Zinc Oxide is a mineral UV filter, available in a wide range of primary particle sizes and varying optical properties. However, when formulated, it forms aggregates of primary particles; the degree of aggregation is a function of the primary particle size and manufacturing process. Large aggregates reduce the protection of the formula against UV light, and scatter visible light which increases skin whitening when the formula is applied.

Kobo uses its extensive experience to offer a wide selection of zinc dispersions that include various particle sizes, surface treatments, and carriers. By carefully selecting carriers and various particle sizes, surface treatments, and wide selection of ZnO dispersions that include Kobo uses its extensive experience to offer a applied.

Increases skin whitening when the formula is against UV light, and scatter visible light which aggregates reduce the protection of the formula optical properties. However, when formulated, a wide range of primary particle sizes and varying concentrations of primary particle sizes (PPS) on two different skin types.

These pictures compare the whitening effect of ZnO dispersions at 20% concentration of various primary particle sizes (PPS) on two different skin types.

The transmittance curves in this picture show the relationship between particle size, whitening (visible range) and UVA/UVB attenuation. As the particle size becomes smaller, ZnO becomes more effective in UVB attenuation (up to 2 SPF / ZnO%) and less in UVA protection. Particle size should be optimized when balanced UVA/UVB protection is required.

KSL-384B
All Zinc Sunscreen

Part 1
- TNP70MZ - Kobo Products: Zinc Oxide (And) C12-15 Alkyl Benzoate (And) Polyhydroxystearic Acid (And) Isopropyl Titanium Trisostearate 19.50%
- TNP70ZSI - Kobo Products: Zinc Oxide (And) C12-15 Alkyl Benzoate (And) Polyhydroxystearic Acid (And) Triethoxyacylpropylsilane 15.94%
- Dermol 25B - Alzo International Inc.: C12-15 Alkyl Benzoate 4.41%
- BRB Caprylyl Methicone - BRB International: Caprylyl Methicone 3.00%
- Dowsil™ ES-5226 DM Formulation Aid - Dow Chemical: Capryl Methicone (and) PEG/PPG-18/18 Dimethicone 3.00%
- Xiameter™ PMX-200 Silicone Fluid 100 CS - Dow Chemical: Dimethicone 2.00%
- Abil® WE 09 - Evonik: Cetyl PEG/PPG-10/1 Dimethicone (And) Hexyl Laurate 1.75%
- Abil® EM 180 - Evonik: Cetyl PEG/PPG-10/1 Dimethicone 1.00%

Part 2
- Plandool™-G - Nippon/Kobo Products: Bis- Behenyl/Isostearyl/Phytosteryl Dimer Dilinoleyl Dimer Dilinoleate 0.75%
- Peleomol® GTB - Phoenix Chemical: Tribehenin 0.50%

Part 3
- Deionized Water - Water 32.40%
- Glycerin U.S.P. F.C.C. 96% - Ruger Chemical: Glycerin 6.00%
- Kelto® CG - CP Kelco: Xanthan Gum 0.10%

Part 5
- Magnesium Sulfate - Fisher Scientific: Magnesium Sulfate 0.90%
- ALLANTOIN - RITA: Allantoin 0.15%
- Dermoifeel® PA 3 - Dr. Straetmans/Kinetik: Sodium Phytate (And) Aqua (And) Alcohol 0.15%

Part 6
- Symdiol® 68 - Symrise: 1,2-Hexanediol (And) Caprylyl Glycol 0.50%
- SymSave® H - Symrise: Hydroxyacetophenone 0.50%

Part 7
- MSS-500W - Kobo Products: Silica 5.45%
- MSS-500/N - Kobo Products: Silica 2.00%

Manufacturing Procedure
1. In main vessel, combine Part 1 and homogenize (4800 rpm) while heating to 80-85°C.
2. Once Part 1 reaches a temperature of 80-85°C, add Part 2 and homogenize for an additional 10 minutes.
3. In a side kettle, add Part 3. Pre-mix Part 4 and add to Part 3 with fast speed propeller mixing. While mixing, heat Parts 3 and 4 to 80°C.
4. Add Part 5 ingredients, one at a time, to Parts 3 and 4 with fast speed propeller mixing. (Maintain temperature at 80°C).
5. Slowly add Parts 3, 4 and 5 to Parts 1 and 2 with slow homogenization. Slowly homogenize with side scraping only enough to blend contents thoroughly.
6. When all of the water phase is added, begin cooling batch while homogenizing (3500 rpm).
7. Pre-mix Part 6 until phase is clear and all is dissolved. When batch reaches 40°C, add Part 6 with slow homogenization.
8. Sprinkle in Part 7 and homogenize until batch is smooth and uniform.
9. When batch reaches 30°C, homogenize at moderate speed for 15 minutes, maintaining the temperature at 30°C or less.

Description
This formula is a rich and creamy sunscreen that glides on easily and rubs in leaving very minimal whitening on skin. Skin is left feeling soft and moist, yet non-greasy. The different particle sizes of Zinc Oxide dispersions TNP70MZ and TNP70ZSI provide the SPF and high UVA protection. Plandool™-G helps provide a water-resistant film while also offering skin moisturization. Kobo microspheres MSS-500W and MSS-500/N give the product its soft and non-greasy after feel.

Active Ingredients
- Zinc Oxide 24.06%

Testing
- SPF: in vivo on 3 subjects
- UVA-PF in vivo on 3 subjects
- CW: FDA method

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Technical Literature ref ZnD-002 - February 25, 2020

www.koboproducts.com
This chart was prepared to assist formulators using ZnO Dispersions. The information contained herein is believed to be accurate at the time of printing and represents typical values, but should not be used as a substitute for product specification sheets.

The following information is listed:

- Active content (%)
- Primary Particle Size (nm) of the ZnO pigment used
- Size of aggregates as measured by Dynamic Light Scattering - DLS size (nm) - for comparison; should not be utilized for labeling or notification purpose
- EU Compliance: These ZnO comply with the conditions for Zinc Oxide (nano) as set forth in the Annex VI to Regulation (EC) No 1223/2009
- Viscosity

We recommend that customers make their own assessment when using particle size data for the purpose of identifying nanomaterials in their finished formulations.

Please contact our team at techservice@koboproductsinc.com for additional information on this subject.

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Product Name</th>
<th>INCI Name</th>
<th>Active %</th>
<th>Primary Part. Size (nm)</th>
<th>DLS Size (nm)</th>
<th>EU Compliance</th>
<th>Viscosity</th>
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<tbody>
<tr>
<td>Esters/Oils</td>
<td>TNP50ZSI</td>
<td>C12-15 Alkyl Benzoate (And) Zinc Oxide (And) Polyhydroxystearic Acid (And) Triethoxycaprylylsilane</td>
<td>47</td>
<td>20</td>
<td>N/A</td>
<td>Compliant</td>
<td>Pourable</td>
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<tr>
<td></td>
<td>OMQP50XZ4</td>
<td>Zinc Oxide (And) Octyldodecyl Myristate (And) Polyhydroxystearic Acid (And) Methicone</td>
<td>48</td>
<td>20</td>
<td>N/A</td>
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<td>Pourable</td>
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<tr>
<td></td>
<td>GCP50XZ4</td>
<td>Zinc Oxide (And) Caprylic/Capric Triglyceride (And) Polyhydroxystearic Acid (And) Methicone</td>
<td>48</td>
<td>20</td>
<td>155</td>
<td>-</td>
<td>Pourable</td>
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<tr>
<td></td>
<td>GCP50ZSI</td>
<td>Zinc Oxide (And) Caprylic/Capric Triglyceride (And) Polyhydroxystearic Acid (And) Triethoxycaprylylsilane</td>
<td>47</td>
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<td>130</td>
<td>Compliant</td>
<td>Pourable</td>
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<td>TNQP75HP1</td>
<td>Zinc Oxide (And) C12-15 Alkyl Benzoate (And) Polyhydroxystearic Acid (And) Triethoxycaprylylsilane</td>
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<td>60-100</td>
<td>216</td>
<td>Compliant</td>
<td>Paste</td>
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<td>Zinc Oxide (And) Caprylic/Capric Triglyceride (And) Polyhydroxystearic Acid (And) Stearoyl Glutamic Acid</td>
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<td>20</td>
<td>125</td>
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<td>Pourable</td>
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<td></td>
<td>GCP55MZ8SG</td>
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<td>UV Boosters</td>
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<td>CAQP60ZSI</td>
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<td>20</td>
<td>145</td>
<td>Compliant</td>
<td>Pourable</td>
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</tbody>
</table>

Formulation guidelines

Estimation of use level for SPF
1. PPS : 20 - 30 nm, PS < 150 nm 1.0 - 2.0 SPF / ZnO %
2. PPS : > 60 nm, PS > 200 nm 0.5 - 1.0 SPF / ZnO %

Our dispersions are often divided into two general categories:

1. High Solids® Dispersions: These are usually in paste form and have a high active ZnO loading and efficacy.
2. High Speed™ Dispersions: These are usually pourable and easy to incorporate into a formulation.

US 20180235855A1, WO 2007048057A3
Zinc Oxide powder blends, their production and use.
US 9949904B2
Method of Formulating ZnO powder blends for balanced UVA/UVB attenuation.

Please contact our team at techservice@koboproductsinc.com for additional information on this subject.