

Technical Information

TEGO® SP 13-1 & TEGO® SP 13-6

Smart Polymers – Smart Solutions!

Intended use

Sensory additive, film former

Benefits at a glance

- SPF boosting & water resistance in sun care & color cosmetics
- Deliver a noticeably quick absorption and perceived richness
- Providing improved pigment dispersion & wear resistance
- Optimize the formulation texture due to oil-phase thickening properties

INCI (PCPC name)

Poly C10-30 Alkyl Acrylate (CFDA: yes)

Chemical and physical properties

Form	pellets
Color	white to light yellow

Properties & benefits

TEGO® SP 13-1

- Melting point: 49 ± 5 °C¹
- Forms more “hard” films
- Matte appearance
- Pronounced “dry feel”
- SPF boosting
- Superior water resistance
- Provides wear resistance
- Oil phase thickening
- More compatible with cosmetic oils

TEGO® SP 13-6

- Melting point: 66 ± 5 °C¹
- Forms more “soft” films
- Glossy appearance
- “Dry feel” with a slippery note
- Superior SPF boosting
- Water resistance

- Provides wear resistance
- Improves pigment dispersion
- Shrinkage upon cooling, which is beneficial in stick production

¹ Note: the melting point of the polymer does typically not correspond to the “melting point” in cosmetic formulations

Our studies based on TEGO® Smart Polymers

Oil thickening efficacy

TEGO® Smart Polymers have oil thickening properties. They are dissolved in emollient by heating above their melting point (e.g. 80 °C), cooled down with stirring until the cloud point is reached, then homogenized with UltraTurrax for 60 s. The dispersibility/thickening effect of 2% TEGO® Smart Polymer in emollient was evaluated.

Emollient	Polarity	TEGO® SP 13-1	TEGO® SP 13-6
TEGOSOFT® XC MB	•••••	+	+
TEGOSOFT® TN	•••••	+	+
TEGOSOFT® E	•••••	0	0
TEGOSOFT® APM	•••••	+	0
TEGOSOFT® AC MB	•••	+	0
TEGOSOFT® M	•••	+	0
TEGOSOFT® CT	•••	+	0
TEGOSOFT® OER MB	•••	+	+
TEGOSOFT® OS	••	+	+
TEGOSOFT® DEC	••	+	+
Cyclopentasiloxane	••	-	-
Mineral Oil (30 mPa·s)	•	+	+
ABIL® Wax 9840	•	0	-

With: + dispersible, thickening; 0 partly dispersible, low thickening; - incompatible, separation

TEGO® Smart Polymers are compatible with a wide range of organic oils, but hardly compatible with silicone oils. For formulating silicones, a combination with organic oils should be used. In general, TEGO® SP 13-1 is more compatible with cosmetic oils than TEGO® SP 13-6.

In vivo SPF and water resistance

An O/W sun care SPF 30 (theoretical) system was formulated with oil soluble UV filters & TEGO® Smart Polymers and *in vivo* SPF & water resistance (ISO 24444:2010 & Colipa guidelines, 2005) were determined in a screening study on 8 volunteers.

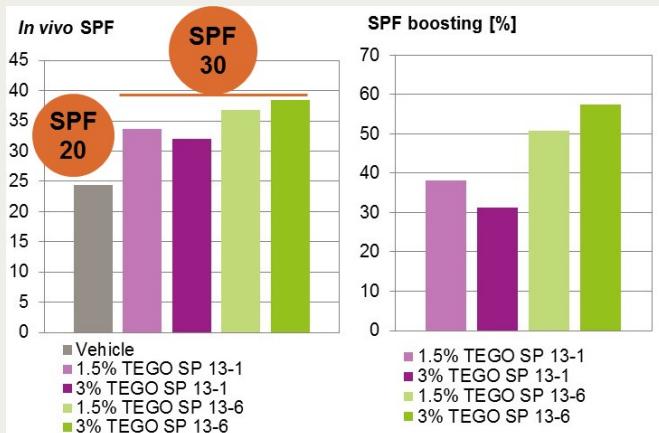


Figure 1: *In vivo* SPF testing results of an O/W sun care system with theoretical (calculated) SPF of 30.

As can be seen in figure 1, the *in vivo* SPF of the vehicle formulation did not reach the calculated SPF and can only be labelled SPF 20. By adding 1.5% or 3% TEGO® Smart Polymer, the targeted SPF 30 was achieved. TEGO® Smart Polymers both provide SPF boosting properties, which can result in significant reduction of UV filter formulation costs. Superior SPF boosting of more than 50% is achieved already with 1.5% TEGO® SP 13-6.

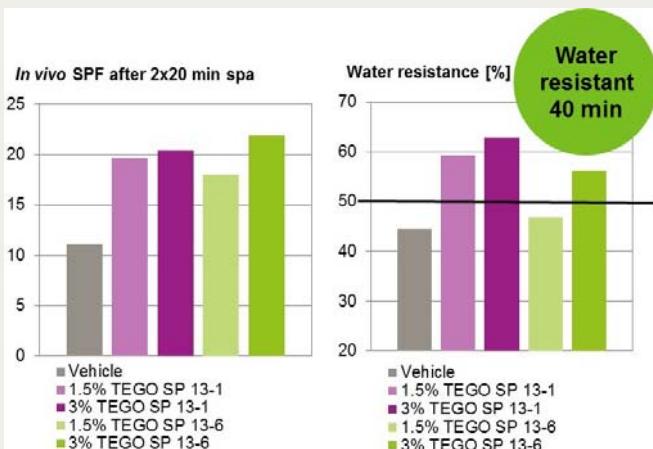


Figure 2: *In vivo* water resistance of TEGO® Smart Polymers in an O/W sun care system with a calculated SPF of 30, after 2x20 min spa.

In addition to the *in vivo* SPF boosting effect, also the water resistance of the O/W sun care formulation was improved. Due to the film forming

properties of TEGO® Smart Polymers they provide water resistance enabling significant remaining UV protection after bathing. A superior water resistance of ~60% is already achieved with 1.5% TEGO® SP 13-1 and enables for water resistant (40 min) claim (minimum requirement: 50%) on the final formulation. A combination of higher amount TEGO® SP 13-1 (matte effect, for maximum water resistance) & smaller amount of TEGO® SP 13-6 (glossy, for maximum SPF boosting) can provide joint benefits.

Sensory profiling

The O/W sun care formulations used in the *in vivo* SPF and water resistance test were evaluated by our in-house sensory panel. The sensory properties of the film forming polymers on the skin feel during application and 5 minutes after application are displayed in the sensory map of TEGO® Care PBS 6 MB (Polyglyceryl-6 Stearate; Polyglyceryl-6 Behenate).

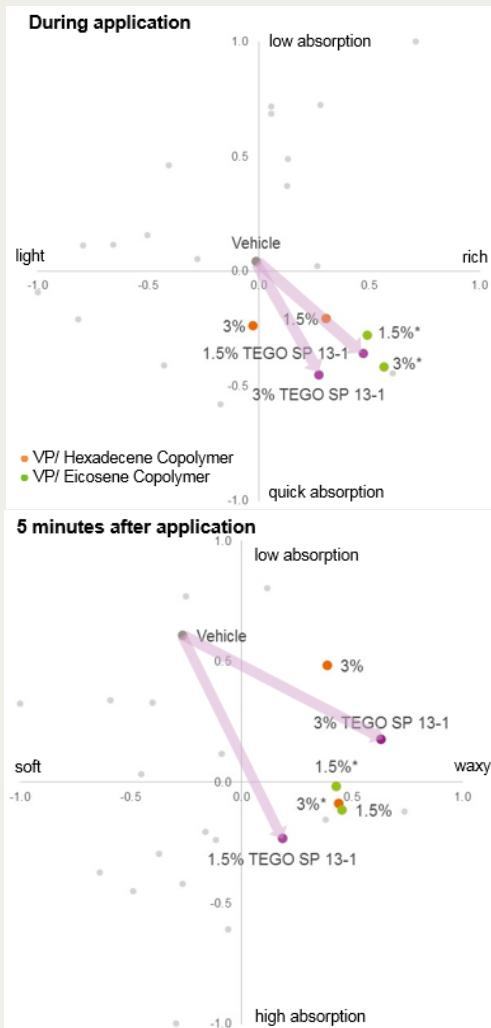


Figure 3: Sensory maps for TEGO® Care PBS 6 MB taken from Sensory Kaleidoscope 2.1. The effect of TEGO® SP 13-1 on skin feel is indicated by arrow. Light grey dots indicate other formulations based on TEGO® Care PBS 6 MB. Market benchmarks are indicated in orange (VP/Hexadecene Copolymer) and green (VP/Eicosene Copolymer).

As can be clearly seen in the sensory maps, the absorption of the O/W sun care system was significantly improved with TEGO® SP 13-1, leading to a pronounced dry afterfeel of the formulation on the skin. A quick absorption during application is essential for efficient film forming, as prolonged application/rubout/rub-off by the consumer will lead to filling of wrinkles with sunscreen and lower film thickness on the surface of the skin, resulting in overall lower sunscreen performance.

Sensory profiling in face care

A typical anti-aging test system was formulated, substituting consistency enhancers (3%) partially or completely with TEGO® SP 13-1. The formulations were evaluated by our in-house sensory panel and sensory mapping was performed.

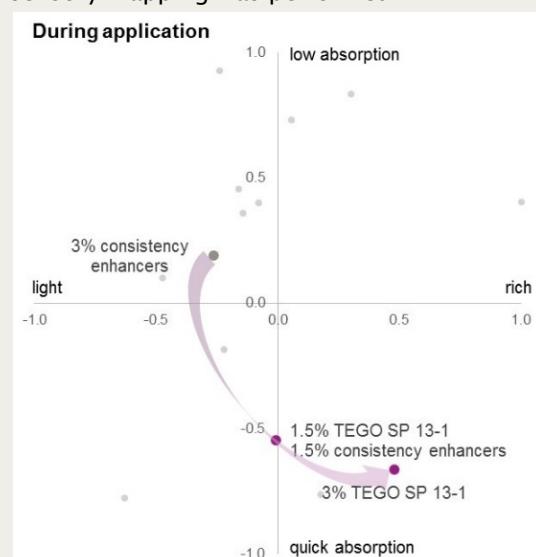


Figure 4: Sensory map during application for TEGO® Care 450 MB taken from Sensory Kaleidoscope 2.1. The effect of TEGO® SP 13-1 is indicated by arrow. Light grey dots indicate other formulations based on TEGO® Care 450 MB.

During application, 1.5% TEGO® SP 13-1 in combination with 1.5% consistency enhancers significantly improve the absorption of the O/W face cream. With 3% TEGO® SP 13-1 and no consistency enhancers, absorption was further improved and richness increased (please note that with only TEGO® SP 13-1 and without consistency enhancer the formulation is not sufficiently stable).

The better absorption and more perceived richness during application is beneficial in face care or in general anti-aging applications, because a "rich" formula is perceived as an "effective" formula by the consumer.

Wear resistance

W/O foundations based on ISOLAN® GPS (Polyglyceryl-4 Diisostearate/Polyhydroxystearate/Sebacate) with TEGO® Smart Polymers or market benchmark hydrophobic film formers were applied to the volar forearm. After 15 min a weight of 300 g wrapped with white fabric was pulled along the forearm at defined speed with an Instron friction equipment. Pigment transfer is determined as color change (ΔE based on L*a*b* color space).

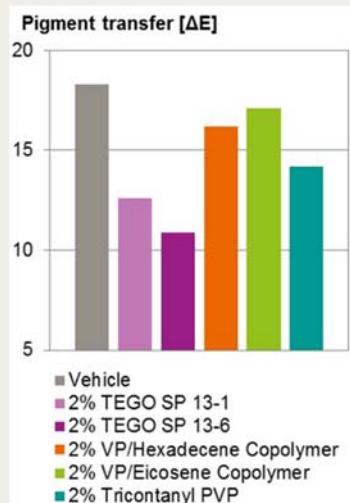


Figure 5: Pigment transfer (indicated as color change ΔE) of W/O foundation on skin to white fabric.

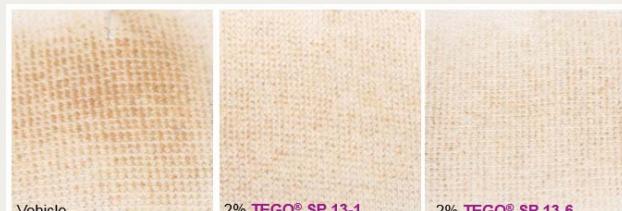


Figure 6: Pictures of white fabric with W/O foundation after pigment transfer test.

As shown in figures 5 and 6, 2% TEGO® SP 13-1 or TEGO® SP 13-6 significantly reduce pigment transfer of a W/O foundation from skin to white fabric, which corresponds to an improved wear resistance.

Pigment dispersion

The color of the same W/O foundations based on ISOLAN® GPS with TEGO® Smart Polymer and market benchmark hydrophobic film formers was measured according to L*a*b* color space in order to determine the effect on pigment dispersion. The test formulations contained 0.35% CI 77491 (red), 0.10% CI 77499 (black), 0.60% CI 77492 (yellow) and 5% CI 77891 (white) pigments.

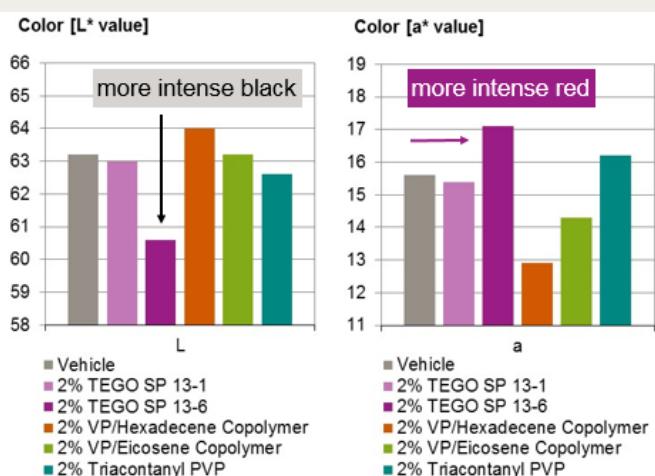


Figure 8: Color (L* value and a* value) of W/O foundations. Reduced L* value indicates more intense black and increased a* value indicates more intense red color.

TEGO® SP 13-6 gives more intense black and red color indicating improved dispersion of red and black pigments. It appears that the longer the side chain of the applied film former, the better the pigment dispersion. Market benchmark hydrophobic film formers show only little effect, most pronounced in Triacontanyl PVP, but still inferior to TEGO® SP 13-6.

Suggested usage concentration

1–3% in O/W and W/O emulsions
Up to 10% in special applications (e.g. lip color).

Preparation

TEGO® Smart Polymers can be easily processed by addition to the oil phase. Heating above the melting point is required in order to properly melt the material. Then the formulation is processed as usual.

In O/W emulsions the thickening efficacy depends on the oil phase composition. Low viscous (fluid, sprayable) systems can be formulated e.g. based on TEGO® Care PBS 6 MB, with relatively low amount of consistency enhancers (e.g. 0.5–1.0%) and relatively low total oil phase content (e.g. 14–19%). In general, consistency enhancer concentration can be partially substituted with TEGO® Smart Polymers.

In W/O emulsions the thickening efficacy depends on the concentration of TEGO® Smart Polymer. The higher the concentration, the higher the viscosity. In general, oil phase can be increased or wax/ clay/ silica concentration reduced to counteract a strong viscosity increase.

For the preparation of sticks TEGO® Smart Polymer is added to the oil/wax mixture which is heated until uniformly molten, before pouring into the mold. TEGO® SP 13-6 shows shrinkage upon cooling which enables easy release from molds.

Application

TEGO® Smart Polymers are especially suitable for

- Sun care
- Face care
- Color cosmetics

Hazardous goods classification

Information concerning

- classification and labelling according to regulations for transport of chemicals
- protective measures for storage and handling
- measures in case of accidents and fire
- toxicological and ecotoxicological effects

is given in our safety data sheets.

Guideline formulations

Summer Paradise Cream (ST 03/17-35)

Phase A

TEGO® Care PBS 6 MB (Polyglyceryl-6 Stearate, Polyglyceryl-6 Behenate)	3.00%
TEGIN® M Pellets (Glyceryl Stearate)	0.50%
TEGO® Alkanol 1618 (Cetearyl Alcohol)	0.50%
TEGOSOFT® XC MB (Phenoxyethyl Caprylate)	4.50%
Bis-ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb S, BASF)	3.00%
Butyl Methoxydibenzoylmethane	2.00%
Ethylhexyl Salicylate	3.00%
Octocrylene	8.00%
Homosalate	3.00%
Ethylhexyl Triazone	1.50%
TEGO® SP 13-1 (Poly C10-30 Alkyl Acrylate)	1.50%

Phase B

Water	61.90%
Glycerin	3.00%
TEGO® Feel C 10 (Cellulose)	2.00%

Phase C

TEGO® Carbomer 341 ER (Acrylates/C10-30 Alkyl Acrylate Crosspolymer)	0.20%
TEGOSOFT® XC MB (Phenoxyethyl Caprylate)	0.80%

Phase D

Sodium Hydroxide (10% in water)	q.s.
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Phase E

Verstatil® PC (Phenoxyethanol, Caprylyl Glycol)	1.00%
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Phase Z

Perfume	q.s.
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Preparation

1. Heat phase A and B separately to approx. 80°C.
2. Add phase A to B with stirring.¹⁾
3. Homogenize.
4. Cool with gentle stirring to approx. 60 °C and add phase C.
5. Homogenize for a short time.
6. Cool with gentle stirring and add phase D and E below 40 °C.
7. Adjust the pH value to approx. 6.5.

¹⁾Important: If phase A has to be charged into the vessel first, phase B must be added without stirring.

Viscosity: ~40 Pa · s (Brookfield RV DV-1, sp. 93, 10 rpm)

Antimicrobial effectiveness testing: Challenge test

passed

SPF: 31.5, UVA balance: 35%

(calculated values, BASF Sunscreen Simulator)

On the go UV protection stick SPF 50 (ST 07/18-34)

Phase A

TEGOSOFT® XC MB (Phenoxyethyl Caprylate)	8.00%
TEGOSOFT® CT (Caprylic/Capric Triglyceride)	7.50%
TEGOSOFT® DEC (Diethylhexyl Carbonate)	8.60%
Titanium Dioxide, Silica, Dimethicone (Parsol TX, DSM)	2.50%

Phase B

TEGOSOFT® CR MB (Cetyl Ricinoleate)	3.00%
TEGOSOFT® MM MB (Myristyl Myristate)	5.00%
Diethylamino Hydroxybenzoyl Hexyl Benzoate	8.00%
Ethylhexyl Salicylate	5.00%
Ethylhexyl Methoxycinnamate	10.00%
Homosalate	5.00%
Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb S, BASF)	4.00%
Beeswax	4.00%
Polyglyceryl-3 Beeswax (Cera Bellina, Koster Keunen)	6.00%
Ozokerite (1899, KahlWax)	3.50%
Copernicia Cerifera (Carnauba) Wax (2442L, KahlWax)	2.50%
dermofeel® Ascorbyl Palmitate (Ascorbyl Palmitate)	0.10%
dermofeel® Toco 70 non GMO (Tocopherol, Helianthus Annuus (Sunflower) Seed Oil)	0.20%
TEGO® SP 13-1 (Poly C10-30 Alkyl Acrylate)	5.00%

Phase C

AEROSIL® 200 (Silica)	2.00%
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Phase D

TEGO® Feel C 10 (Cellulose)	10.00%
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Phase Z

Perfume	q.s.
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Preparation

1. Homogenize phase A until homogeneous.
2. Add phase B to phase A and heat to approx. 85 °C while stirring.
3. Add phase C and D.
4. Cool down to approx. 65 °C and add phase Z.
5. Pour into mold at approx. 60 °C.
6. Let the mold cool down for ~12 hours.

SPF: 53.5, UVA balance: 35%

(calculated values, BASF Sunscreen Simulator)

**Transparent UV protection water spray SPF 30
(ST 16/18-46)**

Phase A

TEGOSOFT® DEC (Diethylhexyl Carbonate)	15.00%
Isododecane	7.50%
TEGOSOFT® XC MB (Phenoxyethyl Caprylate)	5.00%
dermofeel® sensolv MB (Isoamyl Laurate)	5.00%
Butyl Methoxydibenzoylmethane	5.00%
Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb S, BASF)	2.40%
Homosalate	2.00%
Ethylhexyl Salicylate	2.00%
Ethylhexyl Triazone	1.70%
dermofeel® Toco 70 non GMO (Tocopherol, Helianthus Annuus (Sunflower) Seed Oil)	0.50%
TEGO® SP 13-1 (Poly C10-30 Alkyl Acrylate)	0.35%

Phase B

Verstatil® PC (Phenoxyethanol, Caprylyl Glycol)	1.00%
Perfume	q.s.

Phase C

Water	36.95%
Glycerin	3.00%
Disodium EDTA	0.10%

Phase D

Water	9.65%
Phenylbenzimidazole Sulfonic Acid	2.50%
Sodium Hydroxide	0.35%

Phase E

Triethanolamine ¹⁾	q.s.
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Preparation

1. Heat phase A to 80–85 °C.
2. Cool down to room temperature and add phase B while stirring.
3. Add phase C to phase D.
4. Adjust the pH value of phase C/D to 6.8–7.2.
5. Pour phase A/B onto phase C/D/E.

¹⁾ Triethanolamine can be optionally added to optimize the phase separation behavior

Remarks: 2-phase sun care system; Shake before use

Antimicrobial effectiveness testing: Challenge test ongoing

SPF: 30.1, UVA balance: 34%

(calculated values, BASF Sunscreen Simulator)

Facial Moisturizer for Men (JS 11/17-2)

Phase A

TEGO® Care 450 MB (Polyglyceryl-3 Methylglucoside Distearate)	3.00%
TEGIN® M Pellets (Glyceryl Stearate)	1.00%
TEGO® Alkanol 1618 (Cetearyl Alcohol)	0.50%
TEGOSOFT® DEC (Diethylhexyl Carbonate)	5.00%
TEGOSOFT® OP (Ethylhexyl Palmitate)	4.00%
TEGOSOFT® MM MB (Myristyl Myristate)	1.00%
dermofeel® sensolv MB (Isoamyl Laurate)	4.00%
Prunus Amygdalus Dulcis (Sweet Almond) Oil	4.00%
ABIL® 350 (Dimethicone)	1.00%
TEGO® Feel C 10 (Cellulose)	1.00%
TEGO® SP 13-1 (Poly C10-30 Alkyl Acrylate)	1.50%

Phase B

Water	59.90%
Glycerin	3.00%
SKINMIMICS® (Ceteareth-25; Glycerin; Cetyl Alcohol; Behenic Acid; Cholesterol; Ceramide NP; Ceramide NS; Ceramide EOS ; Ceramide EOP; Ceramide AP; Caprooyl Phytosphingosine; Caprooyl Sphingosine)	3.00%
Caffeine	0.50%

Phase C

TEGO® Carbomer 141 (Carbomer)	0.20%
TEGOSOFT® OP (Ethylhexyl Palmitate)	0.80%

Phase D

Sodium Hydroxide (10% in water)	q.s.
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Phase E

Alcohol	5.00%
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Phase F

Verstatil® PC (Phenoxyethanol, Caprylyl Glycol)	1.00%
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Phase Z

Perfume	q.s.
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Preparation

1. Heat phase A and B separately to approx. 75°C.
2. Add phase A to B with stirring.¹⁾
3. Homogenize.
4. Cool with gentle stirring to approx. 60 °C and add phase C.
5. Homogenize for a short time.
6. Cool with gentle stirring.
7. Add phase D below 40 °C and adjust the pH value to 6.2–6.8.
8. Add phase E and F and stir well.

¹⁾ Important: If phase A has to be charged into the vessel first, phase B must be added without stirring.

Viscosity: ~27 Pa·s (Brookfield RV DV-I, sp. 93, 10 rpm)

Antimicrobial effectiveness testing: Challenge test passed

Sweat Proof Foundation (ST 08/17-15)

Phase A

ISOLAN® GPS (Polyglyceryl-4 Diisostearate/Polyhydroxystearate/Sebacate)	4.00%
TEGOSOFT® AC MB (Isoamyl Cocoate)	6.00%
TEGOSOFT® DC MB (Decyl Cocoate)	8.00%
TEGOSOFT® CT (Caprylic/Capric Triglyceride)	4.00%
CI 77891, Triethoxycaprylylsilane (Unipure White LC 981 AS-EM, Sensient)	5.00%
CI 77492, Triethoxycaprylylsilane (Unipure Yellow LC 182 AS-EM, Sensient)	0.60%
CI 77491, Triethoxycaprylylsilane (Unipure Red LC 381 AS-EM, Sensient)	0.35%
CI 77499, Triethoxycaprylylsilane (Unipure Black LC 989 AS-EM, Sensient)	0.10%
Verstatil® TBG (Triethyl Citrate, Glyceryl Caprylate, Benzoic Acid)	1.00%

Phase B

Cera Alba	0.50%
Hydrogenated Castor Oil	0.50%
TEGO® SP 13-1 (Poly C10-30 Alkyl Acrylate)	1.00%

Phase C

Water	63.95%
Zinc Sulfate Heptahydrate	2.00%
Glycerin	3.00%
Citric Acid (10% in water)	q.s.

Phase Z

Perfume	q.s.
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Preparation

1. Homogenize phase A until homogeneous.
2. Add phase B to phase A, heat to 80 °C and mix well.
3. Prepare phase C and adjust pH value to approx. 5.0 – 5.5.
4. Add phase C (room temperature) to phase A/B (80 °C) while stirring (approx. 500 rpm).
5. Homogenize.
6. Cool down below 30 °C while stirring.

Viscosity: ~46 Pa·s (Brookfield RV DV-1, sp. 93, 10 rpm)

Antimicrobial effectiveness testing: Challenge test passed

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Red Carpet Moment (ST 02/18-18)

Phase A

TEGO® SP 13-6 (Poly C10-30 Alkyl Acrylate)	5.00%
TEGOSOFT® CT (Caprylic/Capric Triglyceride)	20.00%
TEGOSOFT® DC MB (Decyl Cocoate)	5.00%
TEGOSOFT® OER MB (Oleyl Erucate)	10.00%
TEGOSOFT® MM MB (Myristyl Myristate)	4.00%
TEGOSOFT® CR MB (Cetyl Ricinoleate)	4.00%
Ricinus Communis (Castor) Seed Oil	22.50%
Euphorbia Cerifera (Candelilla) Wax (2039L, KahlWax)	6.00%
Copernicia Cerifera (Carnauba) Wax (2442L, KahlWax)	3.00%
Ozokerite (1899, KahlWax)	4.00%
Polyglyceryl-3 Beeswax (Cera Bellina, Koster Keunen)	4.00%
Ricinus Communis Seed Oil; CI 15859 (Covapate Unired LC 3703, Sensient)	1.00%
Ricinus Communis Seed Oil; CI 15859 (Covapate Unired LC 3779, Sensient)	3.00%

Phase B

CI 77891; Silica; Mica; Tin Oxide (Xirona Volcanic Fire, Merck)	8.00%
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Phase C

Perfume (Chocolate FEMA, Cosnaderm)	0.50%
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Preparation

1. Heat phase A to 80–85 °C while stirring.
2. Cool down to 70–75 °C.
3. Add phase B to phase A. Remove air by applying vacuum or keeping temperature at 70 °C for 15 min while stirring gently.
4. Add phase C while stirring and pour into mold between 65–70 °C.
5. Let the mold cool down for ~12 hours.

B 10/18

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