Non-Nano Zinc Oxide
Sunscreen Technologies

Inorganic UV filters have been manufactured during the past forty years for use in sunscreen products. They are preferred over organic UV filters because of their physical and chemical stability, as well as their non-irritating properties. In order to optimize the protection against UV light, and to minimize the scattering of visible light, zinc oxide with particle sizes less than 100nm, or “nanoparticles,” have become increasingly popular. However, there are recent safety concerns surrounding “nanoparticles,” particularly skin penetration, risk of inhalation, eco-toxicity, and bioaccumulation in the human body.

In light of perceived health risks associated with “nanoparticles,” pigment producers have been challenged to develop grades with a mean particle size over 100nm, while maintaining adequate UV-protection and cosmetic acceptability.

Kobo offers a grade of Zinc Oxide, where the primary particle size is greater than 100nm when measured by image analysis. This non-nano ZnO is available coated with either organic or inorganic surface treatments, and also dispersed in various vehicles for easier use in formulations. They will help formulators develop sunscreen products with broad spectrum protection without nanoparticles.

Kobo Non-Nano Patent Information:
U.S. Patent Application No.: 12/331,593 for Zinc Oxide Aqueous and Non-Aqueous Dispersions including its making and use in sunscreen product.

Comparison of the transmittance curves of Non-Nano ZnO, ZnO-C (red curve) and an ultra fine grade Zinc Oxide (blue curve) in dispersions.

Particle Size Curve Chart

<table>
<thead>
<tr>
<th>Particle Size Chart</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ZnO350 (attenuation grade)</strong> - 28.6</td>
<td><strong>ZnO-C</strong> - 24.4</td>
</tr>
<tr>
<td>SPF</td>
<td>UVA Ratio</td>
</tr>
<tr>
<td>80</td>
<td>0.80</td>
</tr>
</tbody>
</table>

* Data from Sumitomo Osaka Cement
**Non-Nano ZnO**

### Powders

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Surface Treatment</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZnO-C-+</td>
<td>None</td>
<td>Hydrophilic</td>
</tr>
<tr>
<td>ZnO-C-12</td>
<td>Isopropyl Titanium Tristearate</td>
<td>Lipophilic</td>
</tr>
<tr>
<td>ZnO-C-NJE3+</td>
<td>Jojoba Esters</td>
<td>Hydrophobic</td>
</tr>
<tr>
<td>ZnO-C-DMC2</td>
<td>Hydrogen Dimethicone</td>
<td>Hydrophobic</td>
</tr>
<tr>
<td>ZnO-C-DS4</td>
<td>Dimethicone</td>
<td>Hydrophobic</td>
</tr>
<tr>
<td>ZnO-C-ASG3+</td>
<td>Stearoyl Glumatic Acid</td>
<td>Hydrophobic</td>
</tr>
</tbody>
</table>

Note: NJE Treatment

Patent # US 8623386 B2

NJE: Natural Ester, Wax or Oil Treated Pigment, Process for Production Thereof, and Cosmetic Made Therewith

### Dispersions

<table>
<thead>
<tr>
<th>Carrier/ solvent</th>
<th>Product Name</th>
<th>INCI Name</th>
<th>Active %</th>
<th>Viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esters/Oils</td>
<td>GC70MZCJ-G+</td>
<td>Zinc Oxide (And) Caprylyl/Caprylic Triglyceride (And) Jojoba Esters (And) Glyceryl Behenate/Eicosadiol</td>
<td>67</td>
<td>Paste</td>
</tr>
<tr>
<td></td>
<td>GC70MZCSG++</td>
<td>Zinc Oxide (And) Caprylyl/Caprylic Triglyceride (And) Stearoyl Glumatic Acid (And) Glyceryl Behenate/Eicosadiol</td>
<td>68</td>
<td>Paste</td>
</tr>
<tr>
<td></td>
<td>GCP70MZCSG</td>
<td>Zinc Oxide (And) Caprylyl/Caprylic Triglyceride (And) Stearoyl Glumatic Acid (And) Silica (And) Polyoxyhydroxystearic Acid</td>
<td>68</td>
<td>Paste</td>
</tr>
<tr>
<td></td>
<td>HBP75MZCM</td>
<td>Zinc Oxide (And) Butyloctyl Salicylate (And) Polyoxyhydroxystearic Acid (And) Hydrogen Dimethicone (And) Glyceryl Behenate/Eicosadiol</td>
<td>73</td>
<td>Paste</td>
</tr>
<tr>
<td></td>
<td>TNPB80MZCM-G</td>
<td>Zinc Oxide (And) C12-15 Alkybenzoate (And) Isopropyl Myristate (And) Polyoxyhydroxystearic Acid (And) Stearalkonium Hectorite (And) Hydrogen Dimethicone (And) Glyceryl Behenate/Eicosadiol (And) Propylene Carbonate</td>
<td>79</td>
<td>Paste</td>
</tr>
<tr>
<td></td>
<td>TNSS75MZCM</td>
<td>Zinc Oxide (And) Ethylhexyl Methoxyecrylene (And) C12-15 Alkybenzoate (And) Polyoxyhydroxystearic Acid (And) Hydrogen Dimethicone</td>
<td>72</td>
<td>Paste</td>
</tr>
<tr>
<td>Natural Esters/Oils</td>
<td>JOP80MZCJ+</td>
<td>Zinc Oxide (And) Simmondsia Chinensis (Jojoba Seed Oil (And) Polyoxyhydroxystearic Acid (And) Jojoba Esters)</td>
<td>78</td>
<td>Paste</td>
</tr>
<tr>
<td>Silicons</td>
<td>CMX80MZCM</td>
<td>Zinc Oxide (And) Cyclopentasiloxane (And) Dimethicone (And) PEG/PPG-18/18 Dimethicone (And) Hydrogen Dimethicone</td>
<td>78</td>
<td>Paste</td>
</tr>
<tr>
<td>Volatile Non-D5</td>
<td>DIM2FH75MZCM</td>
<td>Zinc Oxide (And) Dimethicone (And) Isononyl Isononanoate (And) Polycryloyl-6 Polycrincinoleate (And) PEG-10 Dimethicone (And) Hydrogen Dimethicone</td>
<td>74</td>
<td>Pourable</td>
</tr>
<tr>
<td></td>
<td>DMX80MZCM</td>
<td>Zinc Oxide (And) Trisiloxane (And) Dimethicone (And) PEG/PPG-18/18 Dimethicone (And) Hydrogen Dimethicone</td>
<td>78</td>
<td>Paste</td>
</tr>
<tr>
<td></td>
<td>MTMX80MZCM</td>
<td>Zinc Oxide (And) Methyl Trimethicone (And) Dimethicone (And) PEG/PPG-18/18 Dimethicone (And) Hydrogen Dimethicone</td>
<td>78</td>
<td>Paste</td>
</tr>
<tr>
<td>Water/Glycols</td>
<td>GLW70MZC</td>
<td>Zinc Oxide (And) Water (And) Glycerin (And) Sodium Polyacrylate (And) Cellulose Gum</td>
<td>70</td>
<td>Paste</td>
</tr>
</tbody>
</table>

The method of measurement used to classify these products as Non-Nano is the Image Analysis method.

### Sunscreen with Non-Nano Zinc Oxide

**Formula KSL-200A**

**Part 1**
- Deionized water - Water: 53.90%
- Liposorb® L-20 - Lipo Chemicals: 1.80%
- Polysorbate 20

**Part 2**
- Propylene Glycol - Symrise: Propylene Glycol: 1.50%
- KELTROL® CG - CP Kelco: Xanthan Gum: 0.30%

**Part 3**
- HALLBRITE® H8H - Hallstar: Butyloctyl Salicylate: 7.50%
- Neo Heliopan® AV - Symrise: Benzophenone-3: 7.50%
- Ethylhexyl Methoxycinnamate

- **ZNO-C-DMC2** - Kobo Products:
  - Zinc Oxide (And) Hydrogen Dimethicone: 7.00%
  - Ceraphyl® 368 - ISP: Ethylhexyl Palmitate: 3.00%
  - Lipo® GMS-450 - Lipo Chemicals: Glyceryl Stearate: 3.00%
  - Neo Heliopan® BB - Symrise: Benzophenone-3: 7.50%
  - Finsoyl® TN - Finetex: C12-15 Alkybenzoate: 2.50%
  - Lipomuls® 165 - Lipo Chemicals: Lecithin: 2.00%
  - Glyceryl Stearate (And) PEG-100 Stearate: 2.00%
  - Covi-ox® T-50 - Cognis Corp.: Tocopherol: 0.50%
  - Lipowax® D - Lipo Chemicals: Cetyl Alcohols (And) Ceteareth-20: 0.50%
  - Liposorb® TS - Lipo Chemicals: Sorbitol Tristearate: 0.30%

**Part 4**
- Botanista® 72 - DD Chemco: 1.00%
  - Phenoxethanol (and) Caprylyl Glycol (and) Ethylhexylglycerin (and) Hexylene Glycol

**Part 5**
- Aculyn™ 44 - Rohm & Hass: 1.00%
  - PEG-150/Decyl Alcohol/SMDI Copolymer

**Manufacturing Procedure**
1. In main kettle, combine Part 1 ingredients and heat to 78-80°C.
2. Add Part 2 ingredients and heat to 80°C. Mix until uniform using propeller mixer.
3. Add Part 3 to Part 1 and mix until uniform.
5. Add Part 4 while cooling.
6. Homogenize for approximately 2 minutes at 4000 rpm.
7. Add Part 5 to batch.
8. Homogenize for approximately 1 minute at 4000 rpm.
9. Cool batch to 30°C.
10. Add Part 5 to batch.

**Description**

This sunscreen contains Kobo’s Non-Nano Zinc Oxide Powder ZnO-C-DMC2. This sunscreen also contains organic sunscreens for broad spectrum.

**Active Ingredient(s)**
- Zinc Oxide: 7.35%
- Benzophenone-3: 3.00%
- Ethylhexyl Methoxycinnamate: 7.50%

**Broad Spectrum Protection**

**Formulation Guidelines**

- **Estimation of Use Level for SPF/UVA-PF**
  - SPF Units: 0.8 SPF / % ZnO
  - SPF / UVA -PF <3
  - Critical Wavelength > 370nm

**In vivo SPF 37 CW 370**