

The image shows a banner for 'Silicone Spectator'. On the left, there are several pieces of translucent, crystalline silicone material. The text 'Silicone Spectator' is prominently displayed in a large, bold, orange font. Below it, the contact information is listed in a smaller orange font: 'P.O. Box 715', 'Dacula, GA 30019', and 'www.SiliconeSpectator.com'. A short paragraph in white text describes the newsletter as an electronic publication in silicone chemistry, welcoming comments and articles. At the bottom right, it states 'Silicone Spectator is a trademark of SurfaTech Corporation ©2008 All rights reserved'.

# Silicone Spectator

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[www.SiliconeSpectator.com](http://www.SiliconeSpectator.com)

Silicone Spectator™ is electronic newsletters in the field of Silicone Chemistry, placed on the web four times a year. We welcome comments, articles and information on the content of this newsletter.

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## *August 1, 2008 Supplemental Edition*

**Editor's note:** In its quest to provide the most up to date information on new silicone technology, the Silicone Spectator® endeavours to provide the latest information on new products and technologies. This information is provided as supplements to the quarterly newsletters. The Silicone Spectator® welcomes articles from the public introducing new technologies of interest to those in the silicone community of practice.

Andrew O'Lenick Editor August 1, 2008

**This supplement to the Silicone Spectator is provided by Siltech LLC.**

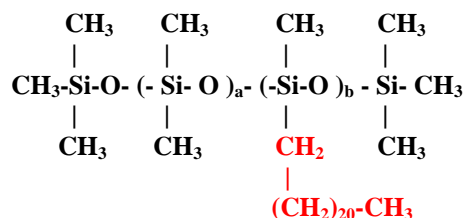
### **Multi Domain Silicone Waxes – A New Class of Ingredients for Personal Care**

#### Background

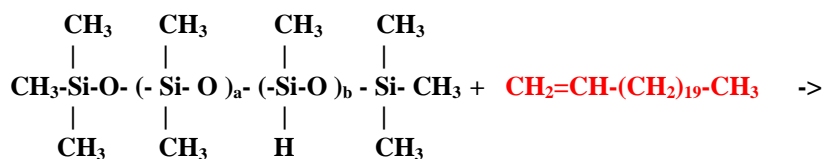
Dimethicone is difficult material to incorporate into many formulations since it is insoluble in both water and oil. Silicones lower surface tensions and provide elegant skin feel to many formulations when added to the oil phase. One of the most important physical attributes of a cosmetic product is skin feel. This attribute is a major consumer perceptible property of virtually all cosmetic products. Two major components in achieving good skin feel are cushion and play time. The ability to alter the cushion and play time in a cosmetic product is a highly prized formulation skill. If one rubs oil on the skin of the hand with the index finger, the Cushion is "the gap" between the finger and hand that the oil occupies. Play time is the length of time cushion exists. Many organic oils cushion and playtime are directly related. Materials with a lot of cushion have a lot of play time. Silicones added to formulations lower surface tension and provide elegant skin feel. The proper selection of alkyl silicone will allow for the ability to reduce play time without effecting cushion.

## Alkyl Silicones Chemistry

Alkyl dimethicone polymers are a class of amphiphilic silicones that have both an alkyl (in RED) and a silicone portion (in Black) present in the same molecule. Mutually insoluble groups include water, oil, silicone and fluorocarbon.

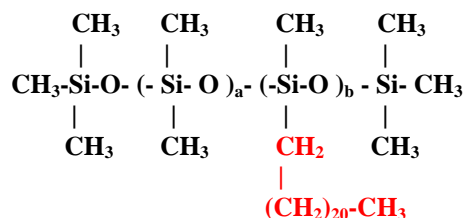


Alkyl dimethicone compounds are made by the reaction of a silanic hydrogen containing polymer and an alpha olefin.



Silanic Hydrogen polymer

C22 alpha olefin



Behenyl dimethicone

## Physical Properties

### Solubility

Alkyl silicones are insoluble in water, isopropanol, and dimethicone. They are soluble in mineral oil, triglycerides and fatty esters. Their solubility in oily materials makes these products of interest in personal care applications.

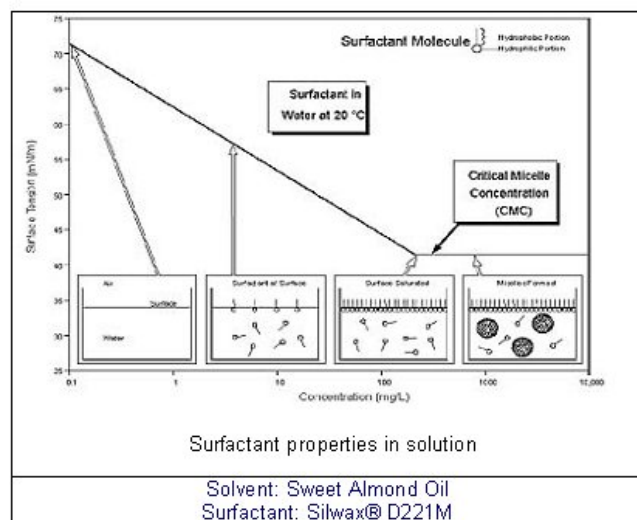
Despite the fact that alkyl silicones are soluble in many oils, they tend to aggregate at the surface, lowering surface tension. As the concentration of alkyl silicones is increased, the interface becomes saturated and micelles form. This is called the Critical Micelle Concentration (CMC). It is this property of alkyl silicones that offer the formulator the most advantage. The lowering of surface tension from 30 dynes/cm<sup>2</sup> to 20 dynes/cm<sup>2</sup> makes the oil based product feel more like silicone.

The melt point of an alkyl dimethicone is determined in large part by the length of the alkyl group attached to the silicone. The amount of silicone can also effect the melt point, but to a lesser degree. The amount of silicone present on the molecule alters the hardness of the alkyl dimethicone. As the amount of silicone increases in a molecule, the material becomes softer.

Typical values for alkyl dimethicone products having alkyl chains are: C-22 alkyl 35°C; C-26 alkyl 50°C and C-32 alkyl 60°C.

## Surfactant Properties

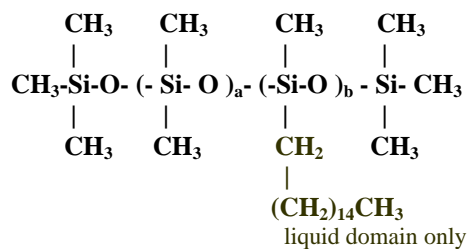
The graphic below shows the action of amphilic materials in solution. In this case the multi domain silicones in oils. The beneficial effects of surface tension lowering on spreadability and both cushion and playtime are key benefits of this technology. The applicability reaches through all product types for personal care including serums, emulsions, sun products and pigmented products.



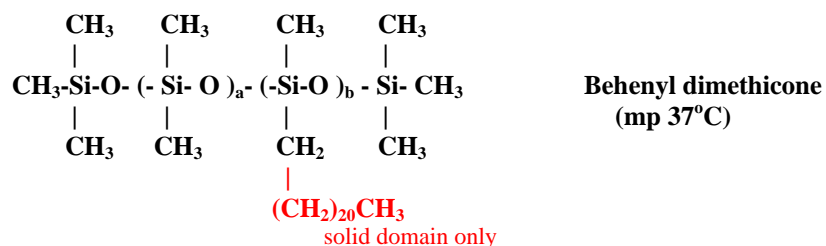
## States of Matter

A solid is a state of matter in which the material shows resistance to deformation and changes in volume. Solids have their molecules closely packed together in fixed positions. If the molecules are fixed in repeating groups a crystalline group occurs. A liquid is the state of matter in which molecules are fluid that is they can move easily around, assuming the shape of the container.

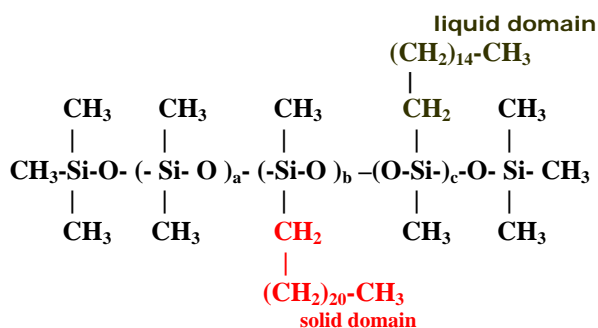
Alkyl dimethicone compounds have been around for many years. They are soluble in a variety of oils like mineral oil, and esters. The length of the alkyl chain determines the melt point of the traditional alkyl dimethicone. Consequently, cetyl (C16) dimethicone is liquid and Behenyl dimethicone (C22) is solid.



**Cetyl dimethicone**  
**(liquid at room temp).**



Unlike the products shown above, Multi-domain silicone polymers are carefully engineered materials that have segments called domains that have both solid and liquid alkyl groups placed on the same silicone backbone. The result is an inability to form a hard wax. The reason for this is that the molecule takes on the lowest energy confirmation in which there are solid domains and liquid domains within the matrix. The presence of these different domains within the polymer results in unique properties. The liquid and solid domains within the same molecule limit the ability to form hard solids and result in soft cosmetically elegant wax.



**SILWAX® D221M**

**SILWAX® D221M** is an example of a patent pending multi-domain alkyl silicone, having one solid and one liquid alkyl chains present on the same molecule. The result is a polymer that does not crystallize, rather orientates to provide a soft thixotropic material. The result is a cosmetically elegant product with wider melting point range of 34-37°C. Silwax D221M provides a very soft glossy feel on the skin. The product has been described as transient petrolatum, providing the feel and cushion of petrolatum, but has minimal playtime, rapidly disappears to leave high gloss and no tack, for this reason it has been called *Vanishing Petrolatum*.

## TYPICAL PROPERTIES

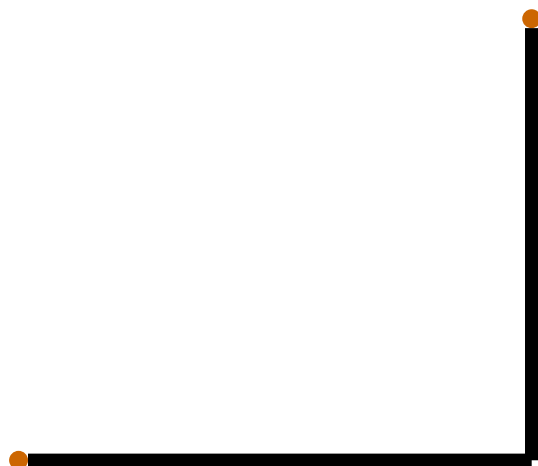
|   |  |
|---|--|
| Appearance  | Gel  |
| Active Content %  | 100  |
| Color, Gardner  | 3 Max  |
| Solubility (1% and 10%):<br>-Water<br>-IPA<br>-Mineral Oil<br>-Cyclopentasiloxane (D5)<br>-350 visc. Silicone Fluid | -Insoluble<br>-Insoluble<br>-Soluble<br>-Insoluble<br>-Insoluble |

## USES AND APPLICATIONS

**SILWAX® D221M** provides gloss, softness, barrier properties and lubrication. The melt point suggests the use of the material in lipsticks to minimize syneresis. Key product applications include: sun care products to increase SPF, moisturizers, lotions, antiperspirants and deodorants and pigmented products (lipsticks, mascara, foundations). Typical formulations are attached.

## COMPARISON

A comparison of the multi-domain silicone polymer and product made by blending two silicone polymers on which there is one alkyl group each is shown below. The two products have the same average composition, but the multi-domain product is clearly different. This difference is because of the structuring provided by the multi domain design.



## Comparison

Multi-Domain alkyl silicone and blend of two different alkyl silicone polymers (having the same ratio of alkyl groups)



Multi domain alkyl silicone

Blend of two alkyl silicones

## Conclusion

The comparison above clearly demonstrates that the effect of a multi domain alkyl silicone polymer. The product on the left is translucent, and flows slightly. The blended product is hard and opaque. The Multi domain silicone is thixotropic liquefying under pressure feels like petrolatum on the skin but has minimal playtime. It spreads rapidly and has no stickiness. This is attributed to the low surface tension and spreadability provided by the two domains in the one molecule.

This product represents only one of a large number of homologues available. The ability to alter the concentration of alkyl groups relative to each other, the amount of silicone in the molecule and the molecular weight allows for the custom tailoring of molecules for specific applications.



## Formulations

### Sunscreen Stick

| <i>Component</i>             | <i>wt%</i>   |
|------------------------------|--------------|
| Silsurf Resin 5580           | 12.50        |
| Microcrystalline Wax 190/195 | 3.25         |
| Ozokerite 1070               | 16.50        |
| Spider Ester GEC             | 15.00        |
| Silsurf 208-612              | 4.00         |
| Isostearyl Neopentionate     | 20.00        |
| <b>Silwax D221M</b>          | <b>3.75</b>  |
| Octocrylene                  | 7.50         |
| Oxybenzone                   | 3.00         |
| Avobenzone                   | 2.00         |
| Silica Spheres MSS-500       | <u>12.50</u> |
|                              | 100.00       |

#### Procedure:

1. Add first 6 ingredients to Vessel and heat until waxes melt.
2. Add Sunscreens and mix until uniform.
3. Add Silica Spheres and mix until uniform.
4. Fill



## Extended Wear Lipstick

| Phase | Ingredient                         | CTFA/INCI Name   | %w/w          |
|-------|------------------------------------|--|---------------|
| A     | Hexanediol Behenyl Beeswax         | Hexanediol Beeswax   | 11.00         |
| A     | Candelilla Wax                     | Candelilla Wax   | 8.00          |
| A     | Carnauba Wax                       | Carnauba Wax   | 2.00          |
| A     | Ozokerite 1477                     | Ozokerite  | 1.00          |
| A     | <b>Silwax D221M</b>                | <b>Cetyl/behenyl dimethicone</b>   | 2.00          |
| A     | Silwax B116 (Siltech)              | Cetyl Dimethicone  | 2.00          |
| A     | Siltech CE-2000 (Siltech)          | Trioctyldodecyl Citrate  | 5.00          |
| A     | Propylparaben                      | Propylparaben  | 0.20          |
| B     | Castor Oil                         | Castor Oil   | 47.79         |
| B     | Oxyxex K (Rona/EM Industries)      | PEG-8 (and) Tocopherol (and) Ascorbyl<br>Palmitate (and) Ascorbic Acid (and) Citric Acid | 0.01          |
| B     | Red Iron Oxide RFHC 72261 (Cardre) | Iron Oxides (and) Perfluoropolymethyl-<br>Isopropeth Phosphate                           | 8.00          |
| B     | TiO2 RFHC 72269 (Cardre)           | Titanium Dioxide (and) Perfluoromethyl-<br>Isopropeth Phosphate                          | 12.00         |
| C     | Colorona Red Brown (Rona/EM Ind.)  | Mica (and) Iron Oxides (and)<br>Titanium Dioxide   | <u>1.00</u>   |
|       |                                    |  | <u>100.00</u> |

### Procedure

Mix Phase A to uniformity while heating to 85°C.

Add pre-milled Phase B, while maintaining temperature, and mix to uniformity.

Add Phase C and mix until uniform. Maintain mixing and cool to 75°C and then pour into molds.



## MOISTURIZING LIPSTICK

This moisturizing lipstick features excellent payoff, coverage, and barrier properties. The Silwax D-221M provides a elegant skin feel and improved spreadability because it reduces the surface tension on the skin.

| <u>Phase</u> | <u>Chemical/Tradename (Supplier)</u>      | <u>CTFA/INCI Name</u>   | <u>%w/w</u>           |
|--------------|---|---|-----------------------|
| A            | Silwax D221M                              | Cetyl behenyl dimethicone   | 10.00                 |
| A            | Candelilla Wax                            | Candelilla (Euphorbia Cerifera) Wax   | 8.00                  |
| A            | Carnauba Wax                              | Carnauba (Copernicia Cerifera) Wax  | 2.00                  |
| A            | Ozokerite 1477 (Ross)                     | Ozokerite   | 1.00                  |
| A            | Silwax F (Siltech )                       | Dimethiconol Fluoroalcohol Dilinoleic Acid  | 5.00                  |
| A            | Silube 5580 (Siltech)                     | Dimethicone   | 2.00                  |
| A            | Siwax Di5026 (Siltech )                   | Ceretyl Dimethicone   | 2.00                  |
| A            | Siltech CE-2000 (Siltech)                 | Octyldodecyl citrate  | 5.00                  |
| A            | Propylparaben                             | Propylparaben   | 0.20                  |
| B            | Castor Oil                                | Castor (Ricinus Communis) Oil   | 43.79                 |
| B            | Oxyhex K (Rona/EM Industries)             | PEG-8 (and) Tocopherol (and) Ascorbyl Palmitate (and) Ascorbic Acid (and) Citric Acid | 0.01                  |
| B            | Red Iron Oxide SAT-R-338075               | Iron Oxides (and) Dimethicone   | 10.00                 |
| B            | TiO <sub>2</sub> SI-UFTR-Z (US Cosmetics) | Titanium Dioxide (and) Methicone  | 10.00                 |
| C            | Timiron Starlight Gold (Rona/EM Ind)      | Mica (and) Titanium Dioxide   | <u>1.00</u><br>100.00 |

### Procedure:

Mix Phase A to uniformity while heating to 85°C. Add pre-milled Phase B, maintaining temperature and mixing to uniformity. Add Phase C; mix to uniformity. Maintain mixing and cool to 75°C. Maintain pigment suspension and pour into molds.

## Makeup Formula

| Part |   | S MU 041906A | S MU 041906B |
|------|---|--------------|--------------|
|      |   | %            | %            |
| A    | Water   | 38.45        | 38.45        |
| A    | Cetyl hydroxyethylcellulose Polysurf 67 CS 1% | 0.35         | 0.35         |
| A    | Propylene Glycol                              | 2.00         | 2.00         |
| A    | Na <sub>2</sub> EDTA                          | 0.10         | 0.10         |
| A    | NaCl  | 1.00         | 1.00         |
| B    | Color Blend                                   | 15.00        | 15.00        |
| C    | Silsurf J208-812                              | 5.00         |              |
| C    | Silsurf J208-612                              |              | 5.00         |
| C    | <b>Silwax D221M</b>                           | <b>8.50</b>  | <b>6.50</b>  |
| C    | Spider Ester ESO                              | 10.0         | 8.00         |
| C    | Beeswax                                       | 4.00         | 3.00         |
| C    | Propylparaben                                 | 0.20         | 0.20         |
| C    | Methylparaben                                 | 0.40         | 0.40         |
| D    | Cyclomethicone Pentamer C5                    | 15.00        | 20.00        |
|      |   | <hr/>        | <hr/>        |
|      |   | 100.00       | 100.00       |

### Color Blends

|                   |       |
|-------------------|-------|
| Titanium Dioxide  | 10.02 |
| Yellow Iron Oxide | 0.96  |
| Red Iron Oxide    | 0.29  |
| Black Iron Oxide  | 0.08  |
| Kaolin USP        | 2.25  |
| Excel Talc        | 1.40  |
|                   | <hr/> |
|                   | 15.00 |

### Procedure:

1. Heat water to 75° C or higher. Add Polysurf with vigorous mixing and continue mixing until completely dispersed.
  2. Allow to cool to 35° C while continuing to mix.
  3. Add remaining Part A ingredients and mix until uniform.
  4. Pre blend and mill Color Blend
  5. Add part B and disperse in part A until uniform.
  6. Heat part A to 60° C
  7. Heat part C to 70° C and mix until all solids are dissolved
  8. Add part D to part C, maintain temperature of combined phase at 65° C
  9. Add Part AB to part CD with high speed propeller mixer.
- Cool to 30° C and fill

The Silwax D-221M provides an elegant skin feel and improved spreadability because it reduces the surface tension on the skin.

## Elegant Moisturizer Cream

| Part |                         | MC 042006A   |
|------|-------------------------|--------------|
| A    | Silsurf Di-10018-F      | 1.70         |
| A    | Mineral Oil             | 21.00        |
| A    | <b>Silwax D221M</b>     | <b>10.00</b> |
| B    | Sodium Chloride         | 0.5          |
| B    | Water                   | 48.80        |
| C    | Water                   | 9.00         |
|      | Urea                    | 9.00         |
|      | Preservative, Fragrance | As desired   |
|      |                         | 100.00       |

### Preparation:

1. Heat phase A to approx. 80 °C. Mix until uniform.
2. Heat phase B to 80°C. Add phase B slowly while stirring.
3. Homogenize for a short time.
4. Cool with gentle stirring and add phase C below 40 °C.  
Homogenize again below 30 °C.

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