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HARKE GROUP

Sun Care

01 | 2022

SunCat Series

Safe and Efficient Sunscreen Dispersion

ONE PARTNER.
ONE RESPONSIBILITY.

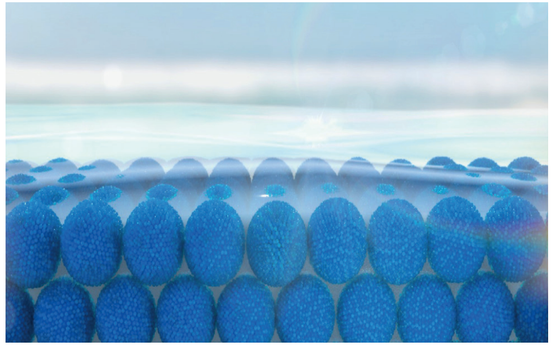
HARKE GROUP

ONE PARTNER.
ONE RESPONSIBILITY.

Our Partner

BioNest Biochemical Technology Co., Ltd. is a company that manufactures raw materials for cosmetics and skin care products. With the mission of technology and the health of users, they are committed to improving the manufacturing technology and effectiveness of various active ingredients. The experience and service of BioNest Biochemical Technology Co., Ltd. is a competitive advantage in the market. They will focus more on the development and manufacture of innovative raw materials.

Introduction for SunCat Series



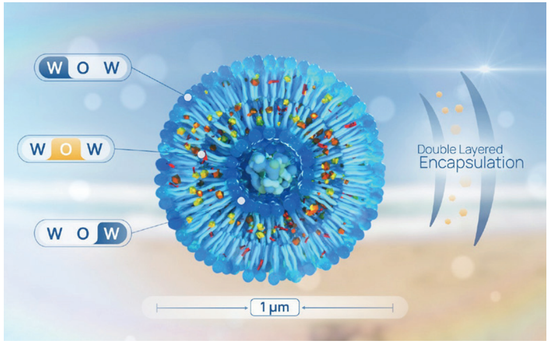
The trial prototypes of the SunCat series of sunscreen products were launched in parts of the international market in 2005. Since then, the convenience, safety, and high performance of this next generation UV filter dispersion has received enthusiastic praise and appreciation from formulators, manufacturers and customers.

We are now proud to announce the launch of SunCat in response to our customer demands, and also recognizing latest trends in the preferred organic UV absorbers and in compliance with latest safety regulations such as REACH, Europe.

SunCat incorporates 3 globally approved UV filters. SunCat has been produced using a specially developed proprietary enwrapping technique to stabilize the chemical sunscreens and to ensure high performance with prolonged and consistent SPF values. The aqueous encapsulated sunscreen of SunCat allows for ease of use. Non-irritant and not absorbed into the skin, SunCat can also provide a longer skin surface residence time as well as reproducible SPF values with broad spectrum protection in minimum sunscreen concentration. The performance in terms of SPF and SPA ratios are far beyond the conventional levels.

It is noted that further SunCat formulation options are being developed to stay abreast of changing market preferences and further optimizing safety and performance/cost ratios.

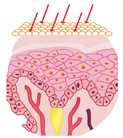
Encapsulated Sunscreen of the next generation



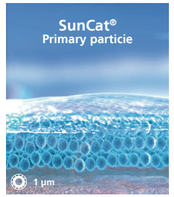
- Pre-solubilized mixture of both liquid and powder chemical sunscreen
- Through a proprietary, high pressure, and high shear process
- Micronized sunscreen enwrapped in double-layered sphere
- Negatively charged outer sphere
- Prevent aggregation

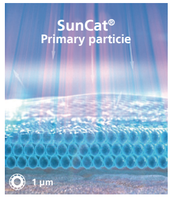
Evenly spread to provide uniform protection

SunCat Series

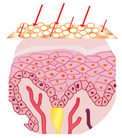


Evenly spread protection of SunCat





Traditional Sunscreen



Traditional chemical sunscreen with uneven protection

Introduction of UV Rays

UV rays can be classified according to wavelength as UVA, UVB and UVC, the shorter its wavelength, the stronger its energy. For UVC, it does not penetrate earth's ozone layer. Because there are a lot of active molecules in ozone layer, the high energy radiation such like UVC will easily be absorbed, and proceed further chemical reaction. For UVB, it is well known that it can reach skin surface, and cause burning and tanning. For UVA, it always goes into skin deeper, initiate releasing of free radicals, and cause DNA damage. If serious damage is formed, the skin cancer happens.

DNA with normal structure helps cells produce integrated and sufficient proteins, which bring our skin beauty and health. However, there are thousands of DNA damaged by active oxygen substance and UV radiation, it will induced function failure or death of cell. Sufficient proteins might not be produced and skin aging appears earlier.

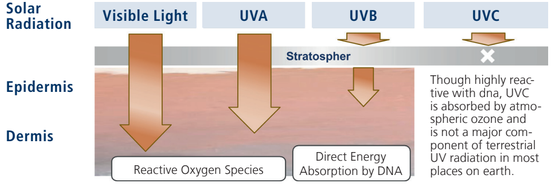
UV Rays	Description	Wavelength (nm)
UVC	Shortest wavelength, usually stay outside the Earth's ozone layer	200 - 290
UVB	Longer wavelength that reach the skin surface can cause tanning and burning	290 - 320
UVA	Longest wavelength that can penetrate deep into the skin's surface releasing free radicals and causing DNA changes that can result in skin cancer	320 - 400

Influence on Skin by UV Rays

% Reaching Ground

UVA	UVB	UVC
95 %	5 %	
Causes Aging Sunscreen protection	Causes Burning & Tanning	Blocked by Atmosphere
STAR SYSTEM	SUN FARTORY (SPF)	

In the past, sunscreen product always emphasize SPF for UVB protection. In fact, the UVB only cover 5% of UV reaching ground. The other 95% is UVA. In these years, consumer product companies and consumers are aware of the importance to incorporate UVA protection into sunscreen production, and labelling of star and PA+ system are becoming more welcomed.



Though highly reactive with dna, UVC is absorbed by atmospheric ozone and is not a major component of terrestrial UV radiation in most places on earth.

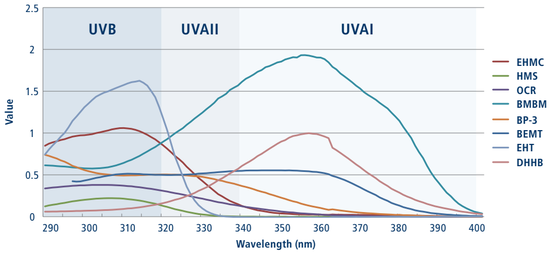
Actually, longer wavelength, deeper penetration. UVB stays on epidermal layer, and UVA will reach dermal one. For UVA, it generates active oxygen species, then oxidative damage happens. It will also cause DNA damage. For UVB, once it is absorbed by DNA, pyrimidine dimer and photoproduct will be produced. Generally speaking, once UV light causes DNA damage, mutation and skin cancer might occurs.

Photoaging Caused by UV Rays

The skin, like other organs in the body, will age over time. The difference is that the skin is in direct contact with the external environment, so the external environment is more damaging to the skin, the biggest source of damage is the sun's ultraviolet rays. The aging of the skin caused by UV radiation is called photoaging, and its process is similar to the general aging, which is a cumulative process.

Photoaging causes loss of elasticity of skin elastin, severe loss of collagen in the dermis, and loss of antioxidant defense system in the skin, which eventually leads to permanent genetic changes and aging.

UV Spectra if UV Filters in SunCat Series

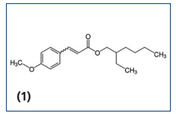


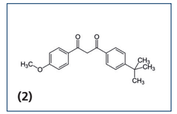
- EHMC: Ethylhexyl methoxycinnamate
- HMS: Homosalate
- OCR: Octocrylene
- BMBM: Butyl methoxydibenzoylmethane
- BP-3: Benzophenone-3
- BEMT: Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb® S)
- EHT: Ethylhexyl Triazone (Uvinul® T 150)
- DHHB: Diethylamino Hydroxybenzoyl Hexyl Benzoate (Uvinul® A Plus)

Note: All UV spectra are obtained with conc. of 10 ppm in ethanol except for BEMT (in C12-15 Alkyl benzoate).

SunCat MTA

New UV Filters in SunCat


(1)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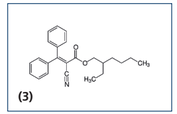

(3)

Composition of SunCat MTA

INCI NAME	CAS No.	EC No.	AMOUNT wt.%
Water	7732-18-5	231-791-2	35.9%
Ethylhexyl methoxycinnamate (1)	5466-77-3	226-775-7	20.0%
Butyl Methoxydibenzoylmethane (2)	70356-09-1	274-581-6	20.0%
Octocrylene (3)	6197-30-4	228-250-8	10.00%
1,3-Butylene Glycol	107-88-0	203-529-7	10.00%
Lecithin	8002-43-5	232-307-2	1.00%
Phenoxyethanol	122-99-6	204-589-7	0.10%

Formulas for the SPF Testing

- Gel, Cream, Cream + TiO_2 formulas are prepared for the below SPF testing samples.
- All these formulas are prepared for efficacy evaluation and observation not for commercial purpose.
- The information given in the SPF table below is a guideline only based on test formulations performed by BioNest. We recommend that you carry out your own testing on your specific formulations to confirm SPF.

Gel formula

PHASE	INGREDIENT	INCI NAME	W%
I	DE	Water	q. s.
	TEA	Triethanolamine	0.030
	Glycerine	Glycerine	5.000
	Carbomer 941 (2%)	Carbomer	15.00
	Preservatives	Phenoxyethanol	0.100
II	SunCat MTA	UV Filters	q. s.

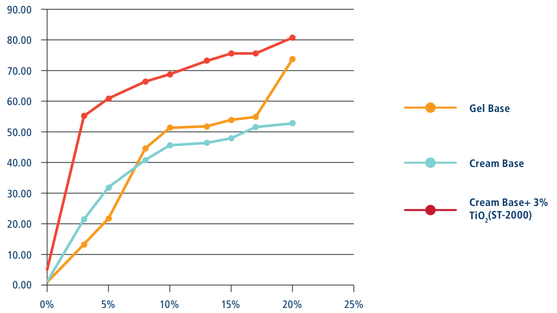
Cream formula

PHASE	INGREDIENT	INCI NAME	W%
I	TEGO CARE 450	Polyglyceryl-3 Methylglucose Distearate	4.500
	W-160L	Cetyl Alcohol (Cetearyl Alcohol)	1.000
	NeSol 2902b	Bio-Squalane (lighter)	14.50
II	PG	Propylene Glycol	7.000
	Chcogum GMT	Euglena Gracilis Polysaccharide	5.000
	DW	Water	q. s.
	Preservatives	Phenoxyethanol	0.120
III	SunCat MTA	UV Filters	q. s.

Cream formula with 3% Titanium Dioxide

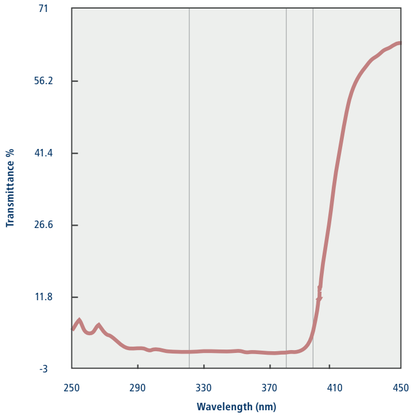
PHASE	INGREDIENT	INCI NAME	W%
I	TEGO CARE 450	Polyglyceryl-3 Methylglucose Distearate	4.500
	W-160L	Cetyl Alcohol (Cetearyl Alcohol)	1.000
	NeSol 2902b	Bio-Squalane (lighter)	14.50
	Nestdry ST-2000	Titanium dioxide & Talc & Dimethicone	3.000
II	PG	Propylene Glycol	7.000
	Chcogum GMT	Euglena Gracilis Polysaccharide	5.000
	DW	Water	q. s.
	Preservatives	Phenoxyethanol	0.120
III	SunCat MTA	UV Filters	q. s.

Correlation Between Concentration and SPF



Remark The results can be followed by formulators to easily develop new sunscreen formula with their desired sun protection factor in the most efficient way.

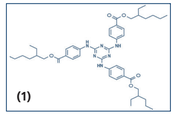
UV Transmission Test

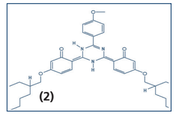


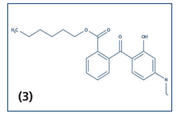
- Sample: 20% SunCat MTA cream
- Protection range: 280 nm ~ 400 nm
- 97% UV light can be screened

SunCat JCW03 & JCW09

New UV Filters in SunCat







Composition of SunCat JCW03

INCI NAME	CAS No.	EC No.	AMOUNT wt.%
Water	7732-18-5	231-791-2	35.9%
C12-15 Alkyl Benzoate	68411-27-8	270-112-4	20.0%
Ethylhexyl Triazone (1)	88122-99-0	402-070-1	10.0%
Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (2)	187393-00-6	–	5.0%
Diethylamino Hydroxybenzoyl Hexyl Benzoate (3)	302776-68-7	443-860-6	15.0%
Propanediol	504-63-2	207-997-3	10.0%
Phenoxyethanol (V/29)	122-99-6	204-589-7	0.7%
Hydroxyacetophenone	99-93-4	202-802-8	0.4%
Lecithin	8002-43-5	232-307-2	3.0%

Composition of SunCat JCW09

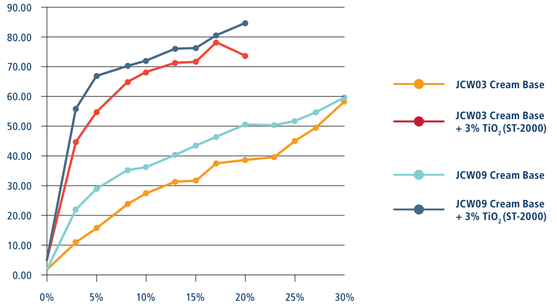
INCI NAME	CAS No.	EC No.	AMOUNT wt.%
Water	7732-18-5	231-791-2	35.9%
C12-15 Alkyl Benzoate	68411-27-8	270-112-4	20.0%
Ethylhexyl Triazone (1)	88122-99-0	402-070-1	10.0%
Diethylamino Hydroxybenzoyl Hexyl Benzoate (3)	302776-68-7	443-860-6	10.0%
Butyl Methoxydibenzoylmethane (s. (2) UV filters MTA)	70356-09-1	274-581-6	10.0%
Propanediol	504-63-2	207-997-3	10.0%
Phenoxyethanol (V/29)	122-99-6	204-589-7	0.7%
Hydroxyacetophenone	99-93-4	202-802-8	0.4%
Lecithin	8002-43-5	232-307-2	3.0%

Formulas for the SPF Testing

- Cream, Cream + TiO_2 formulas are prepared for the below SPF testing samples.
- All these formulas are prepared for efficacy evaluation and observation not for commercial purpose.
- The information given in the SPF table below is a guideline only based on test formulations performed by BioNest. We recommend that you carry out your own testing on your specific formulations to confirm SPF.

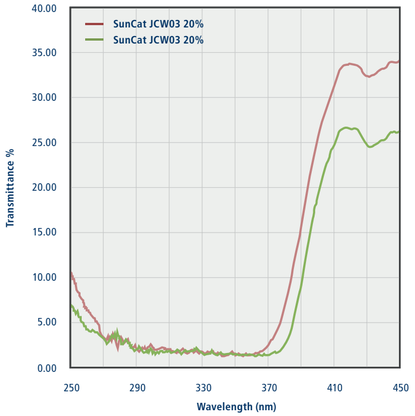
	PHASE	INGREDIENT	INCI NAME	W%
Cream formula	I	TEGO CARE 450	Polyglyceryl-3 Methylglucose Distearate	4.500
		W-160L	Cetyl Alcohol (Cetearyl Alcohol)	1.000
		NeSol 2902b	Bio-Squalane (lighter)	14.50
	II	PG	Propylene Glycol	7.000
		Chcogum GMT	Euglena Gracilis Polysaccharide	5.000
		DW	Water	q. s.
		Preservatives	Phenoxyethanol	0.120
	III	SunCat (JCW03 or JCW09)	UV Filters	q. s.

Correlation Between Concentration and SPF



Remark The results can be followed by formulators to easily develop new sunscreen formula with their desired sun protection factor in the most efficient way.

UV Transmission Test



- Sample: 20% SunCat JCW03 & JCW09 cream
- Protection range: 290 nm ~ 370 nm

SunCat MTA

In vitro SPF Test

This is SPF/UVA protection reference chart for different formulation and different amount of MTA. It's easy to achieve SPF 15 ~ 30 with 3 ~ 5% MTA for daily use and SPF50 with 15% MTA for outdoor use without TiO_2. With amount more than 5% of MTA, you can achieve 4 star based on UVA/UVB star category. With 3% of ST-2000, the SPF values can be improved by more than 20 easily.

SunCat MTA W%	0%	3%	5%	8%	10%	13%	15%	17%	20%
Cream base	1.63 –	21.26 ****	32.53 ****	41.10 ****	46.04 ****	46.82 ****	48.26 ****	51.89 ****	53.15 ****
Gel base	1.57 –	13.39 ****	22.54 ****	44.12 ****	51.66 ****	52.00 ****	54.02 ****	57.26 ****	72.98 ****
Cream base + 3% TiO_2 (ST-2000)	4.88 –	55.12 ****	61.34 ****	66.47 ****	68.49 ****	73.86 ****	76.23 ****	76.64 ****	80.43 ****

Results

For cream and gel base, SPF can be increased significantly with increasing amount of MTA before 10%, then increasing rate slows down. For cream base with ST2000, the critical point is 5%. Those trends are for our simple system, but can be for your reference to develop your own formulation in the most efficient way.

A Synergistic Performance Booster – Nestdry ST-2000

This is another remarkable invention from the laboratory of Bio-Nest Biochemical Technology Co.

In summary, the core product of the Nestdry ST-2000 is rutile 'no-nano' titanium dioxide (70 to 75%), asbestos free talc 20 to 25%, dimethicone and cyclopentasiloxane. The average size of the free-flowing solid particulates is from ca. 200 to 500 nm.

This product was designed to be used in conjunction with SunCat series. In the case of SunCat MTA a combination of 3% SunCat MTA and 3% Nestdry ST-2000 in a cream base results in a truly remarkable SPF 50 sunscreen cream (with PA++++). A remarkable feature is that the chemical sunscreen enwrapping prevents the inter-reaction of titanium dioxide and avobenzone (a well known fact in conventional sunscreens).

In the above chart of this Product Data Sheet (PDS), results of using 3% Nestdry ST-2000 in cream base, along with a range of levels of SunCat MTA up to 20%, illustrate this point.

IMPORTANT NOTE: It is not permitted to introduce to the USA market any sunscreen containg a combination of avobenzone and titanium dioxide.No other exceptions are known at this time. A synergistic performance booster – Nestdry ST-2000

In vitro & in vivo SPF Test

- G3 subjects enrolled panel in skin type II
- Tests performed by AMA Lab.
- The lot for this test is the same as the one for photostability test.

In vitro & vivo SPF	Gel base		Cream base		Cream Base + 3% TiO_2 (ST-2000)	
SunCat MTA, W%	8%	10%	5%	17%	3%	5%
In vitro SPF	42.60	48.39	31.89	51.36	57.36	63.50
In vivo SPF	39.3	62.9	35.7	56.2	63.91	73.11

Result Similar in vivo SPF results are obtained comparing to in vitro ones.

In vivo UVA-PF Test

- 30 subjects enrolled panel in skin type I II/III
- Tests performed by AMA Lab.
- All testing will be performed in accordance with the Declaration of Helsinki and national regulations regarding human studies as described by the International Standard ISO 24442 – Cosmetics – Sun protection test methods – In vivo determination of sunscreen UVA protection.

UVA-PF in vivo	Gel base	Cream base	Cream Base + 3% TiO_2 (ST-2000)
SunCat MTA, W%	10%	5%	3%
UVA-PF Value	18.3	17.9	19.2
UVA-PF	PA++++	PA++++	PA++++

Result The results show that in vivo UVA-PFs of sunscreen products containing SunCat-MTA are consistent with in vitro ones.

SunCat JCW03 & JCW09

In vitro SPF Test

SunCat	0%	3%	5%	8%	10%	13%	15%	17%	20%
UV filters %	0%	0.9%	1.5%	2.4%	3%	3.9%	4.5%	5.1%	6%
JCW03 Cream Base	1.63	11.33	16.35	23.66	27.81	31.41	32.2	37.48	38.68
JCW09 Cream Base	1.63	22.09	28.42	35.3	36.71	40.55	43.35	46.7	50.77
JCW03 Cream Base + 3% TiO_2 (ST-2000)	4.88	44.85	56.8	66.78	68.73	71.89	71.97	78.03	73.78
JCW09 Cream Base + 3% TiO_2 (ST-2000)	4.88	56.22	66.48	70.22	72.34	75.72	75.93	80.84	84.5

SunCat	20%	23%	25%	27%	30%
UV filters %	6%	6.9%	7.5%	8.1%	9%
JCW03 Cream Base	38.68	39.81	45.55	49.18	57.94
JCW09 Cream Base	48.09	50.28	52.39	54.4	59.52

Results

This is SPF protection reference chart for different amount of SunCat JCW03 & JCW09. It's easy to achieve SPF 15 ~ 30 with 5 ~ 13% JCW03 or 3 ~ 8% JCW09 for daily use and SPF 50 with 20% JCW09 for outdoor use without TiO_2. With 3% of ST-2000, the SPF values can be improved by more than 50 easily.

In vitro & in vivo SPF Test

SunCat JCW03	Cream Base	Cream Base + 3% TiO_2
W%	15%	3%
In vitro SPF	32.2	44.85
In vivo SPF	44.8	64.8

SunCat JCW09	Cream Base	Cream Base + 3% TiO_2
W%	15%	3%
In vitro SPF	43.35	56.22
In vivo SPF	41.6	69.89

In vivo & in vitro UVA test

In vivo UVA	JCW03 (Cream Base)	JCW09 (Cream Base)
SunCat, W%	15%	15%
In vivo UVA-PF	18.67	21.67
PA rating	PA++++	PA++++

In vitro UVA	JCW03 (Cream Base)	JCW09 (Cream Base)
SunCat, W%	15%	15%
In vitro UVA	20.3	20.1
SPF LABEL/UVA PF Ratio	1.97	1.99
SPF LABEL/UVA PF Ratio < 3	YES	YES

SunCat MTA

PCR Lab in vivo SPF Results

Study design

- The study was conducted single blind, in a single centre.
- A total of 3 subjects were dosed with the test articles.

Table 1 – Individual and mean SPF values for test article 1 – Gel Base (SunCat MTA 10%) (SPF 50)

Gel Base (SunCat MTA 10%) (SPF 50)	STE	1		2		3		4		5		Re-determined MED	Individual SPF
SUB NO	MED	TIME	GRADE	TIME	GRADE	TIME	GRADE	TIME	GRADE	TIME	GRADE		
1	23	00:15:17	0.0	00:17:07	0.0	00:19:10	0.5	00:21:28	1.0	00:24:03	1.5	23	50.00
2	19	00:12:37	0.0	00:14:08	0.0	00:15:50	0.5	00:17:44	0.5	00:19:52	0.5	19	56.00
3	21	00:13:57	0.0	00:15:37	0.0	00:17:30	0.5	00:19:36	1.0	00:21:57	1.0	21	50.00
Mean													52.00
Std Dev													3.46
95% CI													3.92

Table 2 – Individual and mean SPF values for test article 2 – Cream Base (SunCat MTA 5%) (SPF 30)

Cream Base (SunCat MTA 5%) (SPF 50)	STE	1		2		3		4		5		Re-determined MED	Individual SPF
SUB NO	MED	TIME	GRADE	TIME	GRADE	TIME	GRADE	TIME	GRADE	TIME	GRADE		
1	23	00:09:10	0.0	00:10:16	0.0	00:11:30	0.5	00:12:53	1.0	00:14:26	1.5	23	30.00
2	19	00:07:34	0.0	00:08:29	0.0	00:09:30	0.5	00:10:38	0.5	00:11:55	1.0	19	30.00
3	21	00:08:22	0.0	00:09:22	0.0	00:10:30	0.0	00:11:46	0.5	00:13:10	0.5	21	33.60
Mean													32.00
Std Dev													2.08
95% CI													2.35

Table 3 – Individual and mean SPF values for test article 3 – Cream Base + 3% TiO_2 (SunCat MTA 5%) (SPF 50+)

Cream Base + 3% TiO_2 (SunCat MTA 5%) (SPF 50+)	STE	1		2		3		4		5		Re-determined MED	Individual SPF
SUB NO	MED	TIME	GRADE	TIME	GRADE	TIME	GRADE	TIME	GRADE	TIME	GRADE		
1	23	00:18:20	0.0	00:20:32	0.5	00:23:00	1.0	00:25:46	1.0	00:28:51	1.5	23	53.58
2	19	00:15:09	0.0	00:16:58	0.0	00:19:00	0.0	00:21:17	0.5	00:23:50	0.5	19	67.20
3	21	00:16:44	0.0	00:18:45	0.0	00:21:00	0.5	00:23:31	1.0	00:26:21	1.0	21	60.20
Mean													60.26
Std Dev													6.81
95% CI													7.71

Table 4 – Individual and mean SPF values for test article 4 – P3 Standard

P3 15.7	STE	1		2		3		4		5		Re-determined MED	Individual SPF
SUB NO	MED	TIME	GRADE	TIME	GRADE	TIME	GRADE	TIME	GRADE	TIME	GRADE		
1	23	00:03:51	0.0	00:04:49	0.0	00:06:01	0.5	00:07:31	1.0	00:09:24	1.5	23	15.70
2	19	00:03:11	0.0	00:03:58	0.0	00:04:58	0.5	00:06:13	1.0	00:07:46	1.0	19	15.70
3	21	00:03:31	0.0	00:04:24	0.0	00:05:30	0.5	00:06:52	0.5	00:08:36	1.5	21	15.70
Mean													15.70
Std Dev													0.00
95% CI													0.00

Conclusions

Test article 1 – Gel Base (SunCat MTA 10%) (SPF 50) achieved a mean SPF value of 52.00.
Test article 2 – Cream Base (SunCat MTA 5%) (SPF 30) achieved a mean SPF value of 31.20.
Test article 3 – Cream Base +3% TiO2 (SunCat MTA 5%) (SPF 50+) achieved a mean SPF value of 60.26.

SunCat JCW03 & JCW09

PCR Lab in vivo SPF Results

Study design

- The study was conducted single blind, in a single centre.
- A total of 3 subjects were dosed with the test articles.

Table 1 – Individual and mean SPF values for test article 1 – Cream Base 15% SunCat JCW03 (Expected SPF 30+)

Cream Base 15% SunCat JCW03 (Expected SPF 30+)	STE	1		2		3		4		5		Re-determined MED	Individual SPF
SUB NO	MED	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE		
1	20	637.76	0.0	714.29	0.0	800.00	0.0	896.00	1.0	1003.29	1.0	20	44.80
2	34	1084.18	0.0	1214.29	0.0	1360.00	0.0	1523.20	1.0	1705.98	1.0	34	44.80
3	19	605.87	0.0	678.57	0.0	760.00	0.0	851.20	1.0	953.34	1.0	20	44.80
Mean													44.80
Std Dev													0.00
95% CI													0.00

Table 2 – Individual and mean SPF values for test article 2 – Cream Base 3% SunCat JCW09+ 3% ST-2000 (Expected SPF 50+)

Cream Base + 3% TiO_2 (SunCat MTA 5%) (SPF 50+)	STE	1		2		3		4		5		Re-determined MED	Individual SPF
SUB NO	MED	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE		
1	20	956.63	0.0	1041.43	0.0	1200.00	0.0	1344.00	1.0	1505.28	1.0	20	67.20
2	34	1626.28	0.0	1821.43	0.0	2040.00	0.0	2284.80	0.5	2558.98	1.0	34	75.26
3	19	908.80	0.0	1017.86	0.0	1140.00	0.0	1276.80	1.0	1430.02	1.0	20	67.20
Mean													69.89
Std Dev													4.65
95% CI													11.65

Table 3 – Individual and mean SPF values for P2 standard

P2 16.1	STE	1		2		3		4		5		Re-determined MED	Individual SPF
SUB NO	MED	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE	TIME (s)	GRADE		
1	20	206.08	0.0	257.60	0.0	322.00	1.0	402.50	2.0	503.13	2.0	20	16.10
2	34	350.34	0.0	437.00	0.0	547.40	1.0	684.25	1.0	855.31	2.0	34	16.10
3	19	195.78	0.0	244.72	0.0	305.90	1.0	382.38	1.0	477.97	2.0	19	16.10
Mean													16.10
Std Dev													0.00
95% CI													

Assessments

- The mean SPF value for the P2 standard preparation was 16.10. Since the expected SPF for this preparation was between 13.7 and 18.5 the study can be considered valid.
- The results for the 3 subjects who completed the study for the test articles are as follows:

Conclusions

Test article 1 – Cream Base 15% Sun Cat JCW03 (Expected SPF 30+) produced a value of 44.80.
Test article 2 – Cream Base 3% Sun Cat JCW09 + 3% St 2000 (Expected SPF 50+) produced a value of 69.89.

SunCat Series

Photostability SPF Test (in vitro)

UV Index	Description	Media Graphic Color
0-2	Low danger from sun's UV rays for the average person	Green
3-5	Moderate risk of harm from unprotected sun exposure	Yellow
6-7	High risk of harm from unprotectedsun exposure	Orange
8-10	Very high risk of harm from unprotectedsun exposure	Red
11+	Extreme high risk of harm from unpro-tectedsun exposure	Violet

Test method

- Expose the slides applied with each ample under the natural sunlight for 2, 4, 6 hours.
- After the sun exposure, test the SPF respectively.

SunCat MTA

	Gel base		Cream base		Cream Base + 3% TiO_2 (ST-2000)	
SunCat MTA, W%	8 %	10 %	5 %	17 %	3 %	5 %
SPF, before sun exposure	42.60	48.39	31.89	51.36	57.36	63.50
SPF, after 2 hrs sun exposure	45.59	51.39	36.35	46.81	63.91	73.11
SPF, after 4 hrs sun exposure	42.92	48.71	34.70	46.41	67.46	70.17
SPF, after 6 hrs sun exposure	46.08	51.69	36.52	47.34	70.18	72.63

Results The photostability of SunCat MTA has been proved to effectively provide perfect sun protection even after continuous sun exposure for 6 hours.

SunCat JCW03 & JCW09

Cream base	JCW03		JCW09	
SunCat , W%	15 %	3% + 3 %ST-2000	15 %	3% + 3 %ST-2000
SPF, before sun exposure	35.92	49.5	41.41	60.16
SPF, after 2hrs sun exposure	36.84	52.6	40.2	67.46
SPF, after 4hrs sun exposure	36.38	61.58	42.1	56.82
SPF, after 6hrs sun exposure	36.28	58.95	42.09	52.12

Results The photostability of SunCat JCW03 & JCW09 has been proved to effectively provide perfect sun protection even after continuous sun exposure for 6 hours.

SunCat Series

Summary

Test method

- Non-absorption into the skin leads to longer period of high protection
- No skin irritation/sensitization from the sunscreen active ingredients (even for people normally sensitive to chemical sunscreens on the skin)
- No excess oily formulation needed
- Longer and safer skin residence time
- Forms a thin layer of water resistant protective shield upon skin

Easier formulation

- A specific ratio of sunscreens premixed and solubilized
- No guess work needed to achieve desired SPF
- Aqueous dispersion suitable for almost every cosmetic formulation
- Compatible with both "cold process" and "hot process" formulation
- No pre-emulsion process is needed comparing to conventional UV filters

Proprietary enwrapping procedure

- Prolong the protection capabilities of chemical sunscreen
- Prevent particle aggregation
- Even spread for better protection
- Fewer sunscreen actives and lower concentration used for higher SPF
- Simpler processing and logistics
- Add elegance to sunscreen wearing (not sticky/oily)
- Lower environmental impacts in production and use

NOTE: Regarding formulation, SunCat Series has the following advantages. First, all sunscreens are pre-mixed and solubilized with a specific ratio. It will reduce the processing time and simplify stock manage-ment. Second, you don't need try-error to optimize your formulation using several sunscreens to achieve SPF you desire. You can obtain the correlation between amount and SPF through the reference chart or table. Third, aqueous dispersion is also popular for formulator to design the formulation. It's also com-patible with cold and hot process formulation. All you have to do is just adding SunCat Series in the final stage, no pre-emulsion like conventional UV filters.

Appendix – Formulation Tips

Important points to keep in mind when formulating SunCat Series skin care or Sunscreen products, from 4 different aspects as below:

1. Formulation base – SunCat Series can be applied to the following base:
   - Aqua solution, includes gel system
   - O/W system
   - W/O system
     - Adjusting surfactant HLB value
     - Avoid SunCat Series joining emulsification by adding at the very last step of formulation
2. Manufacturing process
   - SunCat Series must be added at the very last step during formulation process, after
     - Emulsifying is well done
     - The temperature cools down below 45 °C
     - Add SunCat Series
     - Mix completely to ensure SunCat Seriesis well dispersed
3. Incompatible ingredients for SunCat Series
   - Heavy metal and Iron (please do not store SunCat Series in metal container, not even stainless)
   - Methanol – concern: it may break encapsulation
   - Aluminum (all compounds) – concern: it may break encapsulation
4. SunCat Series SPF booster – suggest to use Nestdry ST-2000 which is
   - Uniform larger particles (200 - 500 nm)
   - Silicone coated
   - Aluminum free (Incorporate ST-2000 in oil phase of emulsion)

REMARKS:

1. Please note that over 95% of TiO_2 on the market contains aluminum, therefore please strongly-urge suggest customer to use Nestdry ST-2000 if customer would like to use TiO_2 for SPF boosting purpose (at least for his first trials to demonstrate the result and to compare)
2. All ZnO contains aluminum, that is why it can't be used as SPF booster for SunCat Series.
3. SunCat Series alone can achieve desired SPF easily, we do not suggest or recommend to combine SunCat Series with other chemical UV filters. No need to over-complicate. In addition, some UV boosters may not help boosting SPF for SunCat Series system.

PLEASE FEEL FREE TO CONTACT US IF YOU HAVE FORMULATION PROBLEMS.