
Title : A Guide to Selecting Surface-Treated Pigments and Powders for Cosmetics

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A Guide to Selecting Surface-Treated Pigments and Powders for Cosmetic Products

- Presentation Objective:
- To present some aids in assisting and assessing better selection of surface treatments for cosmetic products.
- Visual diagrams and data are used to aid selection, diagram, although it is recognized that the final decision will be influenced by performance, processing and cost, as well as the technical and patent issues.
- Help to reduce the number of variables and options that exist in formulating with surface treated powders and pigments.

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- Surface treatments can enhance the surface of a material altering its physical and chemical properties. Stronger bonding with the matrix enhances mechanical properties, reduces shrinkage, increases stability, and lessens or eliminates surface or internal defects. Permits higher filler loadings; improves dispersion; and improves powder flow characteristics, as well as flow during mixing.
- The improved powder or pigment can be used for creating new product forms, enhancing daily wear, assisting the application on the skin and optimizing the beauty factor by improving texture.
- Overall performance is a composite of a number of factors:
 1. Physical and chemical properties of the treatment.
 2. Integrity of the bonding between the treatment and substrate.
 3. Degree of completeness and coverage of the coating.
 4. Potential of the substrate for surface-treatment.

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- Loading level on the filler surface is a function of the surface area of the filler.
- While it was thought that one layer should be sufficient, experimentation has shown that several layers can provide optimal results in some cases.
- Typical fillers with average particle sizes of 1 to 5 microns often give best results when treated with about 1 percent (for silane).

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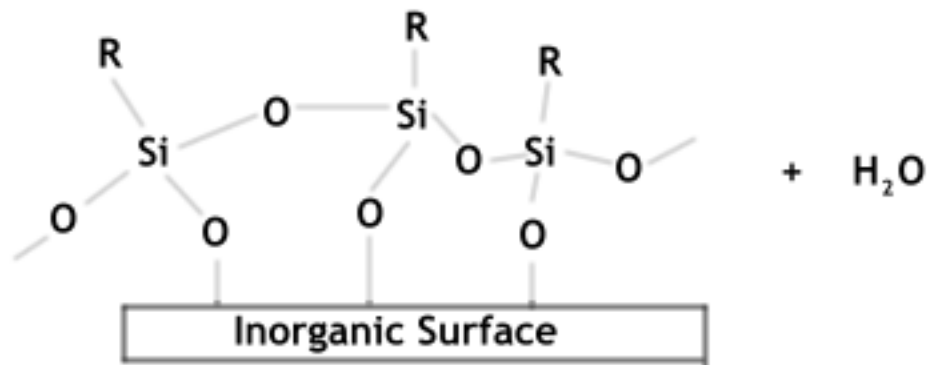
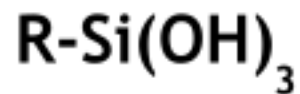
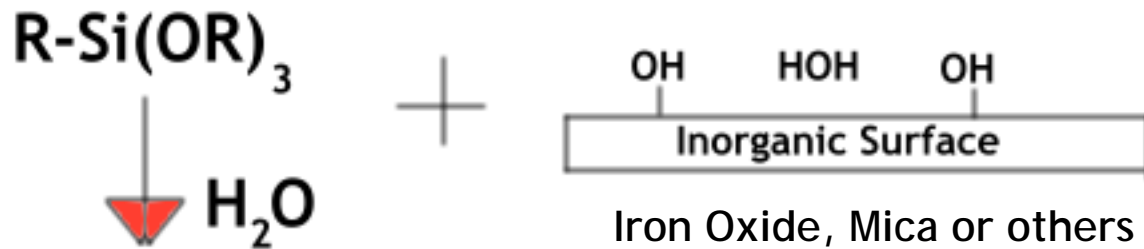
- The potential of the substrate for surface treatment may vary.
- Silicates, hydroxides, inorganic metal oxides possess hydroxyl groups for reaction.

Surface Treatment Potential

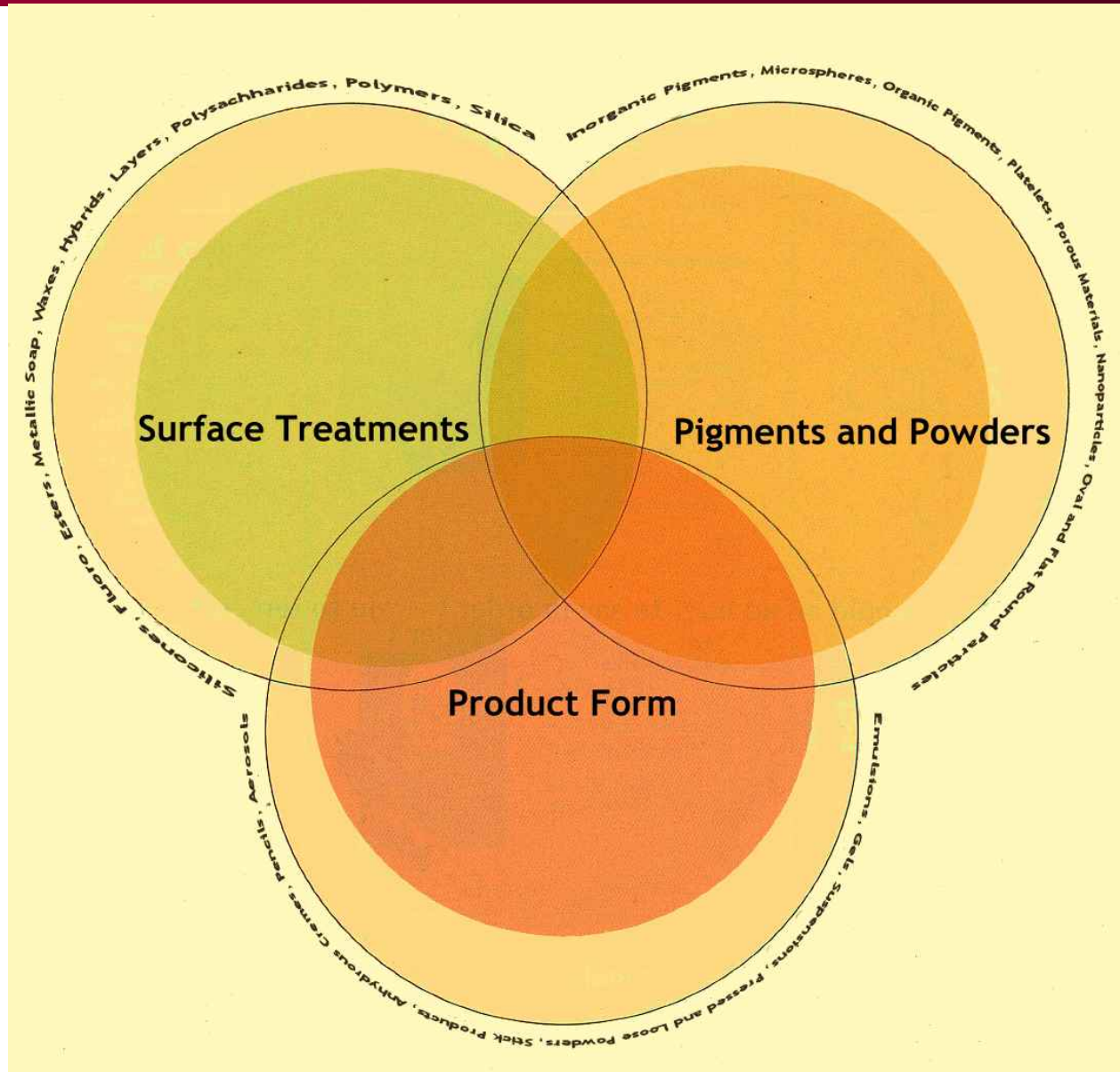
<u>Excellent</u>	<u>Good</u>	<u>Moderate</u>	<u>Poor</u>
Aluminas	Titanium Dioxide	Barium Sulfate	Carbon Black
Kaolin	Micas	Calcium Carbonate	
Silicas	Talc		
Bentonite	Iron Oxides		
	Magnesium Hydroxide		

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Silane Surface Treatment



How do I select the optimal surface treatment for my product?



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- General Selection:
- The choice of which surface treatment to use in a particular application is determined by the nature of the benefit that is to be derived from the treatment.
- If the treatment is designed to provide surface *hydrophobicity*, then a treatment with a hydrophobic group, such as caprylyl, fluorocarbon or phenyl should be chosen.
- If the silane treatment is designed to provide *compatibility* of the mineral in a polymer matrix, then the nature of the organic group on the silane should be similar to the chemical structure of the polymer (i.e., a caprylyl or longer chain alkyl group will help provide compatibility and dispersibility of the substrate in the medium.

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Product Form and Base Formulation are Key Drivers for Surface Treatment Selection

Formulation/Processing Factors for Consideration when Selecting Surface Treatments:

Non-Volatile Base or Minimal Am't of Volatiles Present
Low Pigment Volume Concentration
Treated Pigment and Powder Particle Size - Larger

Volatile Base Formula or Minimal Base is Present
High Pigment Volume Concentration
Treated Pigment and Powder Particle Size - Smaller

Importance of Surface Treatment - More Moderate

Importance of Surface Treatment - Higher



Residual Base Remaining on Skin - Higher
Surface Treatment Contact with Skin - More Moderate

Residual Base Remaining on Skin - Lower
Surface Treatment Contact with Skin - Higher

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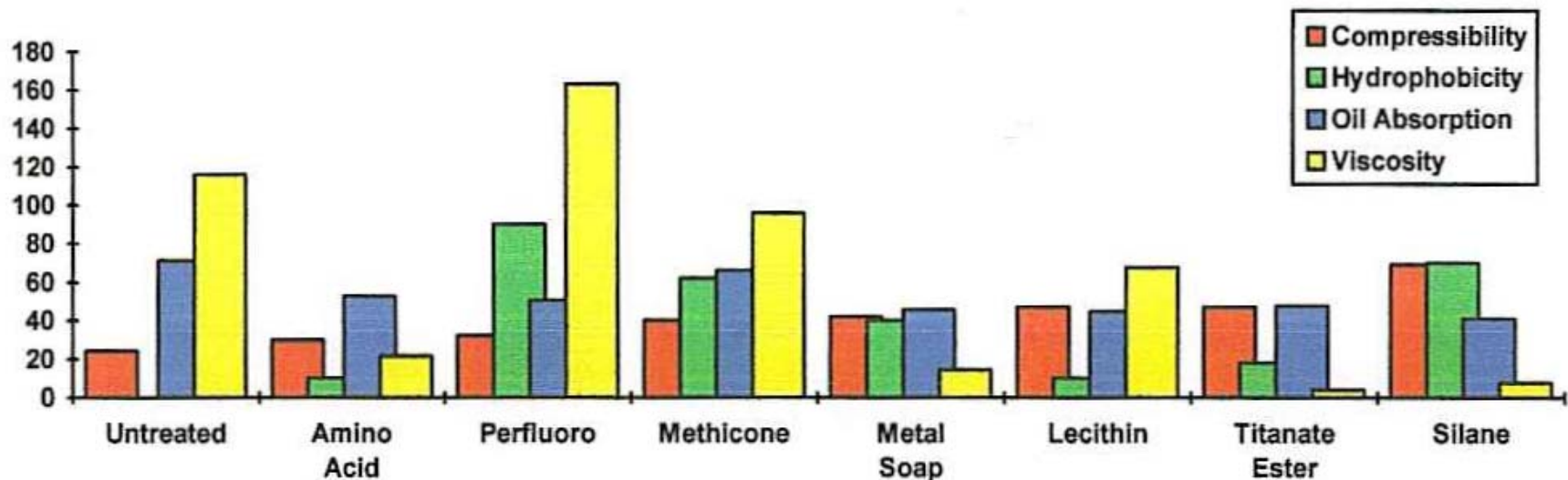
Titanium Dioxide	Particle Size(nm)	Specific Surface Area(m ² /g)
MT-100S	15	50-70
MT-100T	15	50-70
MT-100TV	15	50-70
MT-100Z	15	40-60
MT-100F	15	50-70
MT-150W	15	80-110
MT-100SA	15	80-110
MT-100SAS	15	50-80
SMT-100SAS	15	50-80
MT-500B	35	30-50
MT-500H	35	30-50
MT-500SA	35	30-50
MT-500HD	30	40-60
MT-500SAS	35	25-45
SMT-500SAS	35	25-45
MT-600B	50	25-35
MT-600SA	50	40-60
MT-700HD	50	40-60

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Technical/Physical testing of comparative treatments

Within this evaluation of a few properties, Silane appears to have the best combination of properties.

Technical testing can help to differentiate between multiple surface-treatments. The results would benefit from correlation with sensory data and/or consumer data.



Graph constructed from original data by Jane Hollenberg

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General Approach for Selecting Surface-Treated Materials for a Formulation Project

General:

1

Define and design the initial prototypes for product form or vehicle based upon the concept and technical targets.

2

Gather technical literature and begin search for patent applications and issued patents (past and present) to determine viability and considerations for the project.

3

Create technical and sensory tests, as well as consumer testing plan to evaluate the performance of the product. Conduct stability testing in parallel.

Surface Treatment Selection

Tier I

Tier I - "High Surface Area Products"

[Surface Modification is a highly integral part of the product design.]; Delivers benefits that cannot be obtained without the use of treatments. Product is fully dependent upon the surface-treatment.]

(Surface-treated materials comprise **65 - 100%** (% w/w) of the resultant cosmetic film on skin, or are nanoparticles at >10% that have a high surface area.

On average with a 2% surface treatment, the amount of

Tier II

Tier II - "Moderate Surface Area Cosmetics"

[Surface Modification is of moderate to high importance to the product.]; Provides significant improvements in one or multiple areas, either via sensory attributes, stability or process/manufacturing.

(Surface-treated pigments/powders comprise **10 to <65%** (% w/w) of resultant cosmetic film on skin. On average with a 2% surface treatment, the amount of treatment is 0.7-1.3% (% w/w) of the residual film.) Surface area and contact with skin of

Tier III

Tier III - "Lower Surface Area Cosmetics"

[Surface Modification is of a somewhat less to moderate consideration to the product.]; Provides measureable and marginally or significantly better improvements in one or multiple areas, either via sensory attributes, stability or process/manufacturing.

(Surface-treated pigments/powders comprise **<10%** (% w/w) of resultant cosmetic film on skin. On average with a 2% surface treatment, the amount of treatment is very small, 0-0.2% (% w/w) of the residual film.) Surface area and contact with skin of surface treatment is reduced due to non-volatiles.

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Technical Descriptions of Product Form for each Tier

Technical Description for Tier I Products

Prototype formulation is either a :

1. Powder-type product (neat or with binder)
2. Or is a product form that contains a high concentration of volatile liquids; may also contain a small amount of non-volatile liquids/waxes.
3. Or is a sunscreen product that contains >10% of micronized titanium dioxide or other particles considered to be nanoparticles that occupy a large volume of the resultant film on the skin.
4. A dry or slightly moist powder film is deposited and remains on the skin after evaporation of volatiles, if present.

Tier I

Technical Description for Tier II Products

Prototype formulation is either a :

1. Powder or Creme type product containing a moderate amount of non-volatile liquids/waxes.
2. Or is a product form containing a mixture of a moderate concentration of volatile and non-volatile liquids/waxes.
3. A somewhat moist powder film is deposited and remains on the skin after evaporation of volatiles, if present.

Tier II

Technical Description for Tier III Products

Prototype formulation is either a :

1. Powder or Creme type product containing a high amount of non-volatile liquids
2. Or is a product form containing a mixture of a high concentration of volatile and non-volatile liquids/waxes.
3. A moist powder film is deposited and remains on the skin after evaporation of volatiles, if present.

Tier III

Examples of Product Type for each Tier

Examples of Tier I Products:

Pressed Face Powders and Eyeshadows, Water-in-Volatile Silicone Emulsion Foundation Make-Ups, Volatile Silicone-in-Water Emulsions (Shine Control Products), Anhydrous Volatile Creme Blushers, Mascara Gels or Emulsions and Transformational Products - (Creme-to-Powder) and (Volatile Stick Products; Foundations, Antiperspirants); High SPF Inorganic Sunscreens

Tier I

Examples of Tier II Products:

Oil-in-Water, Water-in-Oil or Silicone Emulsions (Inorganic-Based Sunscreens and Foundation Make-Up), Anhydrous Semi-Volatile Creme Eyeshadows, Concealers; Semi-Volatile Sticks (Lipsticks, Foundations or Antiperspirants)

Tier II

Examples of Tier III Products:

Water-in-Oil Emulsions (Facial Care, Moisturizers with Microspheres/Soft Focus, Color Accentuators, Sunscreens), Anhydrous Non-Volatile Cremes/Gels (Blushers), Non-Volatile Sticks (Sunscreens, Lipsticks, Foundations or Antiperspirants)

Tier III

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Selecting Surface Treatments for each Tier

Tier I - "Use Core Surface Treatments"

Focus on single, individual Surface Treatments. Select surface treatment most closely matched to target attributes and then secondly to compatibility of system. These treatments when used in Tier I systems provide distinct properties in these types of systems. They provide the most direct contact with the skin or lashes/hair when used in this manner.

Some Preferred treatments are:

[MS] (Methicone)
[ITT] (Isopropyl Titanium Triisostearate)
[11S2] (Triethoxy Caprylylsilane)
[MM] (Magnesium Myristate)
[PF] (C9-15 Fluoroalcohol Phosphates)

Tier I

Tier II - "Use Hybridized Surface Treatments"

Focus on hybrid Surface Treatments that provide a blend of matching targeted attributes and compatibility. They should be matched to the solvents/polarity and give the desired properties in these types of systems. They provide good contact with the skin or lashes/hair.

Some Preferred treatments are:

TTB (Isopropyl Titanium Triisostearate/Dimethicone Crosspolymer)
TTS (Isopropyl Titanium Triisostearate/ Triethoxycaprylylsilane Crosspolymer)
TTM (Isopropyl Titanium Triisostearate/Methicone Crosspolymer)

FSA (C9-15 Fluoroalcohol Phosphates (and) Acrylates/Dimethicone Copolymer)
FOTS (C9-15 Fluoroalcohol Phosphates (and) Triethoxy Caprylylsilane)

ASC (Acrylates/Dimethicone Copolymer)

...

Tier II

Tier III - "Use Full Range of Treatments"

Focus on any Surface Treatment that provides the best compatibility and stability, may include higher concentrations of surface treatments (>5 or 10%). They should be matched to the solvents/polarity and give the desired properties in these types of systems. These systems provide less direct contact with the skin or lashes/hair when the absorption is slow.

Some Preferred treatments are:

[ITT] (Isopropyl Titanium Triisostearate)
[11S2] (Triethoxy Caprylylsilane)
TTS (Isopropyl Titanium Triisostearate/ Triethoxycaprylylsilane Crosspolymer)
TTM (Isopropyl Titanium Triisostearate/Methicone Crosspolymer)

ASC (Acrylates/Dimethicone Copolymer)
FSA (C9-15 Fluoroalcohol Phosphates (and) Acrylates/Dimethicone Copolymer)

BAS2 Triethoxysilylethyl Polydimethylsiloxyethyl Hexyl Dimethicone [LL] (Lauoryl Lysine)

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Tier III

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- Summary:
- Surface treatments can be pre-determined and selected earlier in the development process by better defining the product form and placing some limitations on the composition.
- Technical testing can help to guide the selection.
- Creating a greater distinction between individual (single), hybridized and also customized surface-treatments can enhance the understanding of the selection process.

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