. Applying products such as a relaxer cream will break down the chemical bonds of the hair shaft, disrupting the elliptical shape and reconstructing the bonds in a different way. As a result hair may become very brittle and break.

Silsoft CLX-E conditioning agent was tested to show the hair restoration capabilities on relaxed hair. In this test ethnic hair was relaxed with a commercial alkali relaxer, shampooed and treated with Silsoft CLX-E conditioning agent.

Treatment Protocol:

1. After shampooing, apply repairing cream to ampoule to damp hair. Massage product into hair, paying special attention to damaged ends.
2. Allow hair to dry with product.
3. Briefly rinse hair and style as desired.

Figure 6: Damage Repair Treatment



Note: Test results. Actual results may vary.

Ingredients	%w/w
Deionized Water	q.s. to 100
Lactic Acid	0.6
Behenamidopropyl dimethylamine	2.2
Cetearyl Alcohol	4.4
Coconut Oil	5
Silsoft CLX-E conditioning agent	6.6
Preservative	q.s.

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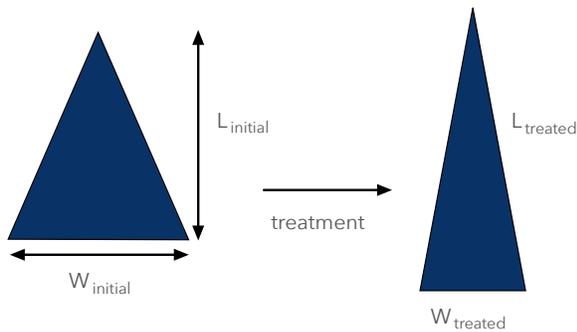
2. Durable Anti-Frizz Effect

Many hair types are impacted by frizz, whether it is just genetics or if hair has been exposed to excessive UV, heat or processing. Frizz typically expands in more humid environments because hydrophilic hair absorbs more water causing the cuticle lift to worsen, creating more unwanted volume.

To test the anti-frizz durability of Silsoft CLX-E conditioning agent, bleached, curly hair was treated with 1% active (6.7% as supplied) Silsoft CLX-E conditioning agent, dried and then passed through a straightening iron 6 times at 234 °C.

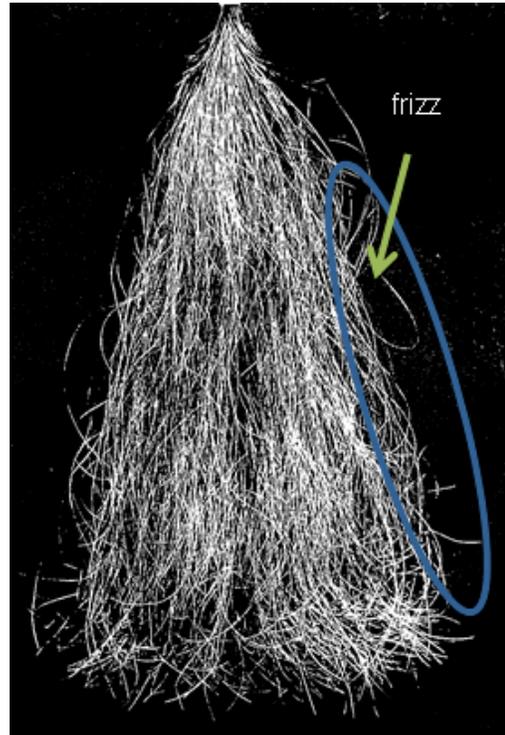
Imaging measurements were taken after storage in a 90% relative humidity chamber to quantify the curl reduction or straightening effect of the hair. Maximum width (W) and maximum length (L) of the hair was measured in both the control and treated hair to obtain a curl reduction factor. $(W/L)_{max}$ corresponds to the value of maximum curl reduction which is measured on an ironed tress before storage at high humidity.

$$\text{Curl Reduction Factor} = \frac{(W/L)_{\text{initial}} - (W/L)_{\text{treated}}}{(W/L)_{\text{initial}} - (W/L)_{\text{max}}} \times 100$$



Frizz reduction is obtained by image analysis from the periphery of the tress (region of loose fibers) (pixel counts).

Figure 7: Binarized Image of the Hair Tress for Curl and Frizz Reduction Assessment



Note: Test results. Actual results may vary.

The tresses were washed ten times with a sodium laureth sulfate solution and then exposed in a chamber at 90% relative humidity for 1 hour.

Figure 8: Pictures of Tresses Post High Humidity Chamber Storage



Note: Test results. Actual results may vary.

3. Progressive Thermal Relaxing

Everyday styling practices such as blow drying, curling and straightening with irons strip the hair of moisture leaving it brittle, dry and more vulnerable to breakage. As a result, most experts recommend that consumers limit the use of flat irons on hair to once a week, leaving women with the need for durable straightening that lasts through several washes.

To understand the thermal straightening capabilities of Silsoft CLX-E conditioning agent, a study was run to assess its durability when used in combination with a flat iron in a progressive hair straightening application.

1. Protocol: Curly hair tresses were washed and treated with a rinse-off conditioner which contained either Silsoft CLX-E conditioning agent or dimethiconol gum.
2. The hair was then dried 80% and passed through an iron six times at 200 °C. After the iron cycle, the hair was shampooed, then treated with the rinse-off conditioner and ironed again.
3. This process was repeated four times.
4. After the fourth cycle, the hair was then washed ten times.

Rinse-off Conditioner

Ingredients	%w/w
Deionized Water	q.s. to 100
Ceteareth-20	2.50
Cetearyl Alcohol	3.00
Coconut Oil	5.00
Silicone (active)	1.00
Preservative	q.s.

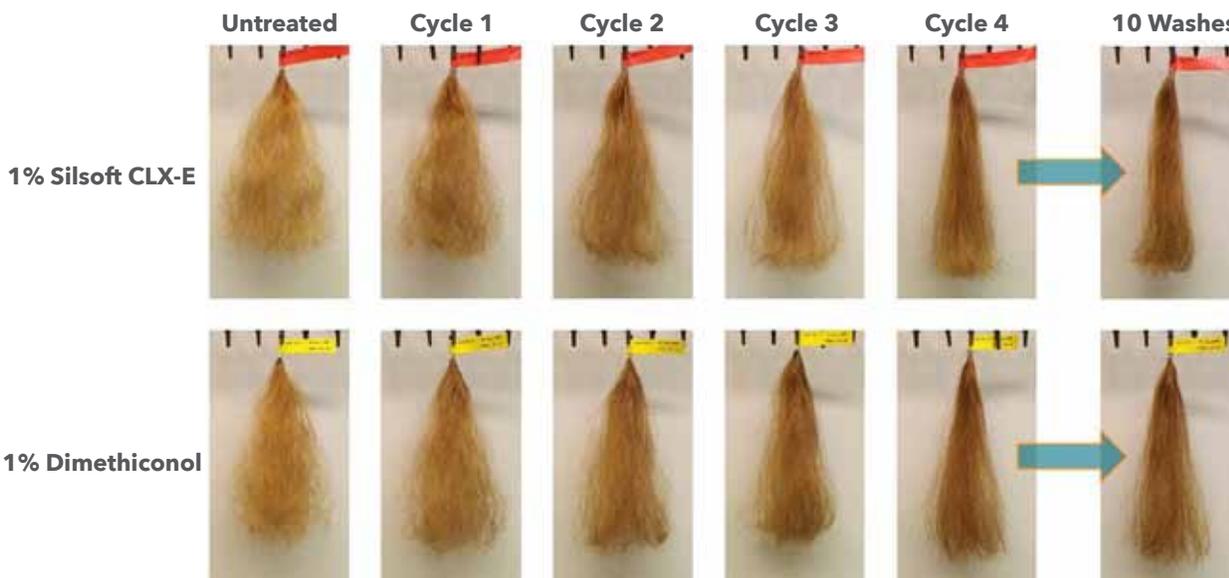
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Silicones:

- Silsoft CLX-E conditioning agent
- Dimethiconol emulsion (control)

All hair tresses were placed in a 90% relative humidity chamber for 1 hour.

Figure 9: Pictures of Tresses Post High Humidity Chamber Storage



Note: Test results. Actual results may vary.

As a result, good volume reduction was obtained through progressive thermal relaxing. The best anti-frizz capabilities were obtained using Silsoft CLX-E conditioning agent.

4. Thermal Protection

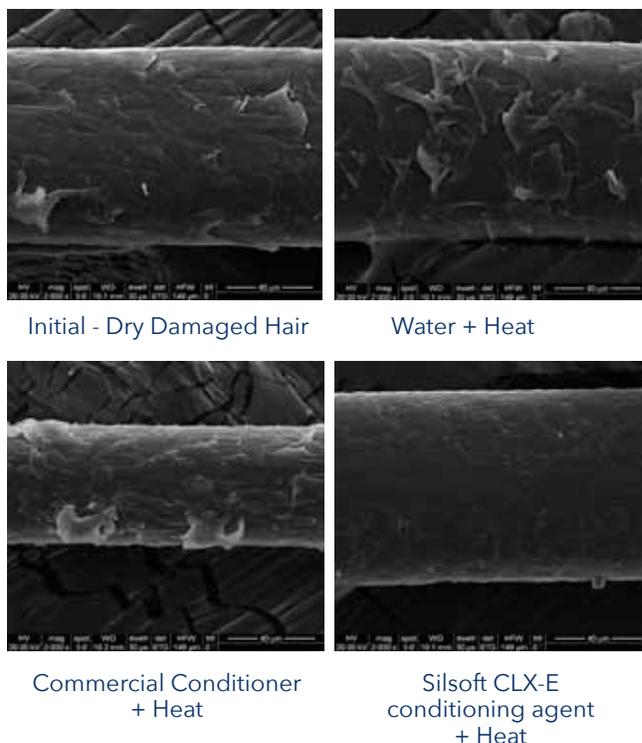
Daily styling practices can also cause extensive damage to hair cuticle causing it to crack, buckle and lift. In turn, the damaged hair cuticles cause hair to look dull, lifeless and frizzy.

In a severe straightening test, heat was applied to damp hair treated with Silsoft CLX-E conditioning agent using a flat iron until dry. SEM images were taken to assess the damage to the cuticle.

Protocol:

1. Damage process: Dip platinum bleached tresses for 1 minute in a 0.5% NaOH bath. Rinse under running water, blow dry.
2. Protection treatment: Tresses are then dipped for 1 minute in a 1% active silicone in water dispersion, prepared from Silsoft CLX-E conditioning agent. Excess liquid was squeezed off.
3. With iron at medium heat (130 °C), pass hair through iron several times until dry (5-7) minutes.

Figure 10: SEM Imaging



Silsoft CLX-E conditioning agent dispersion helped prevent cuticle lift by forming a protective film

Note: Test results. Actual results may vary.

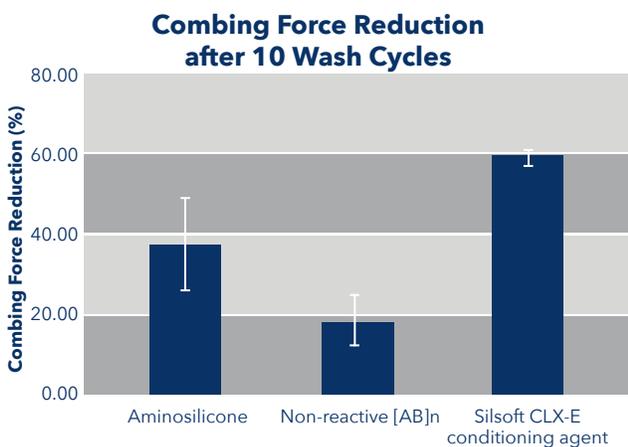
5. Durable Conditioning

Conditioners play an integral part in hair’s health and appearance. As the number of aggressors used on hair increases, the more conditioner can be used to help reduce friction in hair, making hair less vulnerable to breakage as well as leaving hair softer and often easier to manage.

The long-term, durable conditioning effects of Silsoft CLX-E conditioning agent were tested on long (25 cm), damaged hair tresses. The tresses were treated with a 1 % active solution of Silsoft CLX-E conditioning agent as well as two additional treatments with an amodimethicone and a non-reactive [AB]_n silicone. The tresses were dried and then washed ten times with a sodium laureth sulfate solution. The combing force reduction was measured with a Dia-Stron combing force apparatus.⁽¹⁾ These tresses were also evaluated by a ten person hand panel. The tresses treated with Silsoft CLX-E conditioning agent were preferred each time.

(1) Dia-Stron Ltd. Andover, UK

Figure 11: Combing Force Reduction Data



Note: Test data. Actual results may vary.

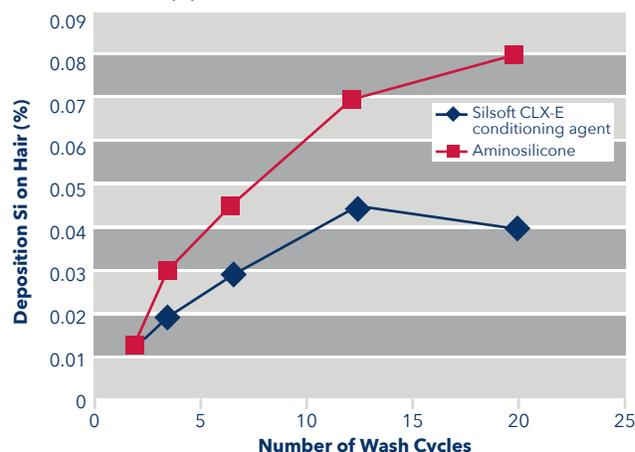
After ten washes, the tresses with Silsoft CLX-E conditioning agent outperformed the tresses treated with amino silicone and non-reactive [AB]_n silicone in the dry-combing test.

6. Build-up Study in Rinse-Off Formulation

The ingredients used in many products such as gel, hairspray, shampoos, conditioners and other hair care products tend to leave behind a residue, or build-up, that is often greasy and may cause hair to appear dull, lifeless or unclean.

The amount of residue that Silsoft CLX-E conditioning agent left behind was tested by adding 1.7% Silsoft CLX-E conditioning agent to a traditional silicone conditioner. Multiple applications of this product were applied to damaged hair everyday.

Figure 12: Silicone Deposition After Multiple Application of Rinse-Off Conditioner



Note: Test data. Actual results may vary.

Due to the self-limiting deposition behavior of the polymer, Silsoft CLX-E conditioning agent is not prone to the build-up traditional amino silicones exhibit.

7. Boosting of 2-in-1 Shampoos

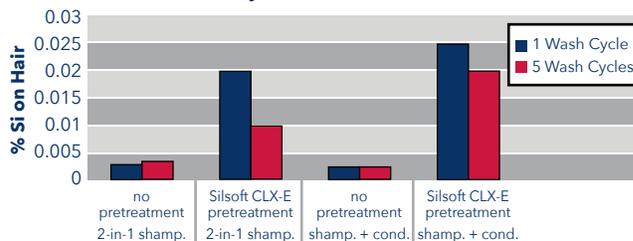
Damaged tresses were treated with 1% active Silsoft CLX-E conditioning agent. Tresses were then washed multiple times with a traditional 2-in-1 shampoo or a combination of shampoo and conditioner all of which contained dimethicone. The level of silicone was then measured on the hair.

Silicone Deposition from Rinse-Off

Tresses pretreated with Silsoft CLX-E conditioning agent showed a higher deposition of silicone on hair than tresses washed with the shampoo and conditioners alone.

Silsoft CLX-E conditioning agent boosted the performance of traditional conditioners and 2-in-1 shampoos on damaged hair.

Figure 13: Silicone Deposition After Multiple Wash Cycles



Note: Test data. Actual results may vary.

Formulations

Deep Conditioning Hair Mask

Phase	Ingredient	INCI Name	Wt %
A	DI Water	Water	q.s. to 100%
	Natrosol 250 HHR ⁽²⁾	Hydroxyethylcellulose	1.50
	Glycerin	Glycerin	3.00
B	Cetearyl Alcohol	Cetearyl Alcohol	1.00
	Arlacel 165 ⁽³⁾	Glycerol Stearate (and) PEG-100 Stearate	1.00
C	Silsoft CLX-E conditioning agent⁽¹⁾	Dipropylene Glycol and Polysilicone-29	5.00
	Preservative	Preservative	q.s.
	Fragrance	Fragrance	q.s.

Procedure:

1. Combine phase A until well dispersed.
2. Add phase B ingredients, heat to 75 °C, mix until uniform.
3. Begin cooling, add Silsoft CLX-E conditioning agent.
4. After 40 °C, add phase E while mixing.

Suppliers:

- (1) Momentive Performance Materials, Inc.
- (2) Ashland Specialty Products, Natrosol is a trademark of Hercules Incorporated
- (3) Croda, Inc. Arlacel is a trademark of Uniquema Americas LLC

Cationic Conditioner

Phase	Ingredient	INCI Name	Wt %
A	Water	Water	q.s. to 100%
A	Lactic Acid	Lactic Acid	0.6
B	Amidet APA-22a ⁽²⁾	Behenamidopropyl Dimethylamine	2.2
B	Kalcol 6850a ⁽²⁾	Cetearyl Alcohol	4.4
C	Silsoft CLX-E conditioning agent⁽¹⁾	Dipropylene Glycol (and) Polysilicone-29	6.0
C	Preservative	Preservative	q.s.

Procedure:

1. Disperse lactic acid in DI water and heat to 75-80 °C.
2. Add behenamidopropyl dimethylamine and mix until completely dissolved and mixture is homogeneous (~1-3 hours).
3. Add cetearyl alcohol and mix until completely melted (0.5-1 hour) and mixture is homogeneous.
4. Cool batch to room temperature while stirring.
5. Add Silsoft CLX-E conditioning agent and stir until mixture is homogeneous.
6. Add desired preservative.

Suppliers:

- (1) Momentive Performance Materials, Inc.
- (2) Kao Chemicals

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

Formulations**Mousse**

Phase	Ingredient	INCI Name	Wt %
A	Water	Water	q.s. to 100%
A	Velvetex BA ⁽²⁾	Cocamidopropyl Betaine	0.5
B	Silsoft CLX-E conditioning agent⁽¹⁾	Dipropylene Glycol (and) Polysilicone-29	6.0
C	Preservative	Preservative	q.s.
C	Fragrance	Fragrance	q.s.

Procedure:

1. Disperse cocamidopropyl betaine in DI water.
2. Add Silsoft CLX-E conditioning agent and stir until mixture is homogeneous.
3. Add preservative and fragrance as desired.

Suppliers:

- (1) Momentive Performance Materials, Inc.
 (2) BASF, Velvetex is a trademark of Cognis IP Management GmbH

Split End Repair Serum

Phase	Ingredient/Trade Name	INCI Name	Wt %
A	Water	Water	q.s. to 100%
	Disodium EDTA	Disodium EDTA	0.05
	Dehyton K ⁽²⁾	Cocamidopropyl Betaine	3.33
	Crotein K ⁽³⁾	Hydrolyzed Keratin	0.10
	SunSine Super Gold ⁽⁴⁾	Synthetic Fluorphlogopite (and) Titanium Dioxide	2.0
	Silsoft CLX-E conditioning agent⁽¹⁾	Dipropylene Glycol (and) Polysilicone-29	6.50
B	OptaSense RMA 110 ⁽³⁾	Sodium Polyacrylate (and) Isotridecyl Isononanoate (and) Trideceth-6	2.00
	Silsoft 034⁽¹⁾	Caprylyl Methicone	5.00
	Fragrance	Fragrance	q.s.
C	Preservative	Preservative	q.s.

Procedure:

1. Mix all ingredients of A.
2. Mix all ingredients of B and add to A.
3. Mix until homogeneous. Homogenize for 1-2 minutes (- 9500 rpm).
4. Add preservatives as desired and adjust pH to 5-6.

Suppliers:

- (1) Momentive Performance Materials Inc.
 (2) BASF, Dehyton is a trademark of Cognis IP Management GmbH
 (3) Croda, OptaSense is a trademark of Croda, Inc.
 (4) SUN Chemical

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Formulations

Anti-Aging Hair Balm

Phase	Ingredient	INCI Name	Wt %
A	Water	Water	q.s. to 100%
	Disodium EDTA	Disodium EDTA	0.05
	Dehyton K (30%) ⁽²⁾	Cocamidopropyl Betaine	3.0
	Dehyquart A CA (25%) ⁽²⁾	Cetrimonium Chloride	7.0
	Glycerin	Glycerin	1.5
B	Panthenol	Panthenol	0.7
	Genamin KDMP (80%) ⁽³⁾	Behentrimonium Chloride	1.0
	Lanette 14 ⁽²⁾	Myristyl Alcohol	2.0
C	Lanette 16 ⁽²⁾	Cetyl Alcohol	4.0
	Croton K ⁽⁴⁾	Hydrolyzed Keratin	0.05
D	Hydrolactin 2500-PW ⁽⁴⁾	Hydrolyzed Milk Protein	0.05
	Schercemol NGDO ⁽⁵⁾	Neopentyl Glycol Diethylhexanoate	0.5
	Silsoft 034 ⁽¹⁾	Caprylyl Methicone	0.5
E	Silsoft CLX-E conditioning agent ⁽¹⁾	Dipropylene Glycol (and) Polysilicone-29	3.0
	Fragrance	Fragrance	q.s.
	Preservative	Preservative	q.s.

Procedure:

1. Combine all ingredients in Phase A. Mix until solids have completely dissolved. Begin heating to 65 - 70 °C.
2. Mix all ingredients of phase B. Heat to 65 - 70 °C.
3. At 65 - 70 °C, combine phase B into phase A. Mix until homogeneous. Homogenize for 1-2 minutes (- 9500 rpm). Begin cooling to 45 °C.
4. When temperature has reached 45 °C, begin adding phase C and Phase D ingredients to batch. Mix well between each addition.
6. At 35 - 40 °C, add fragrance and preservatives as desired and adjust pH to 5-6.

Suppliers:

- (1) Momentive Performance Materials Inc.
- (2) BASF, Dehyton, Dehyquart, and Lanette are trademarks of Cognis IP Management GmbH
- (3) Clariant
- (4) Croda
- (5) Lubrizol Advanced Materials, Inc.

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