

**A Multifunctional Ingredient for Next-Generation  
Skin Care Products**

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Today's savvy buyers of skin care products expect aesthetics and performance in a single package. Products that improve the skin's appearance and hide the effects of aging drive the premium skin care market, propelled by an aging baby boomer population. Purchasing trends set by these consumers indicate that claims of counteracting or masking signs of aging in a gentle and believable way will play an increasingly dominant role in this highly competitive market.

For skin care marketers, the key is to present products that are easy to use and effective in small quantities. Those that perform more than one function—imparting color while controlling sebum, for example—capture interest and stand out from the competition. Novel sensory profiles are essential as well. Creams that spread easily and leave a distinctive silky, smooth film on skin, reduce the appearance of fine lines or provide a matte appearance stand a greater chance of success with consumers.

### An Evolving Technology

Silicones have been useful ingredients in skin care products for more than fifty years. These versatile materials are recognized for their emolliency, wetting and spreading characteristics and ability to reduce tackiness. As silicone technology evolves, materials increasingly offer multifunctional, high performance properties. Silicone elastomers are among the newest performance-enhancing ingredients in this category.

Silicone elastomers for personal care applications were first developed in Japan.<sup>1</sup> The original material was an elastomer powder prepared by cryogenic grinding of cured silicone elastomer. Several years later, Dow Corning used suspension polymerization to produce *Dow Corning*<sup>®</sup> 9506 Powder (INCI: dimethicone/vinyl dimethicone crosspolymer). Elastomer pastes composed of silicone elastomers swollen by solvents such as cyclomethicone followed. Today, the spectrum of available silicone elastomers is broad.

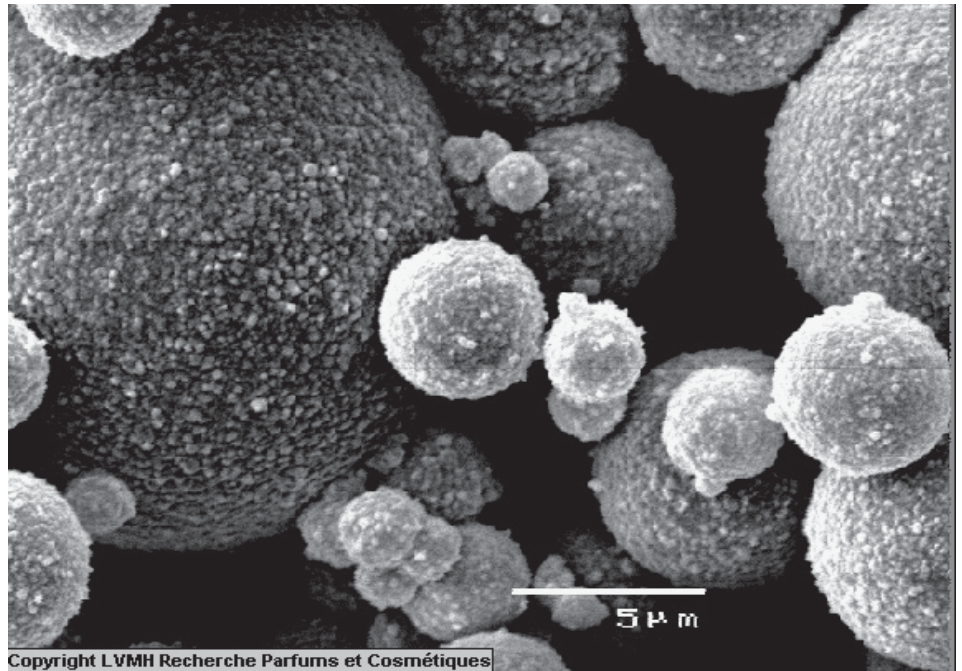


Figure 1. Larger silicone elastomer spheres are coated with smaller silica particles, which have a lighter appearance in this photo. (SEM image courtesy of and copyright by LVMH Labs.)

Cross-linking differentiates silicone elastomers from linear silicone polymers.<sup>1</sup> Many silicone elastomers are made from linear silicone polymers with reactive sites along their polymer chains. These sites react with the cross-linker to form connections between the chains.

The suspension polymerization process used to form silicone elastomer powder begins with an aqueous emulsion of the dimethicone polymer and a cross-linker. This suspension typically has a droplet size of less than five microns and is usually stabilized with a

small amount of surfactant. A catalyst initiates cross-linking, and heating drives the reaction to completion. This cross-linking process changes the liquid droplets into small spherical particles of silicone elastomer, which can be spray dried to produce a powder.

### A New Sensory Experience

Compared to silicone fluids, silicone elastomers have a different feel on the skin. This unique feel has been described as “dry,” “smooth,” “silky,” and “powdery.” The sensory properties of the elas-

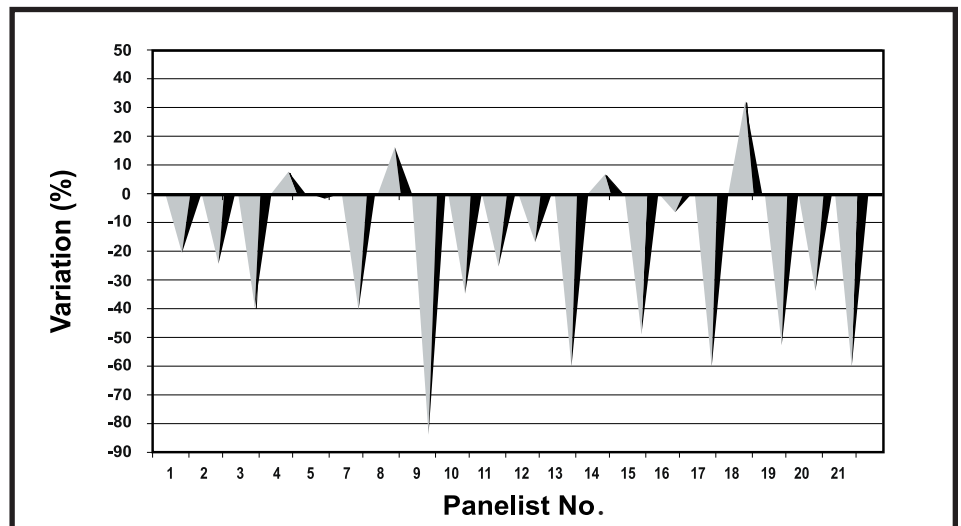


Figure 2. Results of wrinkle-masking evaluations.

## Formulation 1. Water-in-Silicone Skin Cream (00653)

Ingredient	Wt. %	Trade Name/Supplier
<b>Phase A</b>		
1. Dimethicone/Vinyl Dimethicone Crosspolymer (and) Silica	4	Dow Corning® 9701 Cosmetic Powder
2. Cyclopentasiloxane (and) PEG/PPG-18/18 Dimethicone	10	Dow Corning® 5225C Formulation Aid
3. Cyclopentasiloxane	16	XIAMETER® PMX-0245 Cyclopentasiloxane
4. PPG-3 Myristyl Ether	0.5	Promyristyl PM-3/Croda, Inc.
<b>Phase B</b>		
5. Distilled Water	to 100	
6. Glycerin	5	
7. Sodium Chloride	2	
8. Propylene Glycol (and) Diazolidinyl Urea (and) Methylparaben (and) Propylparaben	0.5	Germaben II/ISP

### Procedure

1. Mix phase A ingredients.
2. Mix phase B ingredients.
3. Add phase B to phase A slowly under strong mixing.
4. Homogenize using a high shear mixer (Ultraturrax or Silverson type).

toomer particles also are affected by their spherical shape and a “ball-bearing” effect on the skin, which produces a dry, lubricating feel.

The aesthetics of silicone elastomers and their ability to absorb various oils and sebum are among their most important properties for skin care applications. One of the newest materials is a silicone elastomer cosmetic powder, *Dow Corning® 9701 Cosmetic Powder* (INCI: dimethicone/vinyl dimethicone crosspolymer (and) silica), which consists of silicone elastomer spheres coated with silica.

Besides absorbing sebum, the new powder provides wrinkle-masking benefits, and its spherical structure is responsible for free-flowing properties without agglomeration, so handling and formulation are easy. Predispersion is not required, even in the presence of pigments. The silicone elastomer structure makes it possible to incorporate the powder into a range of skin care and color cosmetic formulations, including hydrogels, without using sophisticated processes or equipment. Figure 1 illustrates the spheres and their silica coating. The average particle size of

the spheres is from approximately 1 to 10 microns.

*Dow Corning® 9701 Cosmetic Powder* can be incorporated into formulations for creams, lotions, gels, face masks and products that exfoliate or offer sun care, whitening or anti-aging benefits. Numerous potential applications exist in color cosmetics, including pressed and loose foundation powders and makeup, eye shadow, blushers, liquid foundations, lipsticks and bronzers.

### Hiding Wrinkles and Controlling Skin Oils

*Dow Corning® 9701 Cosmetic Powder* has multifunctional benefits that give formulators new options for creating novel products for the premium skin care market.

The wrinkle-masking effects of this material were evaluated through in

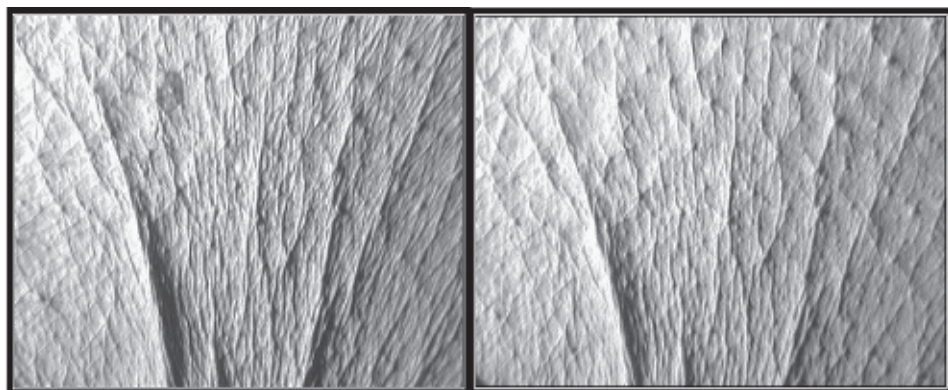


Figure 3. A water-in-silicone cream with 4% silicone elastomer powder improved the appearance of crow's foot wrinkles. Left, before treatment; right, 1 hr after treatment. (Panelist 21 from Figure 2.)

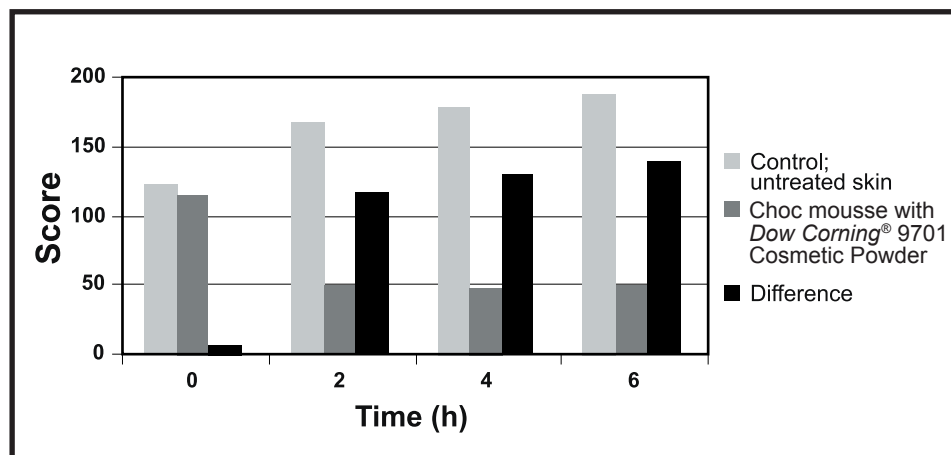


Figure 4. Results of sebumeter readings using chocolate mousse formulation containing the elastomer powder.

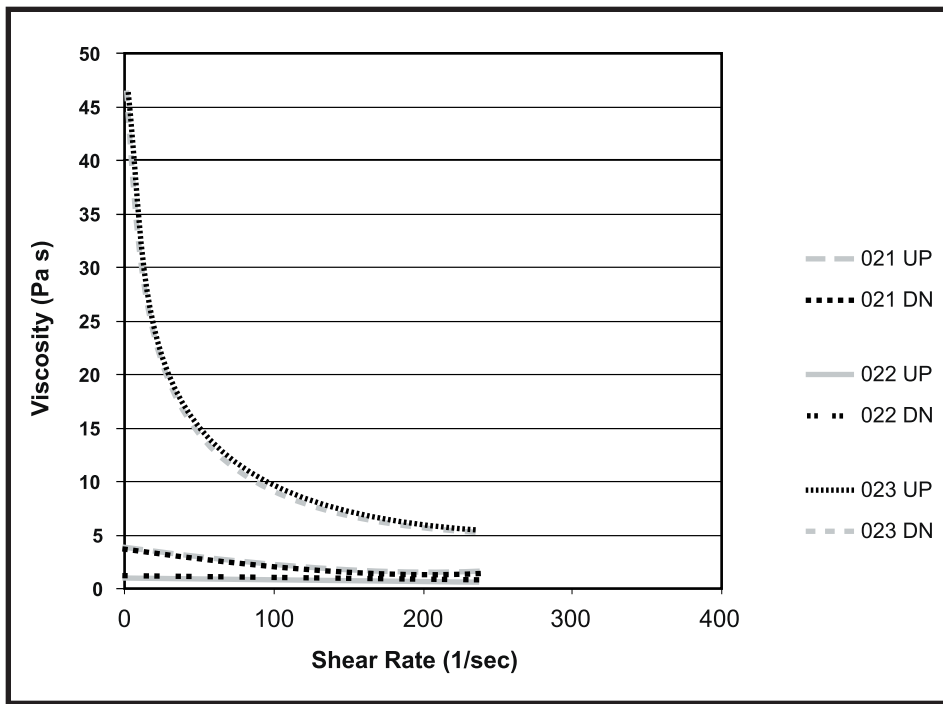


Figure 5. Shear-thinning properties of gel foundation formulation (021= gel foundation without silica-coated silicone elastomer powder; 022= gel foundation without water; 023=gel foundation containing 7.1% silica-coated silicone elastomer powder).

vivo tests based on a documented protocol. A print of the crow's foot area was taken for each panelist before and one hour after treatment, and the prints were compared by image analysis. Results showed a lifting effect on panelists' crow's foot wrinkles and an immediate improvement of the skin appearance.

Formulation 1 represents the most efficient formula tested, a prototype water-in-silicone cream containing 4% elastomer powder. The same formula containing 10% elastomer powder did not show additional improvement in the appearance of the crow's foot wrinkles.

Figure 2 shows the results of the wrinkle-masking evaluations. An improvement of wrinkles up to 84% occurred for 75% of the subjects, with a significant total mean decrease of 28% ( $p < 0.01$ ) for the panelists shown on the graph.

Figure 3 shows before and after images based on the treatment for crow's foot wrinkles with the water-in-silicone skin cream.

The ability of silicone elastomers to absorb oils other than silicones has led to their applications as oil control ingredients in facial products. The absorption mechanism can also be useful for its mattifying effect on the skin. The evaluation in Figure 4 was performed using the chocolate mousse foundation of Formulation 6. *Dow Corning*<sup>®</sup> 9701 Cosmetic Powder shows good sebum absorption properties.

In addition to its ability to absorb sebum, the silica-coated elastomer can also absorb significant amounts of fluids. The presence of the silica coating on the surface of the elastomer spheres (*Dow Corning*<sup>®</sup> 9701 Cosmetic Powder) does not negatively impact absorption ability compared to the silicone elastomer without the coating (*Dow Corning*<sup>®</sup> 9506 Powder).

## Formulation 2. Gel Foundation (00838)

Ingredient	Wt. %	Trade Name/Supplier
<b>Phase A</b>		
1. Cyclopentasiloxane	38.43	XIAMETER <sup>®</sup> PMX-0245 Cyclopentasiloxane
2. Lauryl PEG/PPG-18/18 Methicone	1.5	<i>Dow Corning</i> <sup>®</sup> 5200 Formulation Aid
3. Cyclopentasiloxane (and) Dimethicone Copolyol	23.5	<i>Dow Corning</i> <sup>®</sup> BY 11-030
4. Dimethicone (and) Trisiloxane	7.6	XIAMETER <sup>®</sup> PMX-1184 Silicone Fluid
5. Isononyl Isononanoate	7.6	Isononyl Isononanoate/LCW Sensient
6. Phenoxyethanol (and) Methylparaben (and) Ethylparaben (and) Butylparaben (and) Isobutylparaben (and) Propylparaben	0.3	Dekaben/Jan Dekker
<b>Phase B</b>		
7. CI 77499 (and) Triethoxycaprylylsilane	0.2	Unipure Black LC 989 AS-EM/LCW Sensient
8. CI 77891 (and) Triethoxycaprylylsilane	4.4	Unipure White LC 981 AS-EM/LCW Sensient
9. CI 77492 (and) Triethoxycaprylylsilane	0.9	Unipure Yellow LC 182 AS-EM/LCW Sensient
10. CI 77491 (and) Triethoxycaprylylsilane	0.4	Unipure Red LC 381 AS-EM/LCW Sensient
11. Cyclopentasiloxane	5.9	XIAMETER <sup>®</sup> PMX-0245 Cyclopentasiloxane
<b>Phase C</b>		
12. Dimethicone/Vinyl Dimethicone Crosspolymer (and) Silica	7.1	<i>Dow Corning</i> <sup>®</sup> 9701 Cosmetic Powder
13. Mica (and) Iron Oxides (and) Titanium Dioxide	0.5	Lumiral/LCW Sensient
14. Silica Dimethyl Silylate	1	Covasilic 15/LCW Sensient
<b>Phase D</b>		
15. Water	0.67	

### Procedure

- Mix phase A ingredients until all ingredients are completely dissolved.
- Premix the pigments in XIAMETER<sup>®</sup> PMX-0245 using Ultra-Turrax, homogenize until uniform.
- Add phase B to phase A and homogenize.
- Mix phase C ingredients.
- Add phase C to AB blend, slowly and with turbulent mixing.
- Continue to stir for 1 hour at 1400 rpm.
- Homogenize using a high shear mixer.
- Add phase D under stirring, and reduce the stirring speed (formulation will rapidly increase viscosity). Continue to stir for additional 5-10 minutes. Final viscosity is around 35,000-40,000 cps (Spn7, 20 rpm).

### Formulation 3. Silicone-in-Water Cream (00652)

Ingredient	Wt.	%Trade Name/Supplier
<b>Phase A</b>		
1. Cyclopentasiloxane	11	XIAMETER® PMX-0245 Cyclopentasiloxane
2. PEG-12 Dimethicone	4	Dow Corning® 5329 Performance Modifier
3. Dimethicone/Vinyl Dimethicone Crosspolymer (and) Silica	10	Dow Corning® 9701 Cosmetic Powder
4. Lauryl PEG/PPG-18/18 Methicone	0.5	Dow Corning® 5200 Formulation Aid
<b>Phase B</b>		
5. Deionized Water	72.5	
<b>Phase C</b>		
6. Polyacrylamide (and) C13-14 Isoparaffin (and) Laureth-7	2	Sepigel 305/Seppic S.A.

#### Procedure

1. Mix phase A ingredients.
2. Add phase A to phase B with high-speed stirring (2-3 min with Silverson).
3. Add phase C with mixing.

### Rheological Versatility

Because of their ability to swell when combined with solvents, silicone elastomers are recognized as effective oil-phase thickeners. Compared to other organic powders, the silicone elastomer powder shows superior viscosity enhancement (based on the same use level of powder in the same formulation). For example, in a water-in-silicone cream that incorporated 5% silicone elastomer powder, we observed a viscosity enhancement of approximately 33% over a control formulation without the elastomer powder.

Figure 5 shows the useful shear-thinning properties of *Dow Corning*® 9701 Cosmetic Powder. The shear-thinning properties of the gel foundation in Formulation 2, which has a high viscosity, allow use of a pump dispenser. The thick, creamy gel transforms to a fluid-like texture and is easy to spread for good skin coverage and an even tone. The foundation incorporates the elastomer powder in combination with a silicone polyether emulsifier.

### Novel Sensory Effects

The silicone elastomer powder can provide sensory benefits and novel textures, while remaining cost effective because low use levels are required to impart sensory effects. Based on evaluations of a prototype water-in-silicone system, the required

use level was 4%, and for a prototype hydrogel formulation 3%. In a silicone-in-water formulation that incorporated an organic coemulsifier, the required use level was 3%, and when using silicone as a coemulsifier the required use level was 2%.

Formulation 3 demonstrates the addition of *Dow Corning*® 9701 Cosmetic Powder to a prototype silicone-in-water cream using *Dow Corning*® 5329 Performance Modifier, a silicone polyether (INCI: PEG-12 dimethicone), as an emulsifier. Sensory profiles showed a decrease in gloss on the skin when

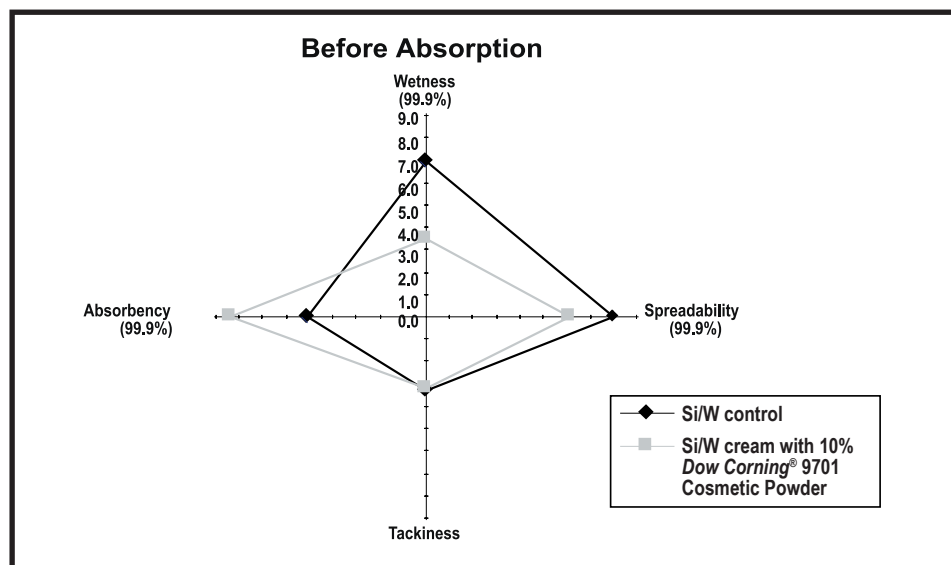


Figure 6. Sensory profile of silicone-in-water cream before absorption.

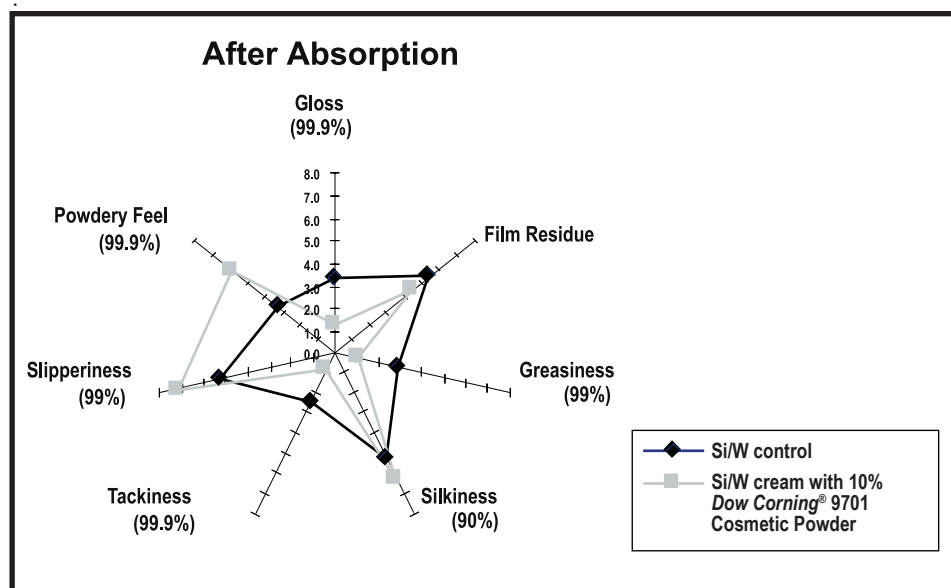


Figure 7. Sensory profile of silicone-in-water absorption.

## Formulation 4. ShimmerSoft Perfume Powder (00650)

Ingredient	Wt. %	Trade Name/Supplier
1. Dimethicone/Vinyl Dimethicone Crosspolymer (and) Silica	88	Dow Corning® 9701 Cosmetic Powder
2. Fragrance	10	CelineCe/Symrise
3. Calcium Sodium Borosilicate (and) Titanium Dioxide	2	Reflects Pinpoints of Pearl/Engelhard Corporation

### Procedure

- Mix ingredients at room temperature with an appropriate blender.

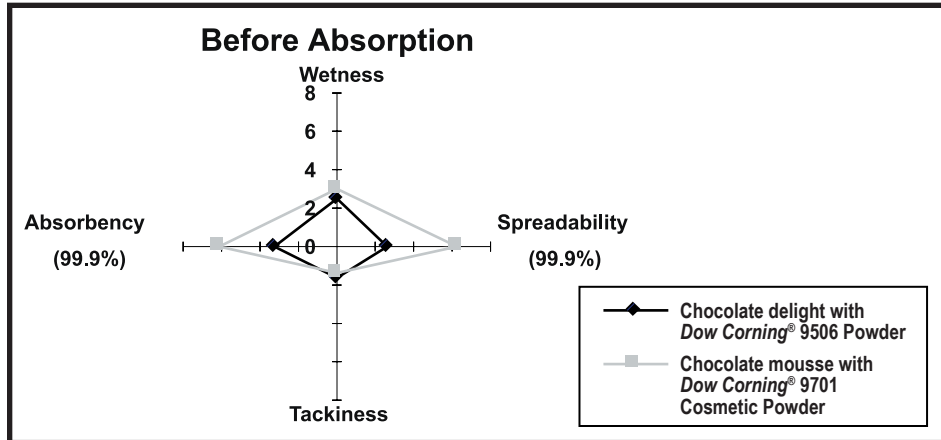


Figure 8. Sensory profile of foundation formulations containing Dow Corning® 9506 Powder (without silica coating) and Dow Corning® 9701 Cosmetic Powder (with silica coating); before absorption.

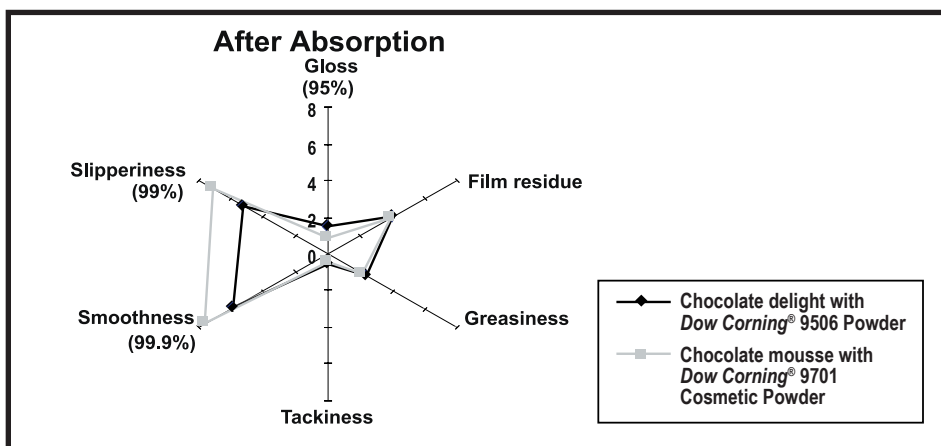


Figure 9. Sensory profile of foundation formulations containing Dow Corning® 9506 Powder (without silica coating) and Dow Corning® 9701 Cosmetic Powder (with silica coating); after absorption.

## Formulation 5. Tinted Body Powder (00654)

Ingredient	Wt. %	Trade Name/Supplier
1. CI 77891 Dimethicone	13.43	SAT-T-47051/US Cosmetics Corp.
2. CI 77491 Dimethicone	0.97	SAT-R-33128/US Cosmetics Corp.
3. CI 77492 Dimethicone	2.43	SAT-Y-338073/US Cosmetics Corp.
4. CI 77499 Dimethicone	0.17	SAT-B-33134/US Cosmetics Corp.
5. Dimethicone/Vinyl Dimethicone Crosspolymer	17	Dow Corning® 9506 Powder
6. Dimethicone/Vinyl Dimethicone Crosspolymer (and) Silica	34	Dow Corning® 9701 Cosmetic Powder
7. Fragrance	2.5	Coconut Paradise/Symrise
8. Perfume	2.5	Vanilla/Expressions Parfumees
9. Cyclopentasiloxane	25	XIAMETER® PMX-0245 Cyclopentasiloxane
10. Calcium Sodium Borosilicate (and) Titanium Dioxide	2	

### Procedure

- Grind the pigments together.
- Add ingredients in order and mix at room temperature using an appropriate blender.

compared to the same formulation without the powder. After absorption, the formula with the silicone elastomer showed lower tackiness and greasiness as well as greater slipperiness and a significant improvement in the powdery feel of the product (Figures 6 and 7).

Because it can absorb high levels of fluids, the elastomer powder offers a new approach to delivering perfume. Formulation 4 combines fragrance delivery with a novel sensory effect in the form of a light, yet absorbent powder perfume. The elastomer powder can also be used to deliver glitter and fragrance for a shimmering, and silky effect on skin.

Dow Corning® 9701 Cosmetic Powder can also contribute to unique color cosmetics. The primary ingredients in Formulation 5 are the silicone elastomer powder and pigments. The free-flowing and nonagglomeration properties of the silicone elastomer make it possible to create a tinted body powder with the elastomer's distinctive silky aesthetics. In this formulation, the powder is directly ground with the pigments.

The foundation in Formulation 6 has a texture similar to that of a chocolate mousse. In addition to the basic texture, Dow Corning® 9701 Cosmetic Powder provides sebum absorption properties as illustrated in Figure 4. This tinted cream formulation has the texture, color and aroma of chocolate mousse.

Compared to the same formula in which Dow Corning® 9506 Powder (without silica coating) is substituted, the initial formula is easier to spread, smoother and more slippery. It shows enhanced and faster sebum absorption, more even pigment dispersion and improved homogeneity of the color on the skin with less gloss. Figures 8 and 9 illustrate the sensory characteristics of the two formulations, before and after absorption.

## Formulation 6. Chocolate Mousse (00650)

Ingredients	Wt. %	Trade Name/Supplier
<b>Phase A</b>		
1. CI 77891 Dimethicone	0.528	SAT-T-47051/US Cosmetics Corp.
2. CI 77491 Dimethicone	0.456	SAT-R-33128/US Cosmetics Corp.
3. CI 77492 Dimethicone	0.732	SAT-Y-338073/US Cosmetics Corp.
4. CI 77499 Dimethicone	0.284	SAT-B-33134/US Cosmetics Corp.
<b>Phase B</b>		
5. Dimethicone/Vinyl Dimethicone Crosspolymer (and) Silica	23	Dow Corning® 9701 Cosmetic Powder
6. Zinc Oxide (and) Dimethicone	6	Z-Cote HP-1/BASF Corporation
<b>Phase C</b>		
7. Distilled Water	4	
8. Water (and) Propylene Glycol (and) Helianthus Annuus (Sunflower) Seed Oil (and) Theobroma Cacao (Cocoa) Extract (and) Sclerotium Gum	1	Cocoa Phytolait/Alban Muller International
9. Dimethicone	22.75	XIAMETER® PMX-200 Silicone Fluid 5 cSt
10. Cyclopentasiloxane	22.75	XIAMETER® PMX-0245 Cyclopentasiloxane
11. Cyclopentasiloxane (and) Dimethiconol	5	XIAMETER® PMX-1501 Fluid
12. Cyclopentasiloxane (and) Dimethicone Crosspolymer (and) Dimethicone/Vinyl Dimethicone Crosspolymer (and) Dimethiconol	5	Dow Corning® 9546 Silicone Elastomer Blend
13. Theobroma Cacao (Cocoa) Seed Butter	1	Cocoa Butter/Alban Muller International
14. Cocos Nucifera (Coconut) Oil (and) Gardenia Tahitensis Flower Extract	1	Monoi de Tahiti Butter - Fragranced/ Pacifique Sud Cosmetique
15. Tocopheryl Acetate	0.5	dl-alpha-Tocopheryl Acetate/DSM Nutritional Products
16. Polysilicone-15	5	Parsol-SLX/DSM Nutritional Products
<b>Phase D</b>		
17. Fragrance	1	Chocolat Creme 0310585/Expressions Parfumees

### Procedure

1. Pregrind the pigments.
2. Combine phase A and phase B in a covered vessel and mix with high-speed dispersing action until all the powders are uniform. For larger quantities, use nitrogen gas to make the head space of the mixer inert as a safety precaution.
3. To the main mixing vessel, add the ingredients of phase C and heat with mixing to 45°C, or until the cocoa butter is melted and the ingredients are uniform.
4. Add the combined phases A and B to the mixer in increments. Good scraping and high-speed dispersing action are recommended.
5. Add fragrance.

## Conclusions

When wrinkle-masking, sebum control, novel textures and superior sensory profiles are required, *Dow Corning® 9701 Cosmetic Powder* contributes useful properties for skin care and color cosmetic applications. Because this multifunctional material is also easy to process, formulators have expanded opportunities to create the next generation of high-performance, unique product forms to meet the needs of a growing premium skin care market.

## Reference

1. Starch, M., New developments in silicone elastomers for skin care, Dow Corning internal document, form 27-1060B-01 (2002).

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