



# Formulator Report:

## Floramac<sup>®</sup> 10 as a Silicone Alternative in Hair Care



**Floramac 10** [INCI: Ethyl Macadamiate] is a unique botanically-derived emollient that can be utilized in a variety of cosmetic and personal care formulations, including hair care products. **Floramac 10** provides hair care formulations with enhanced product functionality. **Floramac 10** contributes to hair conditioning by improving combability, in addition to delivering protective properties to the hair (from e.g. heat, UV, grooming, etc.), which subsequently reduces hair breakage. The inherent refractive index of **Floramac 10** lends to its ability to promote shine and gloss, without the use of silicones, when used in leave-in hair care products, resulting in the healthier appearance of hair.

**Floramac 10** is also a suitable substitute for low viscosity silicones. It delivers favorable product aesthetics similar to silicones (without the volatility). Additionally, **Floramac 10** imparts a degree of hydration greater than silicones and can also be gelled to mimic the properties of traditional silicones.

**Floramac 10** is EU and China REACH compliant, TGA approved, and listed on AICS.

### Formulation Benefits:

- Provides hair conditioning functionality similar to silicones
- Alternative for some silicones
- Compatible with oils, volatile and non-volatile silicones
- Assists in the dispersion and solubilization of sunscreens
- Botanically-derived
- Allows for silicone-free claims
- Non-volatile
- High spread and low viscosity
- Tolerant of pro-oxidative environments
- Biodegradable<sup>1</sup>

### Hair Study Facts<sup>2</sup>:

In double-blind, vehicle-controlled *ex vivo* and *in vivo* studies, **Floramac 10** produced the following benefits:

- **Reduced wet comb force** up to 45% more than silicones (Figures 1 and 2)
- **Reduced dry comb force** up to 9 times more than silicones (Figures 1 and 2)
- **Reduced hair breakage of heat-damaged hair** up to 76% more than untreated hair (Figures 3 and 4)
- **Increased hair shine** up to almost 8 times more than silicones without the use of heat (Figures 5 and 6)
- **Increased hair shine** up to 2.5 times more than silicones with the use of heat (Figures 5 and 6)
- Significantly **improved consumer perception** of hair qualities for multiple categories (Figures 7, 8, and 9)

### Purpose:

The purpose of this investigation was to evaluate **Floramac 10** as a botanically-derived silicone alternative in hair care products. **Floramac 10** was compared to common silicones (*i.e.* cyclopentasiloxane and/or phenyl trimethicone) within a leave-in hair serum (page 8) and a leave-in hair cream (page 7), and the following conditioning attributes were evaluated: shine, comb force (ease of combing), hair breakage due to repeated grooming, and consumer preference. Additionally, neat **Floramac 10** was compared to neat cyclopentasiloxane and phenyl trimethicone<sup>3</sup> using consumer perception to evaluate the differences in the physical properties of **Floramac 10** versus silicones (page 6), and to determine whether or not these differences had an effect of the functionality of the finished product.

1. Biodegradable according to OECD 301B.

2. Final Reports available upon request. Figures and Tables can be found on the next two pages of this document.

3. When comparing Floramac 10 with SF 1550 (INCI: Phenyl Trimethicone), Floramac 10 was gelled with 10.0% Nomcort SG (INCI: Glyceryl Tribehenate/Isoeostearate/Eicosadioate) and 2.7% Cera Bellina #106P (INCI: Polyglycerol-3 Beeswax) to mimic the viscosity of the silicone; and from here on out will be referred to as Floramac 10+.

## Figures<sup>4</sup>:

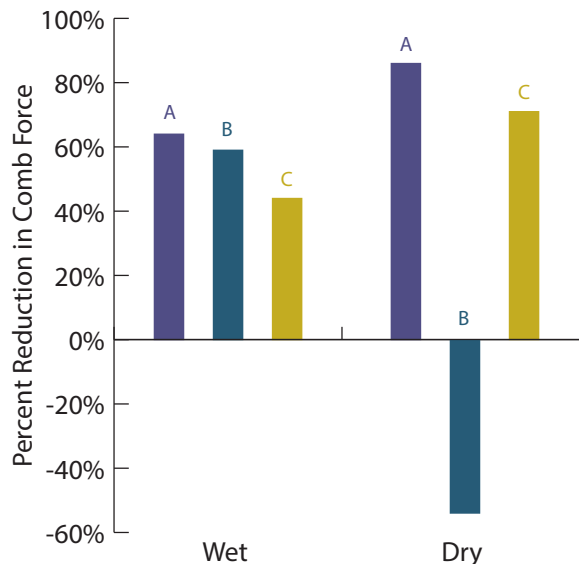
### Reduced Comb Force with Floramac 10 vs. Silicones:

**Leave-in hair serums** containing either Floramac 10, cyclopentasiloxane, or phenyl trimethicone, were applied to wet hair tresses. Wet and dry comb force measurements were taken at baseline and post-treatment. The results appear below in Figure 1.

**Figure 1. Silicone-Free Heat Protection Hair Serum<sup>5</sup>**

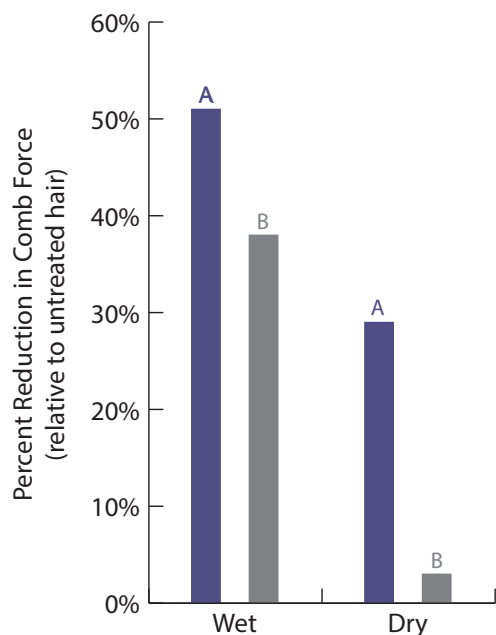
**Figure 1. Floramac 10** reduced wet comb force **up to 45% more** than the leave-in hair serums with silicones; and **reduced dry comb force up to 2.6 times** as much as the leave-in hair serums with silicones.<sup>6</sup> (See Claim Sheet 16-091.)

■ A - Floramac 10  
■ B - cyclopentasiloxane  
■ C - phenyl trimethicone



**Leave-in hair creams** containing either Floramac 10 or phenyl trimethicone, were applied to wet hair tresses. Wet and dry comb force measurements were taken at baseline and post-treatment. The results appear below in Figure 2.

**Figure 2. Healthy Shine Leave-In Hair Cream<sup>7</sup>**



**Figure 2. Floramac 10** reduced wet comb force **35% more** than the leave-in hair cream with phenyl trimethicone; and **reduced dry comb force more than 9 times** as much as the leave-in hair cream with phenyl trimethicone.<sup>8</sup> (See Claim Sheet 19-132.)

■ A - 5% Floramac 10  
■ B - 5% phenyl trimethicone

4. All studies were blinded, and carried out under controlled temperature and humidity conditions.

5. See page 8 for formula.

6. The inclusion of Floramac 10 resulted in statistically significant ( $p < 0.05$ ) reductions in wet comb force compared to phenyl trimethicone; and in statistically significant ( $p < 0.05$ ) reductions in dry comb force compared to both cyclopentasiloxane and phenyl trimethicone. All test articles resulted in statistically significant ( $p < 0.05$ ) changes in wet and dry comb force from baseline.

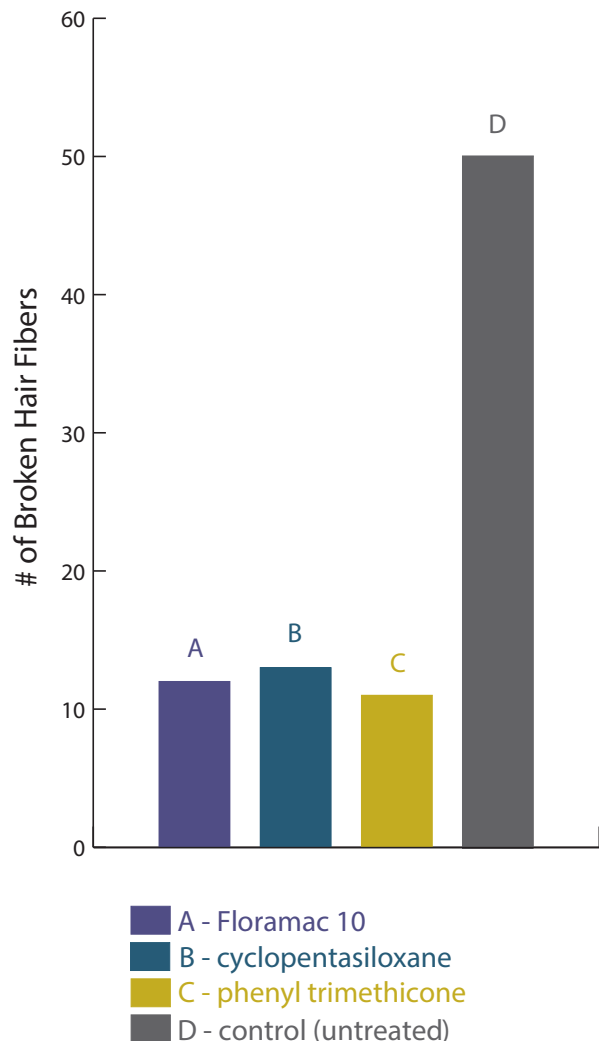
7. See page 7 for formula.

8. The inclusion of Floramac 10 resulted in statistically significant ( $p < 0.05$ ) reductions in wet and dry comb force compared to the inclusion of phenyl trimethicone and compared to baseline.

## Reduced Hair Breakage with Floramac 10 vs. Silicones:

**Leave-in hair serums** containing either Floramac 10, cyclopentasiloxane, or phenyl trimethicone were applied to wet hair tresses, which were then blow dried, flat ironed (100 passes), and combed 1000 times. The broken fibers were collected and counted. The results appear below in Figure 3.

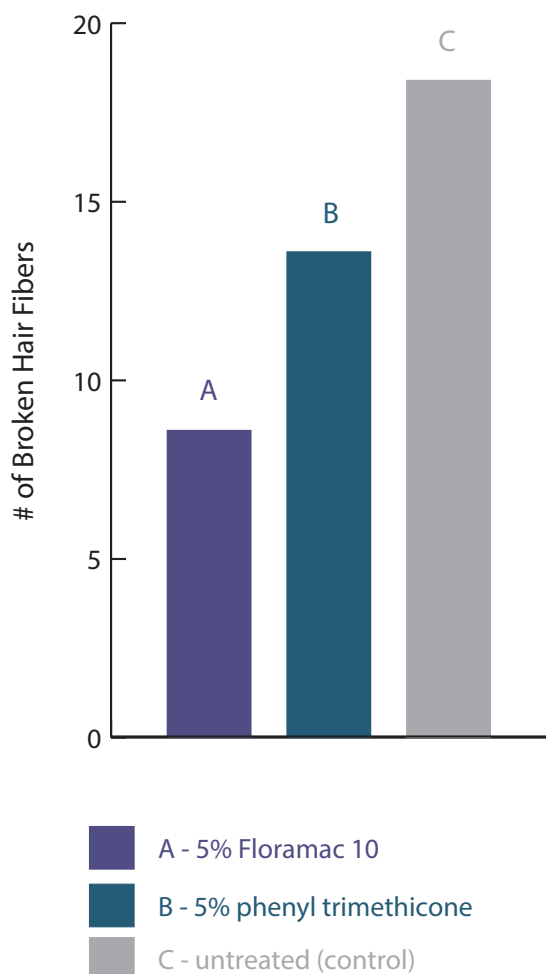
**Figure 3. Silicone-Free Heat Protection Hair Serum**



**Figure 3.** The leave-in hair serum containing **Floramac 10** reduced the number of broken hair fibers 76% better than untreated hair, and similarly to the leave-in hair serum with silicones.<sup>9</sup> (See Claim Sheet 17-095.)

**Leave-in hair creams** containing either Floramac 10 or phenyl trimethicone were applied to wet hair tresses, which were then blow dried, flat ironed (100 passes), and combed 1000 times. The broken fibers were collected and counted. The results appear below in Figure 4.

**Figure 4. Healthy Shine Leave-In Hair Cream**



**Figure 4.** The leave-in hair cream containing **Floramac 10** reduced the number of broken hair fibers 53% better than untreated hair, and similarly to the leave-in hair cream with phenyl trimethicone.<sup>10</sup> (See Claim Sheet 19-133.)

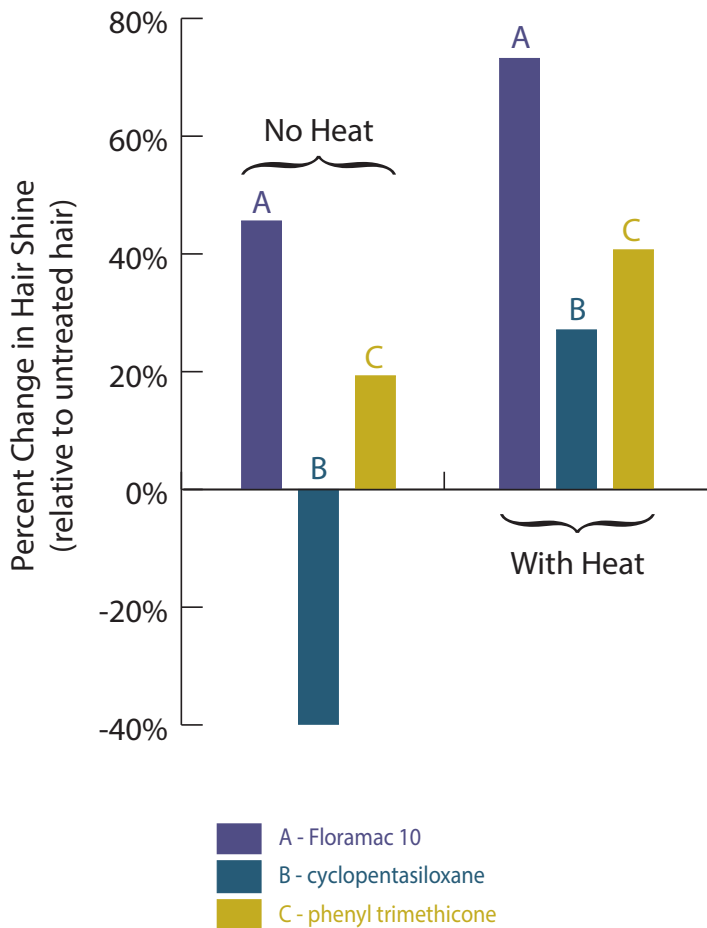
9. The inclusion of Floramac 10 resulted in statistically significant ( $p < 0.05$ ) fewer broken fibers compared to the control (untreated).

10. The inclusion of Floramac 10 resulted in statistically significant ( $p < 0.05$ ) fewer broken fibers compared to the control (untreated), and directionally significantly ( $p < 0.10$ ) fewer broken fibers compared to phenyl trimethicone.

## Increased Hair Shine with Floramac 10 vs. Silicones:

Naturally straight, brown hair tresses were treated with **leave-in hair serums** containing Floramac 10, cyclopentasiloxane, or phenyl trimethicone. Hair gloss measurements were taken before and after hair serum treatment, with heat (*i.e.* flat iron) and without heat. The results appear below in Figure 5.

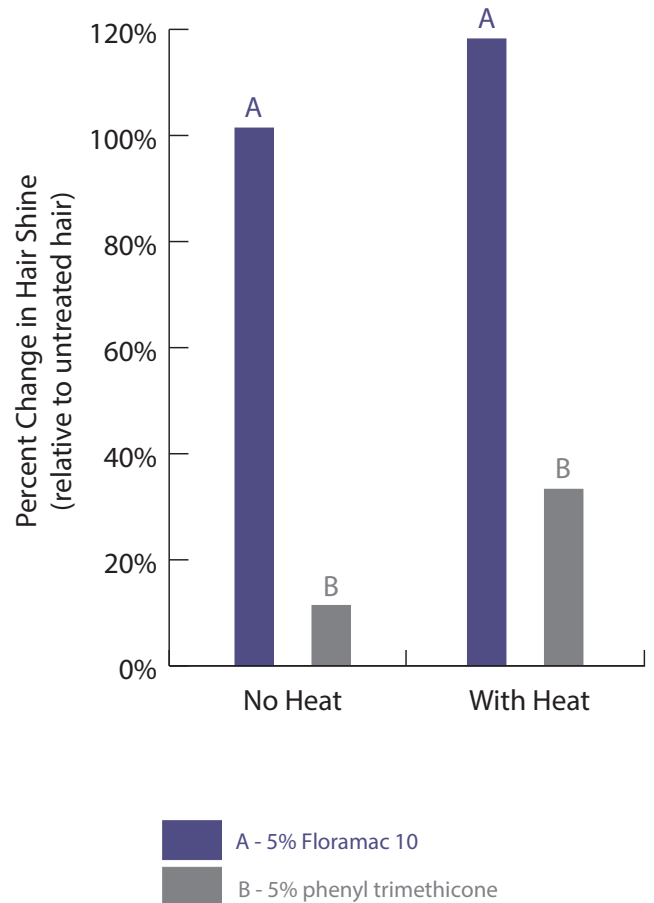
**Figure 5. Silicone-Free Heat Protection Hair Serum**



**Figure 5. Floramac 10 increased hair shine up to 2 times more** than silicones without the use of heat and **up to 1.7 times more** than silicones with the use of heat.<sup>11</sup> (See Claim Sheet 16-089.)

Naturally straight, brown hair tresses were treated with **leave-in hair creams** containing Floramac 10 or phenyl trimethicone. Hair gloss measurements were taken before and after hair cream treatment, with heat (*i.e.* flat iron) and without heat. The results appear below in Figure 6.

**Figure 6. Healthy Shine Leave-In Hair Cream**



**Figure 6. Floramac 10 increased hair shine up to 8 times more** than phenyl trimethicone without the use of heat and **up to 2.5 times more** than phenyl trimethicone with the use of heat.<sup>12</sup> (See Claim Sheet 19-130.)

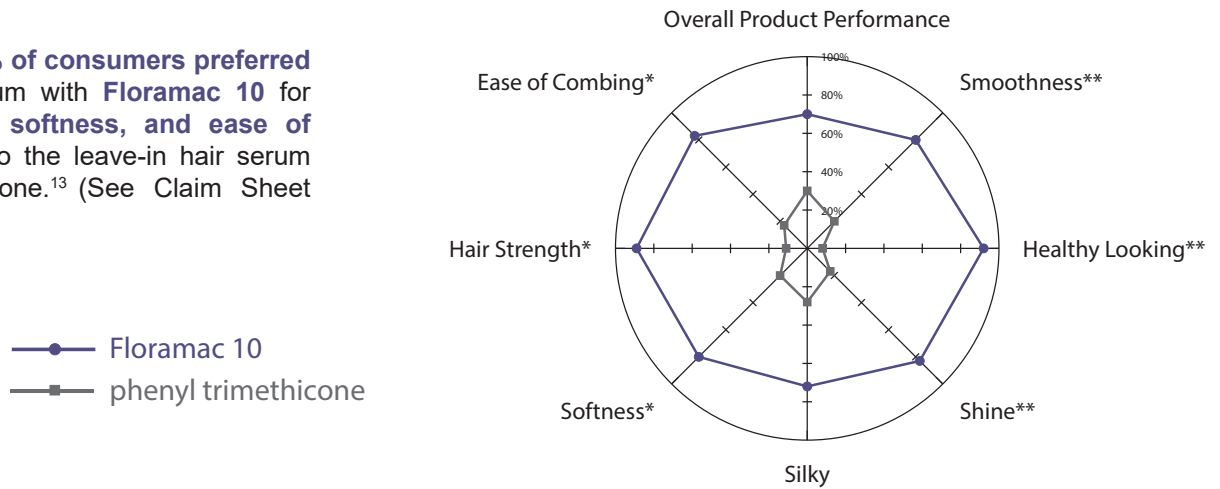
11. The inclusion of Floramac 10 resulted in statistically significant ( $p < 0.05$ ) increases in shine compared to each respective silicone-containing test article with heat, compared to the cyclopentasiloxane-containing test article without heat, and compared to baseline (with and without heat).  
 12. The inclusion of Floramac 10 resulted in statistically significant ( $p < 0.05$ ) increases in shine compared to phenyl trimethicone and baseline (with and without heat).

## Increased Consumer Preference with Floramac 10 vs. Silicones:

**Leave-in hair serums** containing either Floramac 10 or phenyl trimethicone were compared by consumers (n=24) in a half head, randomized, double-blind fashion after one week of every other day product use. The results appear below in Figure 7.

### Figure 7. Silicone-Free Heat Protection Hair Serum

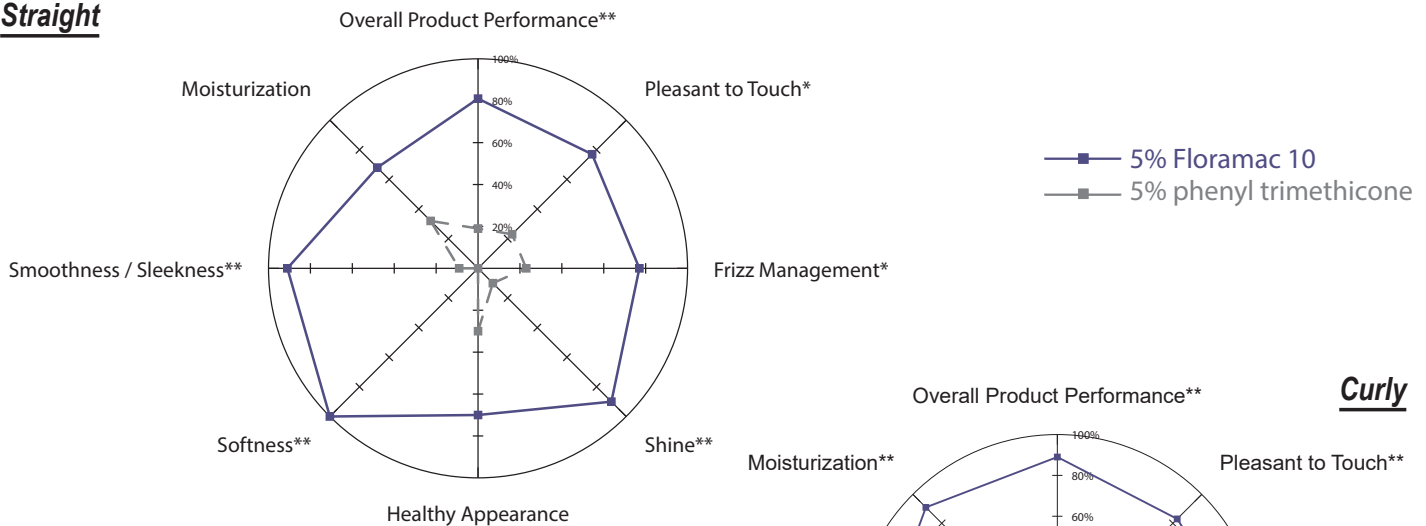
**Figure 7.** At least **80% of consumers preferred** the leave-in hair serum with **Floramac 10** for **smoothness, shine, softness, and ease of combing** compared to the leave-in hair serum with phenyl trimethicone.<sup>13</sup> (See Claim Sheet 17-094.)



**Leave-in hair creams** containing either Floramac 10 or phenyl trimethicone were compared by consumers (n=25) on straight and curly hair tresses in a randomized, double-blind fashion. The results appear below in Figures 8 and 9.

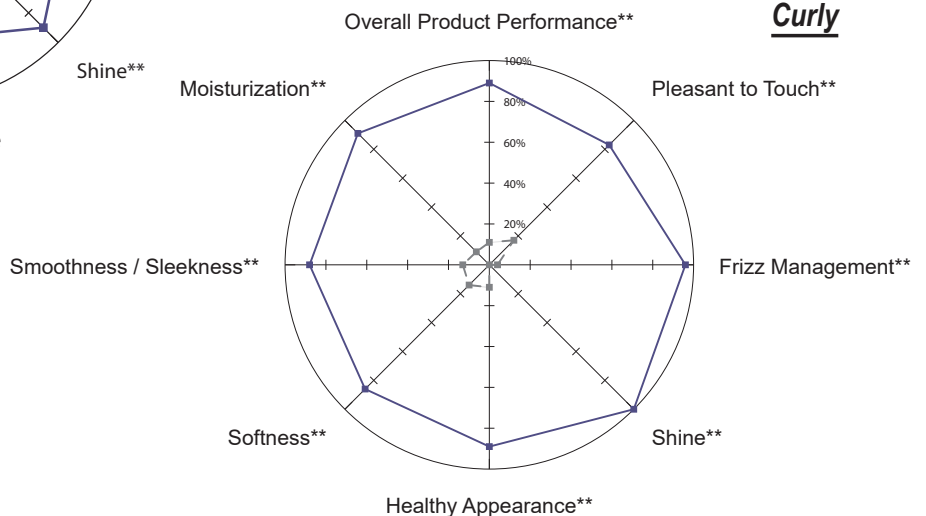
### Figures 8 and 9. Healthy Shine Leave-In Hair Cream

#### Straight



**Figures 8 and 9.** At least **88% of consumers preferred** the leave-in hair cream with **Floramac 10** for **smoothness, shine, and softness** compared to the leave-in hair cream with phenyl trimethicone on both straight and curly hair.<sup>13</sup> (See Claim Sheet 19-131.)

#### Curly

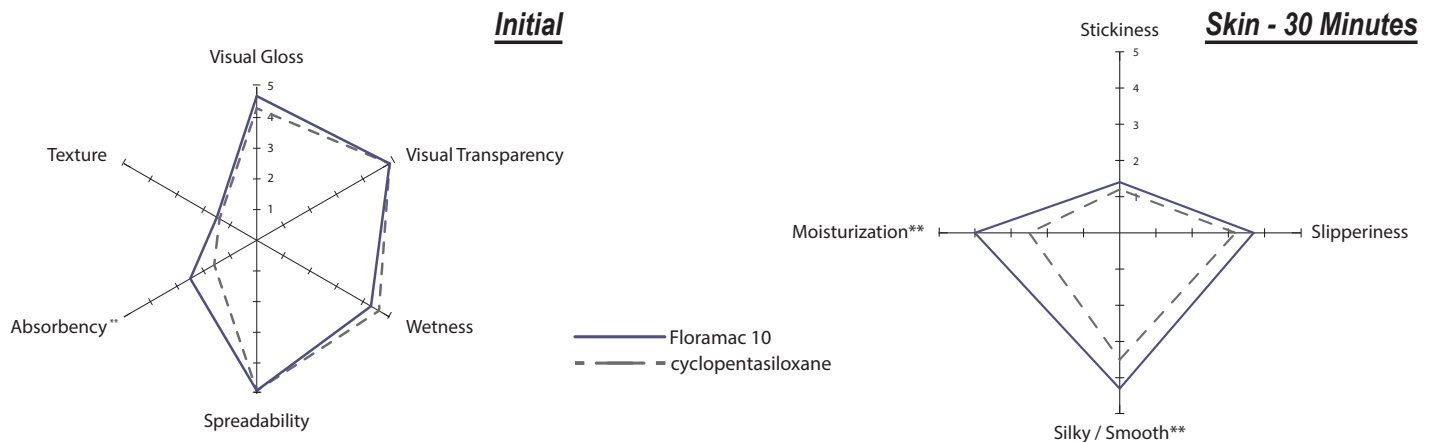


<sup>13</sup>. Statistical (\*\*) and directional (\*) significance was apparent where indicated (p<0.05 and p<0.1, respectively). The preference data does not include subjects that indicated no preference.

## Consumer Perception:

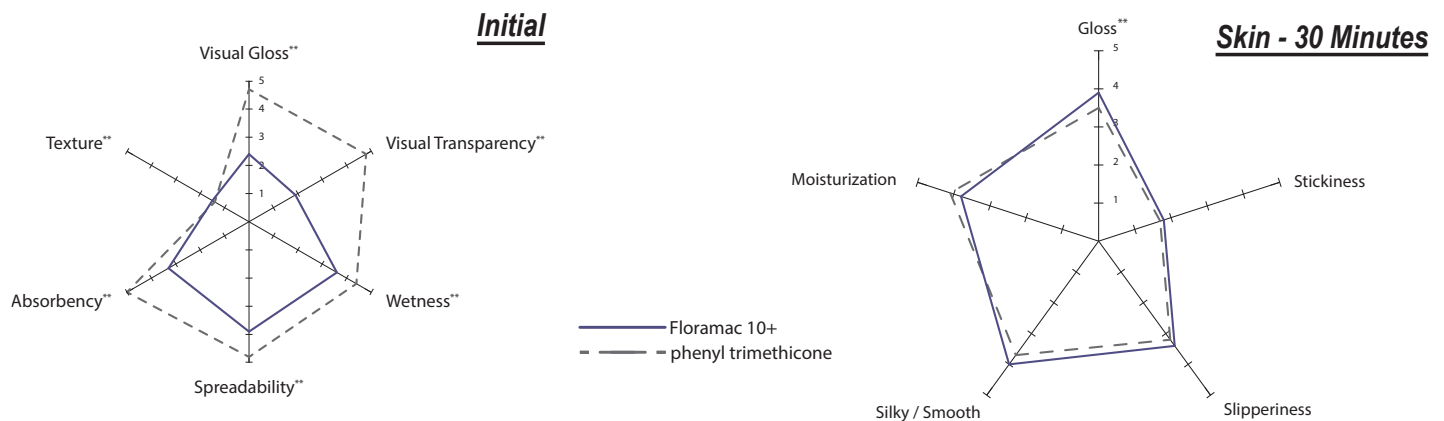
Each neat silicone / silicone alternative pair, was compared by consumers (n=27) in a randomized, double-blind fashion on a 1-5 scale for initial product evaluations and skin feel observations (30 minutes post-application). The higher the score, the more the listed attribute was perceived by consumers (e.g. a score of 5 for moisturization indicates very moisturized skin, whereas a score of 1 indicates dry skin). For the texture attribute, a higher score indicates a thicker silicone or silicone replacement. The results for each pair appear below in Figures 10 and 11.

**Figure 10. Floramac 10 vs. Cyclopentasiloxane**



**Figure 10.** Initially, there were few perceivable differences between Floramac 10 and cyclopentasiloxane. Thirty minutes post-application, **Floramac 10 left the skin perceivably more silky / smooth and moisturized.**<sup>11</sup>

**Figure 11. Floramac 10+<sup>2</sup> vs. Phenyl Trimethicone**



**Figure 11.** Initially, phenyl trimethicone was visually more glossy, more transparent, wetter, more absorbent, and thinner (texture); however, there were **few perceivable differences between the Floramac 10+ and phenyl trimethicone 30 minutes post-application to the skin.**<sup>11</sup>

## Conclusions:

**Floramac 10** can be used to mimic silicones within hair care products. Although physical properties and initial observations of the neat ingredients vary between **Floramac 10** and the respective silicones, skin-feel as perceived by the consumer was very similar. Additionally, hair care benefits such as increased shine, decreased breakage, heat protection, and reduced hair comb force were superior when **Floramac 10** was evaluated within leave-in hair serums and creams compared to silicones.

## Formula: Healthy Shine Leave-In Hair Cream<sup>14</sup>

Floramac 10 showcases its multifunctional abilities in this lightweight leave-in hair cream formula. Floramac 10 not only conditions the hair, but also reduces comb force (wet & dry), increases shine, and provides heat protection. Emulsun contributes a pleasing texture. This formulation is powerful enough to hydrate the hair, yet delicate enough to be used as leave-in conditioner without weighing down the hair.

Phase	Trade/Common Name	INCI Name	Manufacturer	% wt./wt.
A	Deionized Water	Water	----	q.s.
	Versene® Na2 Crystals	Disodium EDTA	The Dow Chemical Co.	0.10
B	<b>Floramac 10</b>	<b>Ethyl Macadamiate</b>	<b>Florotech</b>	<b>5.00</b>
	<b>Emulsun®</b>	<b>Ethyl Macadamiate Hydrogenated Sunflower Seed Oil Polyglyceryl-3 Esters (and) Hydrogenated Sunflower Seed Oil Glyceryl Esters (and) Cetearyl Alcohol (and) Sodium Stearoyl Lactylate</b>	<b>Florotech</b>	<b>3.00</b>
	SF1202 01P	Cyclopentasiloxane	Momentive Performance Materials	1.00
C	Deionized Water	Water	----	q.s.
	Carbopol® Ultrez 10 Polymer	Carbomer	The Lubrizol Corporation	0.25
D	AMP-Ultra® PC 2000, Neutralizing Amine	Aminomethyl Propanol	Angus Chemical Company	0.24
	Deionized Water	Water	----	q.s.
E	Glaudin Soy Benz	Hydrolyzed Soy Protein	BASF Corporation	0.65
	Preservative <sup>15</sup>	----	----	q.s.
	Fragrance <sup>16</sup>	----	----	q.s.
F	Citric Acid (10% Solution)	Citric Acid (and) Water	Archer Daniels Midland Co.	q.s.
			<b>Total</b>	<b>100.00</b>

### Procedure:

- Mix the Versene Na2 Crystals in the deionized water of Phase A with moderate propeller agitation and heat to 70-75°C.
- In a separate vessel, mix all of the ingredients of Phase B, except the SF1202 01P, at 70-75°C with moderate propeller agitation.
- When the mixture becomes uniform, add the SF1220 01P to Phase B at 75-80°C with moderate propeller agitation.
- When Phase B becomes uniform, add to Phase A with moderate propeller agitation at 75-80°C. Mix Phase AB until uniform and cool to 70-75°C.
- In a separate vessel, add the Carbopol Ultrez 10 Polymer to the deionized water of Phase C at 40-45°C without propeller agitation for self-wetting.
- When the Carbopol Ultrez 10 Polymer is completely wet, add to Phase AB at 70-75°C with moderate propeller agitation. Cool to 60°C with moderate propeller agitation.
- In a separate vessel, combine the ingredients of Phase D. At 60°C, add Phase D to Phase ABC with moderate propeller agitation. Cool to 45-50°C with moderate propeller agitation.
- At 45-50°C, add the ingredients of Phase E to Phase ABCD in the order listed with moderate propeller agitation.
- Add Phase F at 45-50°C with rapid propeller agitation. Cool to 40°C with moderate propeller agitation.
- Stop mixing at 40°C.

### Formula Properties:

Property	Result
pH	5-6
Viscosity	45-95kcP

14. INCI/Trade names must be verified with each manufacturer.

15. Preservative: Euxyl® PE 9010 [INCI: Phenoxyethanol (and) Ethylhexylglycerin] supplied by Schülke & Mayr

16. Fragrance: Sensuous Sandalwood Fragrance Oil supplied by Bramble Berry

## Formula: Silicone-Free Heat Protection Hair Serum<sup>14</sup>

From root to tip, this natural, silicone-free, leave-in serum protects hair from heat damage and increases shine. Non-volatile **Floramac 10** has the silky feel of silicone and can be used as a silicone alternative, or in combination with most silicones. **Floramac 10** also assists in the solubilization of benzophenone-3, and has been shown to increase hair shine more than silicones in a leave-in hair serum.

Phase	Trade/Common Name	INCI Name	Manufacturer	% wt./wt.
A	<b>Floramac 10</b>	<b>Ethyl Macadamiate</b>	<b>Floratech</b>	<b>40.00</b>
	Covi-Ox® T 70 C	Tocopherol	BASF Corporation	0.05
	Cera Bellina #106P	Polyglycerol-3 Beeswax	Koster Keunen, Inc	2.70
	Nomcort® SG	Glyceryl Behenate / Isostearate Eicosandioate	Nisshin Oillio Mills Ltd.	10.00
B	<b>Floramac 10</b>	<b>Ethyl Macadamiate</b>	<b>Floratech</b>	<b>q.s.<sup>17</sup></b>
C	<b>Floramac 10</b>	<b>Ethyl Macadamiate</b>	<b>Floratech</b>	<b>10.00</b>
	Zemea® Propanediol	Propanediol	DuPont Tate & Lyle BioProducts	1.00
	<b>Floraesters K-100® Jojoba</b>	<b>Hydrolyzed Jojoba Esters (and) Jojoba Esters (and) Water (Aqua)</b>	<b>Floratech</b>	<b>0.50</b>
	Salacos® PG-218	Polyglyceryl-10 Dioleate	Nisshin Oillio Mills Ltd.	0.60
	Salacos® DG-158	Polyglyceryl-2 Sesquicaprylate	Nisshin Oillio Mills Ltd.	0.30
	Polyaldo® 10-1-CC Kosher FG	Polyglyceryl-10 Caprylate / Caprate	Lonza, Inc.	0.55
	D	<b>Floramac 10</b>	<b>Ethyl Macadamiate</b>	<b>Floratech</b>
	Eusolex® 4360	Benzophenone-3	EMD Chemicals Inc.	1.00
E	Fragrance <sup>18</sup>	-----	-----	q.s.
	Eldew® PS-203	Phytosteryl / Octyldodecyl Lauroyl Glutamate	Ajinomoto Co. Inc.	0.50
	Preservative <sup>19</sup>	-----	-----	q.s.
			<b>Total</b>	<b>100.00</b>

### Procedure:

- In the main vessel, mix all the ingredients of Phase A at 80°C with moderate propeller agitation.
- When the mixture becomes uniform, begin cooling to 38-40°C. Stop mixing when the mixture reaches 45°C. Continue evenly cooling to 38-40°C. Phase A should become a soft, pasty wax at 38-40°C.
- Add Phase B to Phase A at 35-38°C with rapid propeller agitation. (Overheating can break the viscosity of the finished product.)
- In a separate vessel, mix all the ingredients of Phase C, except the Floramac 10, with low to moderate propeller agitation at room temperature.
- When the mixture is clear and uniform, slowly add the Floramac 10, and continue mixing with low to moderate propeller agitation at room temperature.
- Add Phase C to Phase AB at 35-38°C with rapid propeller agitation.
- In a separate vessel, mix the ingredients of Phase D with moderate propeller agitation at 35-38°C.
- Add Phase D to Phase ABC at 35-38°C with rapid propeller agitation. Once Phase ABCD becomes uniform, begin cooling to room temperature. Stop propeller mixing at 35°C. Continue evenly cooling to room temperature.
- Add Phase E to Phase ABCD in the order listed at room temperature with rapid propeller agitation. Continue mixing until uniform.

### Formula Properties:

Property	Result
Viscosity	15500-19700cP

## Ingredient Information

24/7 Online

**iLabel**<sup>®</sup>  
www.floratech.com/info



Floramac 10

<sup>17</sup> q.s. to 100%.

<sup>18</sup> Fragrance: Enchanted Orchid S9-47005 supplied by Premier Specialties.

<sup>19</sup> Preservative: Bronidox® 1160 [INCI:Phenoxyethanol] supplied by BASF