Pearlescent Pigment Overview

Doug Thornley

California SCC
March 2015
Market Opportunities

Markets

- Coatings 68%
- Plastics 11%
- Cosmetics 15%
- Inks 6%

Pigments Segmentation

- Metal Effect/Aluminum 68%
- Color Travel 5%
- Pearlescent 27%
Market Opportunities

Primary Cosmetic Segments

- Skin Care: 27%
- Make-up: 20%
- Hair Care: 20%
- Fragrance: 10%
- Other: 23%

Total Market Opportunities
The Cosmetic Market

Decorative Cosmetics

- Mascara
- Eye shadow
- Lip Gloss
- Lipsticks
- Nail Polish
- Body Lotions
- Body Oils
- Shower Gel
- Face Powders

And More...
Color Effect Pigments

**Natural Mica**
- Whites
- Interference
- Gold and Metallics
- Colored Mica

**Synthetic Mica**
- Whites
- Interference
- Gold and Metallics
- Color Travel Technology

**Bismuth Oxychloride Pigments**

**Silicate Based Pigments**
- Silicate coated colors
- Color Travel Technology

**Aluminum Effect Pigments**

**Silver Coated Pigments**

**Visual Delivery Systems**
Interference Pigments
**Pearlescent Pigment**

Traditional pearlescent and interference pigments for cosmetics are generally composed of muscovite mica coated with a thin layer of metal oxides (titanium dioxide or iron oxides).

Several parameters are critical to the pigment’s appearance:

- **Lateral size of the particle**
  - Smaller are more satiny & opaque
  - Larger are more sparkly and transparent
- **Metal oxide layer thickness**
- **Semi-transparent**
- **Color based on combination of light interference and absorption color of metal oxide layer**
- **Multiple surfaces of reflection give “pearl luster” finish**
Thickness = Colors

Thickness of the metal oxide layer determines the (reflected) interference color. Note that the complementary color is transmitted.
Mica Based Pearls

- TiO2 Coated Substrates
- Fe2O3 Coated Substrates

- Particle size Effects

<table>
<thead>
<tr>
<th>“Satin”</th>
<th>“Luster”</th>
<th>“Glitter”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 25 micron</td>
<td>10 – 60 micron</td>
<td>&gt; 20 – 150 micron</td>
</tr>
</tbody>
</table>
Natural Mica

Properties:

- Natural Products
- High availability and sustainability
- Relatively low cost

- Mica platelet coated with metal oxide
- Metal oxide film acts as prism to generate reflective interference colors
- Give final products a sparkling effect, a yellowish touch

- Downside
- Layers
- Thickness not controlled
- Natural contamination
Cleaner Substrate

- **Mica**
  - Traditional Substrate
  - Good Chemical & Mechanical Stability

- **Al₂**

  ![Natural Mica](image1)
  ![Synthetic Mica](image2)

- **Glass Flake**
  - Thin Synthetic Substrate
  - Low Variability in Thickness
**Synthetic Mica**

**Properties:**

- Pearlescent pigments based on synthetic fluorphlogopite
- Benefit: substrate with tightly controlled composition
- Excellent brightness compared to natural mica
- High purity – “heavy metal free”
- Slightly transparency, low coverage
- Sparkling effect
- Pure white, clean color
# Applications

## Recommended pigmentation in powder

<table>
<thead>
<tr>
<th>Desired Effect</th>
<th>Finished Product</th>
<th>Recommended concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin coloring</td>
<td>Pressed eye shadow</td>
<td>20 – 70 %</td>
</tr>
<tr>
<td></td>
<td>Loose eye powder</td>
<td>Up to 100 %</td>
</tr>
<tr>
<td>Highlighting, sparkling effects</td>
<td>Blush (loose or pressed)</td>
<td>1 – 40 %</td>
</tr>
<tr>
<td></td>
<td>Face powder (loose or pressed)</td>
<td>1 – 5 %</td>
</tr>
<tr>
<td></td>
<td>Body powder</td>
<td>Up to 100 %</td>
</tr>
</tbody>
</table>

## Recommended pigmentation in different gel/lotions types

<table>
<thead>
<tr>
<th>Finished Product</th>
<th>Level of use (transparent system)</th>
<th>Level of use (opaque system)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair styling gel</td>
<td>0.1 – 0.5%</td>
<td>1 – 3 %</td>
</tr>
<tr>
<td>Hair coloring gel</td>
<td>3 – 7 %</td>
<td>3 – 7 %</td>
</tr>
<tr>
<td>Shower gel</td>
<td>0.05 – 1 %</td>
<td>1 – 3 %</td>
</tr>
<tr>
<td>Eye shadow gel</td>
<td>3 – 5 %</td>
<td>15 – 20 %</td>
</tr>
<tr>
<td>Skin gel</td>
<td>0.1 – 1 %</td>
<td>1 – 5 %</td>
</tr>
</tbody>
</table>
Cleaner Color Effects

Properties:

- In the past ten years we’ve seen a range of improvements to these pigment systems:
  - Substrates:
    - Alumina
    - Silica
    - Mica/Silica Combinations
    - Borosilicate
  - Multi-layer systems
  - Combinations of new substrates/multi-layer systems

- Leading to:
  - Brighter, cleaner pigments of new substrates / multi-layer systems
  - COLOR TRAVEL!
Silicate Pigments

Properties:

- Calcium sodium borosilicate flakes with titanium dioxide coatings
- Optimized gloss delivered by a smooth surface
- Less diffuse scattering effect
- Used to set highlights without impacting the mass tone
- Add great depth and dimensionality because their novel substrate has a high level of transparency
### Applications

#### Recommended pigmentation in powder

<table>
<thead>
<tr>
<th>Finished Product</th>
<th>Use Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressed Powder</td>
<td>12 – 25%</td>
</tr>
<tr>
<td>Loose Powder</td>
<td>1.5 – 100%</td>
</tr>
</tbody>
</table>

#### Recommended pigmentation in Lipstick/Lip gloss

<table>
<thead>
<tr>
<th>Finished Product</th>
<th>Use Level (transparent system)</th>
<th>Use Level (colored system)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipstick</td>
<td>0.1 – 0.2%</td>
<td>4 – 10%</td>
</tr>
<tr>
<td>Lip gloss</td>
<td>2 - 8%</td>
<td>8 - 12%</td>
</tr>
</tbody>
</table>

#### Recommended pigmentation in gel types

<table>
<thead>
<tr>
<th>Finished Product</th>
<th>Level of use (transparent system)</th>
<th>Level of use (opaque system)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair styling gel</td>
<td>0.01 - 0.5%</td>
<td>1 - 3%</td>
</tr>
<tr>
<td>Shower Gel</td>
<td>0.01 – 1%</td>
<td>1 – 3%</td>
</tr>
</tbody>
</table>
Color Travel Technology

The technology behind Color Travel Pigments is the use of thin, precisely controlled coatings of titanium dioxide, silica and tin oxide on Silicate platelets to separate white light into multiple components parts and produce up to four interference colors: three by reflection and one by transmission.

Where Color and Technology work together to produce unique color effect pigments
Due to the **thickness of the silica** layer, the **path length (directly related to the color)** of the reflected light differs significantly.

If the incident light is at a sharper or wider angle, **the reflected light will have differing wavelengths of reflected light** => **different reflected colors.** Variations in structure (silica thickness, mica/silica combinations, etc. will lead to a range of pigment with a variety of color-travel behaviors. 
Bismuth Oxychloride

Properties:

• Bismuth Oxychloride inorganic compound with the formula BiOCl

• It is a lustrous white solid, found naturally in the rare mineral bismoclite

• Light wave interference from its plate-loke structure of alternating layers of bismuth, oxygen, and chlorine atoms gives its suspensions a pearly iridescent light reflectivity similar to nacre

• It is a component of some cosmetics, and has been used as such since antiquity, notably in ancient Egypt
Bismuth Oxychloride Colors

Properties:

• Pigments are obtained as a result of coating Bismuth Oxychloride onto mica
• Offer a soft, elegant luster, excellent transparency and a satiny effect
• Imparts a silky feel in many cosmetic and personal care applications
• Applies well to the skin, excellent adhesives properties for long wear on the skin
• Provides a soft visible sheen to eye shadows, blushes, foundations and other colored makeups
• Strong light refracting properties helps hide imperfections
Aluminum Pigments

**High Chroma Aluminum Colors** - Alchemique pigments transform common flaked aluminum powders into a magical collection of dramatic colors ranging from gold, silver, bronze and copper to the rich colors of cobalt, topaz and jade. This rich collection of effects provides deep, true colors independent of the underlying skin tones normally acquired from the transparent qualities of typical effect pigments.

Silver Coated Pigments

**Silver Coated Silicate Flake Pigment**
Pure glass flake from calcium and sodium borosilicate provide a vapor deposition coating of pure silver. The result is an elegantly and brilliant and totally reflective mirror-like surface that dramatically catches and reflects the surroundings color providing an infinitely unique effect to a wide variety of color cosmetics, eye shadows (Europe only) and nail colors (in US).
Powder Considerations

Powders: tough application for color-travel pigments

Reason: **Light-scattering!**

Color Travel pigments, like all interference pigments, depend on the focusing of reflected light to give its effect.

In a powder matrix, much of the reflection of these pigments is lost through interaction with other powder particles; the reflected light hits other particles, the light is scattered, and the effect is lost.
Enhancing Colors

**Large-sized particles**

In some cases, the addition of large-sized interference pigments can aid in supporting the color-travel behavior on the skin. Thus, a powdered eye shadow containing the following pigment system,

- Blue Pearl Pigment 5
- Black Iron Oxide/Mica 5
- Color-Travel Pigment 15

shows only a small degree of color-travel.

But if 10% of a large-sized (20-200 microns) red or gold interference pigment is added to the system, a noticeable color-travel effect can be seen on the skin.

Concentration effects will also increase both the sparkle and the color-travel effects of these types of system.
“Diamond Rules”

General rules for using color-travel pigments in cosmetics:

- “Formulation-dependent” – trial-and-error still necessary
- Fluid applications (liquids, gels) always show off travel effect better
- Avoid complementary interference pigments
- Less is more: the more transparent the formula, the better the effect
  - Masstone pigments: more transparency gives better effect
  - Large-sized masstone pigments can be combined with color-travel pigments to create very interesting effects.

- Very large-sized (20-200 microns) color-travel pigments are now entering the market. These can be used to provide both color-travel and sparkle in ways previously unavailable to the cosmetic formulator.
Applications

**Fluid applications work best:**
- Nail Polish
- Lip Gloss
- Hair gel
- Eye shadow gel, etc.

**Powder applications** are more challenging, due to light-scattering, but surface effects may help to improve the color-travel effects.
THANK YOU!