

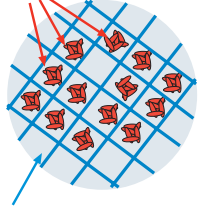
Non-nano Composite UV Powders for Safer Sunscreens

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Nano sized TiO₂ and ZnO have been widely used as effective inorganic UV filters. However, their safety has been questioned due to potential skin penetration and bio-accumulation. In light of the recent regulations on nanomaterials, efforts have been made to address these concerns. One of the most promising type of products developed to solve this problem is composite powders, where ultrafine TiO₂ or ZnO are entrapped within a matrix of polymer which has a particle size much larger than the limit of nanomaterial range (100 nanometers).

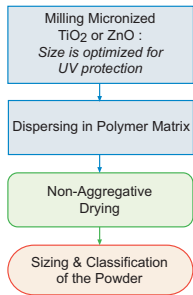
Composite structure

Attenuation Grade TiO₂ aggregates :
Size is optimized for best UV performance



Polymer Matrix :
Forms micron-sized powder
Provides mechanical resistance
Prevents TiO₂ aggregates from agglomerating
Gives better tactile properties

Manufacturing Process



Process and Composition : Patent Pending

Trade Name : Composite ACT-50

INCI Name

Titanium Dioxide (And) Acrylates Copolymer (And) Hydrated Silica (And) Aluminum Hydroxide (And) Algin

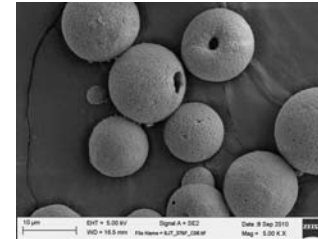
Active Content

TiO₂ (15nm PPS) 45 – 57%

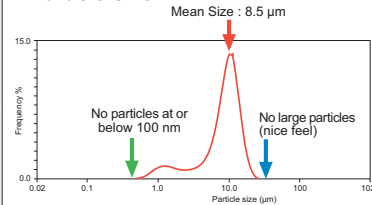
Polymer Matrix

Acrylate Copolymer

SEM Picture



Particle Size



Size measurement made with Horiba LA-910 (Laser Scattering Particle Size Analyzer) - particles dispersed in isopropyl alcohol - sonicated 4min.

Surface Treated Composite ACT-50

Composite ACT-50 can also be surface treated for an improved hydrophobicity and skin feel.

Example : Composite ACT-50-11S2
INCI Name : Titanium Dioxide (And) Acrylates Copolymer (And) Triethoxycaprylsilane (And) Hydrated Silica (And) Aluminum Hydroxide (And) Algin

UV Attenuation Performance

SPF was measured in-vivo on 3 panelists.
Critical wavelength was measured on LabSphere 1000.

Reference	Type	Actives	% TiO ₂	in vivo SPF	Critical wavelength
KSL-199A	W/O	Composite ACT-50 (12%)	6.3%	17.1	371 nm
KSL-199C	W/O	Composite ACT-50-11S2 (12%)	6.3%	17.1	374 nm
KSL-007B	O/W	15nm TiO ₂ dispersion	6.4%	16.0	typically < 360 nm

The results above show lotions formulated with Composite ACT-50 (treated and untreated) have similar SPF values and a higher critical wavelength than lotion formulated with 15nm primary particle size attenuation-grade TiO₂.

Reference	Type	Actives	% TiO ₂	in vivo SPF	Critical wavelength
KSL-138U	O/W	Composite ACT-50 (11.8%) & organics	6.0%	54.8	383 nm
KSL-138	O/W	Only organics	-	41.0	381 nm

These results show that Composite ACT-50 can be used for boosting SPF in a formula containing organic sunscreens .

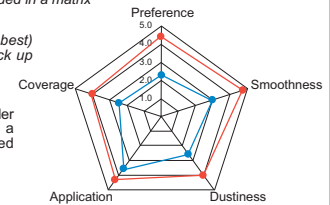
Reference	Type	Actives	% TiO ₂	in vivo SPF	Critical wavelength
KPP-047	Pressed Powder	Composite ACT-50 (25%)	13%	20.8	not measured

In addition to expected good skin feel, Composite ACT-50 provides SPF in pressed powders.

Sensory Test

Formula : Pressed Powder
- Red curve : 15% Composite ACT-50 (8% TiO₂)
- Blue curve : 8% TiO₂ not embedded in a matrix

Test : 5 panelists
- score 1 to 5 (highest score the best)
- the quality of the powders (pick up and application)



The results clearly show that the powder containing Composite ACT-50 has a much better skin feel and is preferred by the panelists.

Transparency on Application



Formulations Examples

W/O High SPF Sunscreen (KSL-199A)

Part	%w/w	Trade Name	INCI Name	Supplier
1	62.74	Deionized Water	Deionized Water	Spectrum Morton Salt Nipa Nipa
	1.00	Magnesium sulfate	Magnesium sulfate	
	0.20	Sodium Chloride	Sodium Chloride	
	0.06	Methyl Paraben Propyl Paraben	Methyl Paraben Propyl Paraben	
2	12.00	Composite ACT-50	Titanium Dioxide (And) Acrylates Copolymer (And) Hydrated Silica (And) Aluminum Hydroxide (And) Algin	KOBO
	5.00	Puroil Disocostearate	Triethylalcohol Disocostearate	
	10.00	Panalane LI4E	Hydrogenated Polyisobutene	
	3.00	Fitoderm	Squalane	
	4.00	SF 1202	Cyclopentasiloxane	
3	1.00	Jeeasil PS-VHBF	Isododecane & Bis-Vinyl Dimethicone/Dimethicone Copolymer	Momentive Jeen
	100.00			

Active content : TiO₂ 6.3%
SPF 16.9

O/W Hybrid Sunscreen (KSL-138U)

Part	%w/w	Trade Name	INCI Name	Supplier
1	44.1	Deionized Water	Deionized Water	Lipo Chemicals
	1.0	Liposorb® L-20	Polysorbate 20	
2	1.5	Propylene Glycol	Propylene Glycol	Symrise CP Kelco
	0.3	Xanthan CG	Xanthan Gum	
3	15.0	Neo Helopan® HMS	Homosalate	Symrise KOBO
	11.8	Composite ACT-50	Titanium Dioxide (And) Acrylates Copolymer (And) Hydrated Silica (And) Aluminum Hydroxide (And) Algin	
	10.0	Neo Helopan® OS	Ethylhexyl Salicylate	
	3.0	Lipo® GMS 450	Glyceryl Stearate	
	3.0	Neo Helopan® BB	Benzophenone-3	
	3.0	Neo Helopan® 357	Butyl Methoxydibenzoylmethane	
	2.0	Lipomulse® 165	Glyceryl Stearate (And) PEG-100 Stearate	
	2.0	Caraphyl® 368	Ethylhexyl Palmitate	
	0.5	Lipowax® D	Cetearyl Alcohol (And) Ceteareth-20	
	0.5	Covi-ox® T-50	Tocopherol	
0.3	Liposorb® TS	Sorbitol Tristearate		
4	1.0	Botanistat PF-64	Phenoxyethanol (and) Caprylyl Glycol (and) Ethylhexylglycerin (and) Hexylene Glycol	DD Chemco
	1.0	Aculyn™ 44	PEG-150/Decyl Alcohol/SMDI Copolymer	
5	1.0			Rohm & Haas
100.0				

Active content : TiO₂ 6.2%
Homosalate 15% - Ethylhexyl Salicylate 10%
Benzophenone-3 3%
Butyl Methoxydibenzoylmethane 3%
SPF 54.8

SPF Pressed Powder (KPP-047)

Part	%w/w	Trade Name	INCI Name	Supplier
1	35.01	TALC NMM3	Talc (And) Magnesium Myristate	KOBO
	26.24	GMS-12	Mica (And) Isopropyl Titanium Trisostearate	
2	25.00	Composite ACT-50	Titanium Dioxide (And) Acrylates Copolymer (And) Hydrated Silica (And) Aluminum Hydroxide (And) Algin	KOBO
	5.00	ZINC MYRISTATE	Zinc Myristate	
	1.80	BYO/MM3	Iron Oxides (C.I. 77492) (And) Magnesium Myristate	
	1.20	BRO/MM3	Iron Oxides (C.I. 77491) (And) Magnesium Myristate	
	0.55	BBO/MM3	Iron Oxides (C.I. 77499) (And) Magnesium Myristate	
	0.10	Propyl Paraben NF	Propylparaben	
	0.10	Methyl Paraben NF	Methylparaben	
	5.00	Jeescreen OMC	Ethylhexyl Methoxycinnamate	
	100.00			

Active content : TiO₂ 13%
SPF 20.8

The authors would like to thank Carl Orr and Edward Bartholomey for their contribution to this study.

Summary :

- No particles at or below 100 nanometers
- UV Attenuation performance similar to that of micronized pigments
- Broad Spectrum protection
- Good skin feel and transparency