INGENIA WHITE MASTERBATCH 101

May 2019
White Masterbatches 101

Performance of white masterbatches depends on:

• Pigment selection
  • Typically TiO2
  • Particle Size Distribution, Refractive Index, surface treatment
• Pigment dispersion
• Pigment loading
• Absence or use of extenders, spacers, opacifiers
Ingenia’s White Masterbatch Grades

Several classes depending on your needs:

• Premium: Premium TiO2 only.
• Standard: TiO2 only.
• Engineered: TiO2 and engineered extenders.
• Extended grades: TiO2 extended with calcium carbonate.
• Blue whites based on any of the above classes.
Pigment Selection Criteria

Pigment selection is based on:

• Light Stability
• Heat Stability
• Ease of Dispersion
• Opacity
• Masstone/ Tint Strength
• Bleed Resistance
• Regulatory compliance (FDA, REACH, etc)
Refraction Of Light

- As light passes through a particle of TiO2 or other pigment, it is refracted or bent. Materials with a higher refractive index bend the light more sharply.

High RI mineral

Low RI mineral
Materials with higher refractive index will have higher opacity, especially in thin films.
## TiO2 Refractive Index

- Rutile TiO2 is the white pigment of choice

<table>
<thead>
<tr>
<th>Mineral</th>
<th>R.I.</th>
<th>Plastic</th>
<th>R.I.</th>
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</thead>
<tbody>
<tr>
<td>Rutile TiO2</td>
<td>2.73</td>
<td>PE</td>
<td>1.5-1.54</td>
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<tr>
<td>Anatase TiO2</td>
<td>2.55</td>
<td>PS</td>
<td>1.6</td>
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<tr>
<td>Antimony Oxide</td>
<td>2.15</td>
<td>PVC</td>
<td>1.48</td>
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<tr>
<td>Zinc Oxide</td>
<td>2.02</td>
<td>PC</td>
<td>1.59</td>
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<tr>
<td>Lithopone</td>
<td>1.84</td>
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<tr>
<td>Calcium Carbonate</td>
<td>1.63</td>
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<td>Silica</td>
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</table>
Relative Tint Strength of White Pigments

- White Lead
- ZnO
- Antimony Oxide
- Lithopone
- Zinc Sulfide
- Anatase TiO2
- Rutile TiO2

Tint Strength
Titanium dioxide comes in two crystal forms:

- Anatase
- Rutile: higher refractive index. Better opacity.
Rutile TiO$_2$ is the material of choice

- Particle size is controlled to produce the final tint tone, smaller particle size results in a bluer tint, larger in yellow tint.
- Scattering efficiency of the base particle increases as you approach the optimal size, approx. half the wavelength of visible light.
- Slightly smaller than optimal size results in a rapid decrease opacity.
TiO2 particles are treated to facilitate handling, processability and dispersion.

Inorganic treatments aid in-process handling and improve durability:
- Alumina treatment minimizes moisture pickup
- Silica is used to enhance durability

Organic treatments aid dispersion:
- Uniformly applied in amounts small enough to avoid volatility, interactions and overlubrication
Rutile TiO2 grades – Not all the same!

• Color/Undertone
• Opacity
• Processability
• Lacing resistance / heat stability
• Durability
• Dispersion
• Light stability
• Crystal structure
Typical TiO2 Specification

• Titanium dioxide: 97 wt % minimum
• Alumina: 1.7 wt % maximum
• Organic treatment: 0.3 wt % Carbon
• Specific gravity: 4.2 g/cm³
• Mean particle size: 0.22 micron
• Opacity strength: High
• Undertone tint: Blue
• Silica treatment for durable TiO2
Difference in Tint Strength of TiO2 Grades

- TiO2 C
- TiO2 B
- TiO2 A

Tint Strength

92  94  96  98  100
Bad Dispersion versus Good Dispersion

TiO2 Light Scattering

Good dispersion = better opacity at lower letdown
Effect Of TiO2 Type On Melt Flow

Melt Flow Rate (g/10min)

Condition

70% TiO2 in LDPE

TiO2 Type

Better surface treatment = higher melt flow = better dispersion
TiO2 Treatment: Weatherability
Some organic treatments volatize at high temperatures.

Some TiO\textsubscript{2} are hydrophilic. They attract moisture.

This leads to volatile bubbles at the die exit during film extrusion causing lacing at worst, fish eyes or lensing, at lower moisture levels.

High quality treatment prevents these issues.
White MB 101 - Conclusions

1) Ingenia has industry leading product offering in White MB!
2) Ingenia has the knowledge, experience and expertise to provide high quality products, designed to meet your application requirements!
3) Ingenia Technical Support staff are available to provide solutions to your most demanding applications!!!

• Contact Ingenia Customer Service to learn more about solutions for White MB applications.
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