T-80 series

Non Nano TiO$_2$
Balanced UV protection
Released in 2012.

Published in ‘Personal Care Magazine’ in Nov. 2012

Sales of T-80 is spiking worldwide in 2013
T-80 series, Non Nano TiO$_2$

TiO$_2$ 20~80nm
Silica Thin layer Coating

Aggregation
Nano TiO$_2$ bound by inorganic silica binder to form Micro size granule

T-80

T-80AS
TiO$_2$ 80%
SiO$_2$ 15%
Alkyl Silane 5%

T-80JJ
or T-80SF
TiO$_2$ 80%
SiO$_2$ 12%
Jojoba Esters 8%
/Sun Flower Ester

T-80LL
TiO$_2$ 80%
SiO$_2$ 12%
Lauroyl Lysine 8%

T-80SA
TiO$_2$ 80%
SiO$_2$ 12%
Stearic Acid 8%
TEM of T-80

Particle Size
D10 : 364nm
D50 : 562nm
D90 : 988nm
7 big Things about T-80 series

1. Non Nano
2. UVA/UVB < 3.0
   Critical Wavelength > 370nm
3. UVB protection as good as 15nm TiO$_2$
4. UVA protection better than 40nm ZnO
5. ECOCERT TiO$_2$
6. No Alumina
7. Good Photo-stability
Are you ready?
I’m going to explain the benefits one by one

Benefit #1

1. Non Nano
2. UVA/UVB < 3.0
   Critical Wavelength > 370nm
3. UVB protection as good as 15nm TiO₂
4. UVA protection better than 40nm ZnO
5. ECOCERT TiO₂
6. No Alumina
7. Good Photo-stability
Particle Size Analysis by Dynamic Light Scattering

**Particle Size**
- D10 : 364nm
- D50 : 562nm
- D90 : 988nm

**Test Equipment**
Maker: Malvern
Model: Master sizer 2000
SEM of T-80

Test Equipment

Maker: HITACHI
Model: S-4700

Test Equipment

Maker: HITACHI
Model: S-4700
Specific Surface Area Measurement

Test Equipment
Maker: Micrometrics
Model: ASAP 2020

BET = 46.9m²/g

THE EUROPEAN COMMISSION HAS ADOPTED THIS RECOMMENDATION (Oct. 2011):
5. Where technically feasible and requested in specific legislation, compliance with the definition in point 2 may be determined on the basis of the specific surface area by volume. A material should be considered as falling under the definition in point 2 where the specific surface area by volume of the material is greater than 60 m²/cm³. However, a material which, based on its number size distribution, is a nanomaterial should be considered as complying with the definition in point 2 even if the material has a specific surface area lower than 60 m²/cm³.
OK...it’s non-nano...but is it strong enough?

We tried to check whether it’s still held together after strong shear force of emulsion process

We tested T-80 series together with the other nano TiO$_2$ & nano ZnO
Non nano & Not Breakable by shear force of emulsion process

NANO Particle detection test results from RAW Material

NANO Particle detection test results from finished formula

2500rpm 30min

2500rpm 30min
Benefit #2, #3, #4

EU Commission Guidelines
1. UVA protection factor must be at least 1/3 of claimed SPF if claimed (i.e. labeled) SPF = 30, in vivo UVAPF > 10, in vitro
2. Critical wavelength should be over 370nm

1. Non Nano
2. UVA/UVB < 3.0
   Critical Wavelength > 370nm
3. UVB protection as good as 15nm TiO₂
4. UVA protection better than 40nm ZnO
5. ECOCERT TiO₂
6. No Alumina
7. Good Photo-stability
Tested Samples

15nm TiO$_2$,
Product “M”
TiO$_2$: 82%
Al$_2$O$_3$ & Stearic Acid: 18%

500nm TiO$_2$,
T-80JJ
TiO$_2$: 80%
SiO$_2$ & Jojoba esters: 20%
T-80 Series meet **EU UVA** Protection Guideline

**Test Formula: W/O sun cream**

<table>
<thead>
<tr>
<th>Part</th>
<th>Trade Name</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>D.I. WATER</td>
<td>65.0</td>
</tr>
<tr>
<td></td>
<td>Natural Extract</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>NACL</td>
<td>1.0</td>
</tr>
<tr>
<td>B</td>
<td>CETIOL CC</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>LAMEFORM TGI</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>DEHYMULS PGPH</td>
<td>2.0</td>
</tr>
<tr>
<td>C</td>
<td><strong>15nm TiO₂ vs. T-80JJ</strong></td>
<td><strong>10.0</strong></td>
</tr>
<tr>
<td></td>
<td>SUNSIL-150H</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**Test Result**

<table>
<thead>
<tr>
<th></th>
<th>15nm TiO₂</th>
<th>T-80JJ</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>in vivo SPF</strong></td>
<td>28</td>
<td>26</td>
</tr>
<tr>
<td><strong>in vivo UVA PF</strong></td>
<td>-</td>
<td>6.0</td>
</tr>
<tr>
<td><strong>in vitro SPF</strong></td>
<td>25.77</td>
<td>27.83</td>
</tr>
<tr>
<td><strong>in vitro UVA PF</strong></td>
<td>8.56</td>
<td>13.79</td>
</tr>
</tbody>
</table>

**SPF/ UVA PF**

- 28/8.56 = 3.27
- 26/13.79 ≤ 1.88 ≤ 3.0

**C.W**

- 363.3
- 379.5 ≥ 370nm

**7 Big Things about T-80**

1. Non Nano
2. UVA/UVB < 3.0 Critical Wavelength > 370nm
3. UVB protection as good as 15nm TiO₂
4. UVA protection better than 40nm ZnO
5. ECOCERT TiO₂
6. No Alumina
7. Good Photo-stability

**Benefit #2**

Logo for compliance with EU recommendation
Transmittances Curve

- **15nm TiO₂**
  - SPF/UVAPF = 3.27
- **T-80JJ**
  - SPF/UVAPF = 1.88

- **Same level of UVB protection**
- **Better UVA protection**
**Broad UVA & UVB protection**

<table>
<thead>
<tr>
<th></th>
<th>UVB In vivo SPF/%</th>
<th>UVA In vivo PA/%</th>
</tr>
</thead>
<tbody>
<tr>
<td>15nm TiO$_2$</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td>40nm ZnO</td>
<td>1.5</td>
<td>0.3</td>
</tr>
</tbody>
</table>

- **UVA protection better than 40nm ZnO**
- **UVB protection as good as 15nm TiO$_2$**
Why Broad UVA & UVB Protection?

T-80 means less Cost & More Formulation Freedom

**Benefits**
- T-80 series can boost SPF & PA at the same time
- No need to add TiO₂ and ZnO separately
- This means less formulation cost and more formulation freedom
- Moreover, T-80 can be good in combination with Avobenzone that is of the most economic UVA filter
Benefit #5, #6

1. Non Nano
2. UVA/UVB < 3.0
   - Critical Wavelength > 370nm
3. UVB protection as good as 15nm TiO$_2$
4. UVA protection better than 40nm ZnO
5. ECOCERT TiO$_2$
6. No Alumina
7. Good Photo-stability
Alumina Free means BMDBM compatible

BMDBM forms a complex with Al$_3^+$ salts from TiO$_2$ coatings

Aluminum oxide is one of the most common coating material for TiO$_2$.

→ The amount of BMDBM decreases
→ Weakening of the UVA protection

Benefit #5, #6

T-80AS, The most hydrophobic coating

ECOCERT

T-80, Hydrophilic silica coating
For water phase

T-80JJ or T-80SF
The best hydrophobic ECOCERT coating

T-80LL,
The best soft feel,
For ECOCERT make up

T-80SA,
The most cheaper
For mass market ECOCERT sun care
Benefit #7

1. Non Nano
2. UVA/UVB < 3.0
   Critical Wavelength > 370nm
3. UVB protection as good as 15nm TiO\textsubscript{2}
4. UVA protection better than 40nm ZnO
5. ECOCERT TiO\textsubscript{2}
6. No Alumina
7. Good Photo-stability
Photo-Stability

T-80 Series show much better photo-stability as compared to other commercially available TiO₂.

<table>
<thead>
<tr>
<th></th>
<th>Nano (15 nm) TiO₂</th>
<th>Non-nano TiO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-80 series</td>
<td>Y.I: 2.70</td>
<td></td>
</tr>
<tr>
<td>Coated TiO₂</td>
<td>2.98</td>
<td>2.69</td>
</tr>
<tr>
<td>Naked TiO₂</td>
<td>2.14</td>
<td>2.83</td>
</tr>
</tbody>
</table>

Test condition:
- Powder:Vaseline = 1:1
- Put under sunlight at room temperature
- 7 days

Test equipment: Nippon Denshoku ZE 2E 2000

Y.I: Yellow Index
Customers’ Questions
Q1. Dosage guideline

How much T-80 series do we have to add to get SPF50?
### % Table of T-80 series for SPF

Unit PA of T-80 series is 0.6

<table>
<thead>
<tr>
<th>Category</th>
<th>Labelled sun protection factor</th>
<th>Measured sun protection factor</th>
<th>% of T-80 series needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low protection</td>
<td>6</td>
<td>6 – 9.9</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10 – 14.9</td>
<td>3.5</td>
</tr>
<tr>
<td>Medium protection</td>
<td>15</td>
<td>15 – 19.9</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>20 – 24.9</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>25 – 29.9</td>
<td>9.9</td>
</tr>
<tr>
<td>High protection</td>
<td>30</td>
<td>30 – 49.9</td>
<td>12.4</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>50 – 59.9</td>
<td>25.0</td>
</tr>
</tbody>
</table>

% Needed for PA

- 4~7% of T-80 needed for PA+
- 7~14% for PA++
- >14% for PA+++
Q2. Poor SPF... I have SPF10 instead of SPF20 for 10% T80JJ

Q: Why?
A: Remember that SPF of formula is always related with how well T80JJ is dispersed

Q: Your suggestion?
A: We recommend to use 3 roll-mill after you make emulsion.

Based on our internal study,

If you put 10% of T80JJ powder directly into emulsion, you would usually have SPF10

But if you pre-mix T80JJ in oil phase then put it and do emulsion, you would have SPF13

If you make emulsion with T80JJ and then do 3-roll milling, you would have SPF15

The best way is using T80JJ dispersion from SUNJIN which is SFT series, you will have SPF20 for 10% of T80JJ
Q: Why?
A: ECOCERT emulsifiers are usually weak emulsifiers. So you should use them enough

Q: Your suggestion?
A: We tested 3 most common ECOCERT emulsifiers at our guideline O/W formula: Montanov 202, Arlatone 2121 & Olivem 1000

<table>
<thead>
<tr>
<th>Tested Formula O/W</th>
<th>Trade Name</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>T-80</td>
<td>25.00</td>
</tr>
<tr>
<td></td>
<td>Glycerin</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>D.I Water</td>
<td>27.00</td>
</tr>
<tr>
<td></td>
<td>5% Veegum</td>
<td>20.00</td>
</tr>
<tr>
<td>B</td>
<td>Cetiol-CC</td>
<td>7.00</td>
</tr>
<tr>
<td></td>
<td>MCT oil</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>Shea Butter</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Beeswax</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td><strong>ECOCERT emulsifier</strong></td>
<td><strong>3.00</strong></td>
</tr>
</tbody>
</table>

**Stability Test Result**
- Montanov 202 3%
  → Day1 separation at 25°C & 50°C
- Arlatone 2121 3%
  → Day1 separation at 25°C & 50°C
- Olivem 1000 3%
  → stable at 25°C for 4 weeks
  → stable at 50°C for 1 week
- **Olivem 1000 4%**
  → stable at 25°C for 4 weeks
  → stable at 50°C for 4 week

**Notes**
- **Montanov 202**: Arachidyl Alcohol/Behenyl Alcohol/Arachidyl Glucoside
- **Arlatone 2121**: Sorbitan Stearate/Sucrose Cocoate
- **Olivem 1000**: Cetearyl Olivate/Sorbitan Olivate
## Evaluation

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>SPF</td>
<td>30</td>
</tr>
<tr>
<td>PA</td>
<td>++</td>
</tr>
<tr>
<td>SPF/UVA</td>
<td>n.a.</td>
</tr>
<tr>
<td>Critical</td>
<td>n.a.</td>
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<tr>
<td>Wavelength</td>
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<tr>
<td>Sensory Index</td>
<td>5.0</td>
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</table>

## SJF-1402-Skin Perfector BB SPF 30, PA+++ W/O ver1.0

### New in 2014

<table>
<thead>
<tr>
<th>Part</th>
<th>Trade Name</th>
<th>INCI Name</th>
<th>%</th>
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<tbody>
<tr>
<td>A</td>
<td>Water</td>
<td>Deionized water</td>
<td>40.50</td>
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<tr>
<td></td>
<td>1,3-B.G.</td>
<td>1,3-Butylene Glycol</td>
<td>7.00</td>
</tr>
<tr>
<td></td>
<td>NaCl</td>
<td>Sodium Chloride</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>ABIL EM 90</td>
<td>Cetyl PEG/PPG-10/1 Dimethicone</td>
<td>2.50</td>
</tr>
<tr>
<td></td>
<td>KSG 16</td>
<td>Dimethicone/Vinyl Dimethicone Crosspolymer</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>BENTONE 38VCG</td>
<td>Quaternium-18 Hectorite</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>KF 6017</td>
<td>PEG 10 Dimethicone</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>Cetiol CC</td>
<td>Dicaprylil Carbonate</td>
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</tr>
<tr>
<td></td>
<td>Parsol MCX</td>
<td>Ethylhexyl methoxycinnamate</td>
<td>5.00</td>
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<td></td>
<td>DC 200F 10CS</td>
<td>Dimethicone</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>ININ</td>
<td>Isononyl isononanoate</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>KF995</td>
<td>Cyclomethicone</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>T-80AS</td>
<td>Titanium Dioxide/Silica/Triethoxy caprylysilane</td>
<td>8.00</td>
</tr>
<tr>
<td></td>
<td>SNOWTITAN-AS</td>
<td>Titanium Dioxide/Silica/Triethoxy caprylysilane</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>IOY AS</td>
<td>Iron Oxide/Triethoxy caprylysilane</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>IOR AS</td>
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<td>0.02</td>
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<tr>
<td></td>
<td>IOB AS</td>
<td>Iron Oxide/Triethoxy caprylysilane</td>
<td>0.15</td>
</tr>
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<td>B</td>
<td>SUNPMMACOCO-170</td>
<td>Methylmethacrylate Crosspolymer</td>
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<tr>
<td>C</td>
<td>Phenoxylethanol</td>
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<tr>
<td></td>
<td>FRAGRANCE</td>
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Sun Care Set 2014