Technical Information

TEGO® SP 13 SUN UP

Smart Polymers – Smart Solutions!

Intended use

Film former, sensory additive

Benefits at a glance

- "Dry feel" sensory additive improving absorption and reducing oily residue / gloss
- Enables the formulation of effective sun care formulations due to optimized film formation properties leading to greater filter performance efficiency
- Provides improved pigment dispersion in inorganic sunscreens
- Superior SPF boosting & excellent water resistance compared to market benchmark
- Reduced sun care formulation costs due to SPF boosting effect and consequently minimized UV filter use level

INCI (PCPC name)

Poly C10-30 Alkyl Acrylate (CFDA: yes, TGA[1]: yes)

[1] TGA = Australian Therapeutic Goods Administration

Chemical and physical properties

Form	pellets
Color	white to light yellow

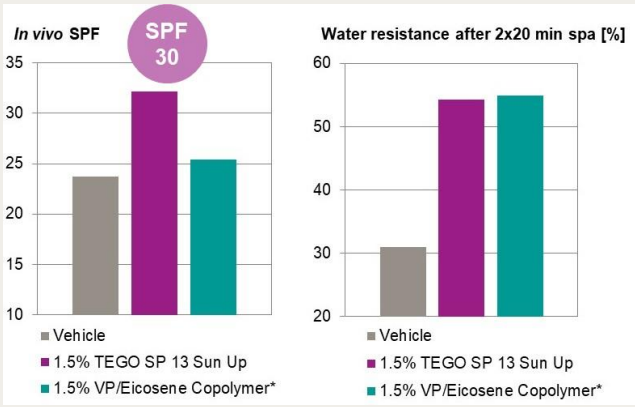
Oil thickening alkyl-modified acrylate homopolymer

Our studies based on TEGO® SP 13 Sun Up

in vivo SPF boosting and water resistance

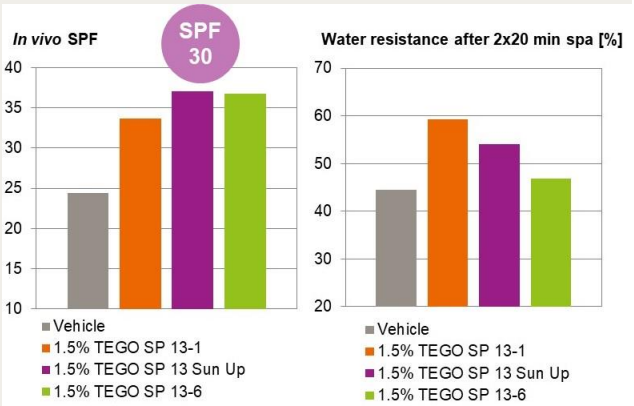
All SPF studies were conducted according to ISO 24444:2010 and water resistance according to Colipa guidelines, 2005, either as screening study (4 volunteers per formulation) or complete study (10 volunteers per formulation).

Test I – US test formulation, 28.0% organic UV filters (oil soluble), screening study



1.5% TEGO® SP 13 Sun Up boosts SPF by 36% which can result in significant reduction of UV filter formulation costs. It also provides >50% water resistance. UV filter efficiency* increases from 0.85 (vehicle) to 1.15. Market benchmark VP/Eicosene Copolymer only provides water resistance.

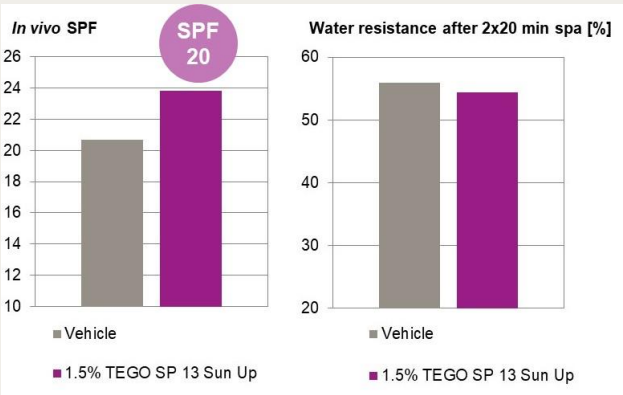
Test II – European test formulation, 20.5% organic UV filters (oil soluble), screening study (TEGO® SP 13-1 and 13-6), complete study (TEGO® SP 13 Sun Up)



1.5% TEGO® SP 13 Sun Up boosts SPF by 52% which can result in significant reduction of UV filter formulation costs. It also provides >50% water resistance and thereby combines the joint benefits of TEGO® SP 13-1 (>50% water resistance) and TEGO® SP 13-6 (superior SPF boosting). UV filter efficiency* increases from 1.19 (vehicle) to 1.81.

* Filter efficiency = SPF / w/w-% of UV filters used

Test III – Inorganic sunscreen, 15.0% inorganic UV filters (coated), screening study

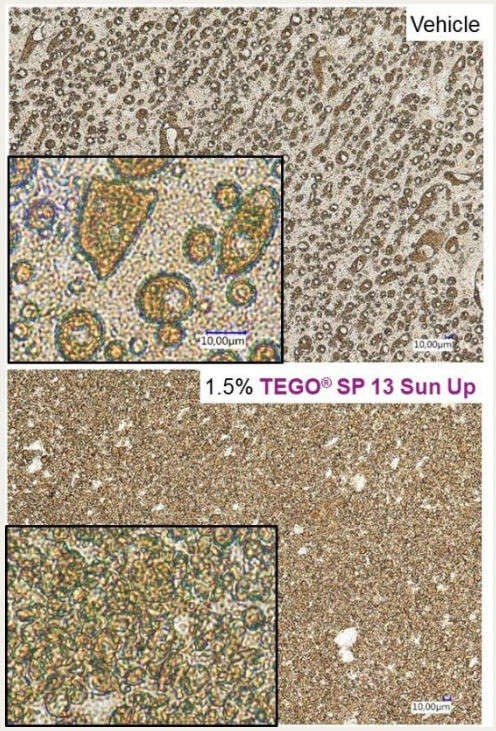


1.5% TEGO® SP 13 Sun Up boosts SPF by 15%. It also provides >50% water resistance. Vehicle formula is already on a very good level of water resistance due to UV filter coating, no further increase by film former is observed. UV filter efficiency* increases from 1.38 (vehicle) to 1.59.

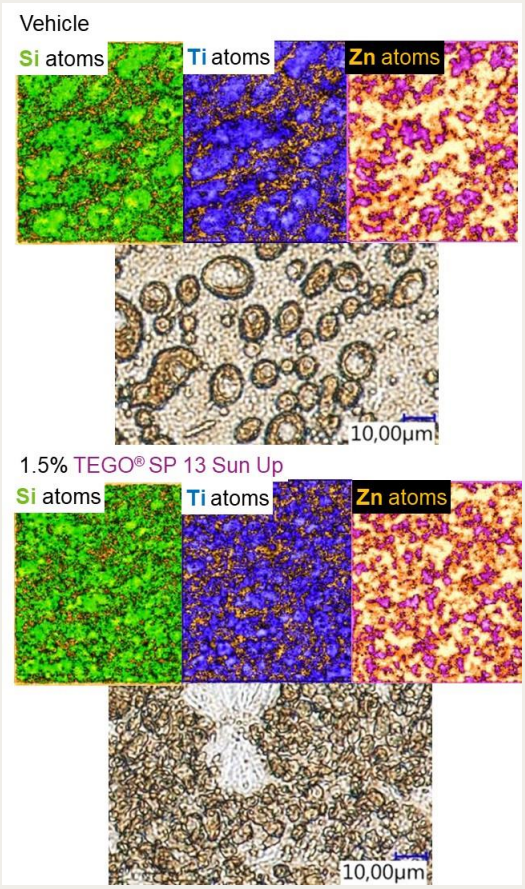
Pigment dispersion

O/W emulsion with 15.0% coated inorganic UV filters (7.8% Zinc Oxide; Triethoxycaprylylsilane plus 7.2% Titanium Dioxide, Silica, Dimethicone).

Light microscopy



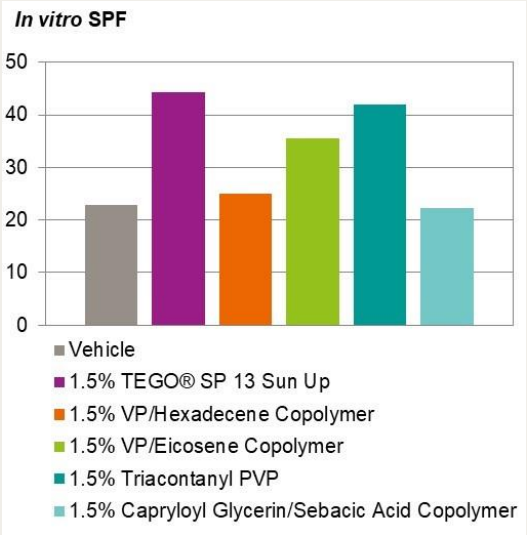
Scanning electron microscopy – EDX analysis (light microscopy images with same resolution at bottom for comparison and scale information)



TEGO® SP 13 Sun Up provides improved pigment dispersion and finer emulsion droplet size distribution resulting in SPF boosting and emulsion stabilization effect.

in vitro SPF boosting

O/W sun care formulations SPF 30 (calculated) with different film formers. *in vitro* SPF (PMMA plates, Labsphere UV2000S)



TEGO® SP 13 Sun Up outperforms market benchmarks with respect to SPF boosting.

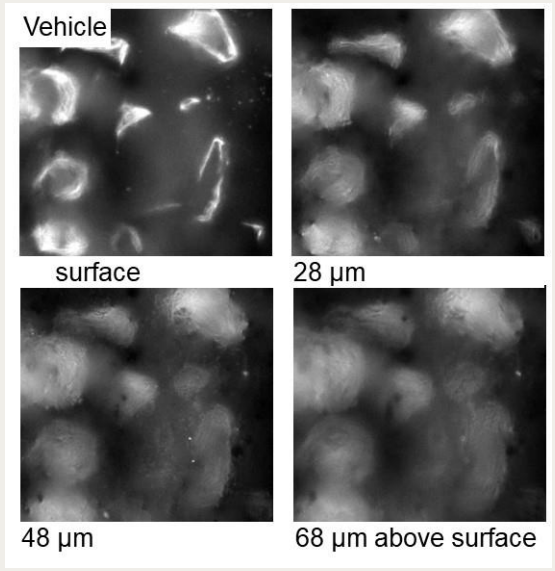
Film formation working mechanism

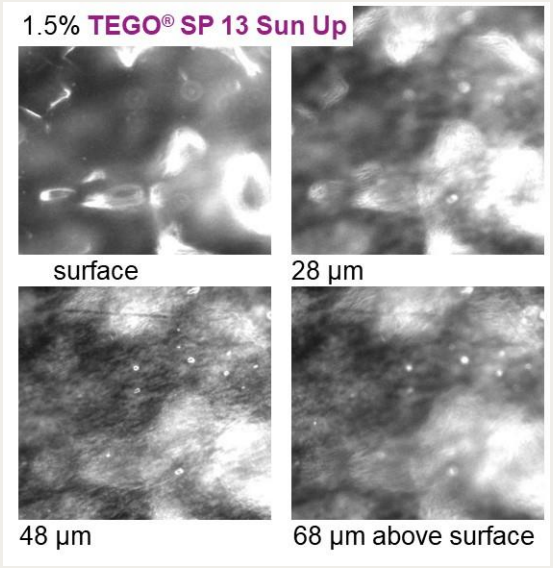
Test formulations were prepared with 0.1% of a 10% solution of fluorescent stain DiI (https://www.thermofisher.com/order/catalog/product/D282) in TEGOSOFT® XC MB added to the oil phase at 70 °C, just prior to homogenization, resulting in 0.01% active matter fluorophor. Fluorescence microscopy was performed with an Olympus IX83 microscope at wavelengths of 523 nm (excitation) and 580 nm (emission).

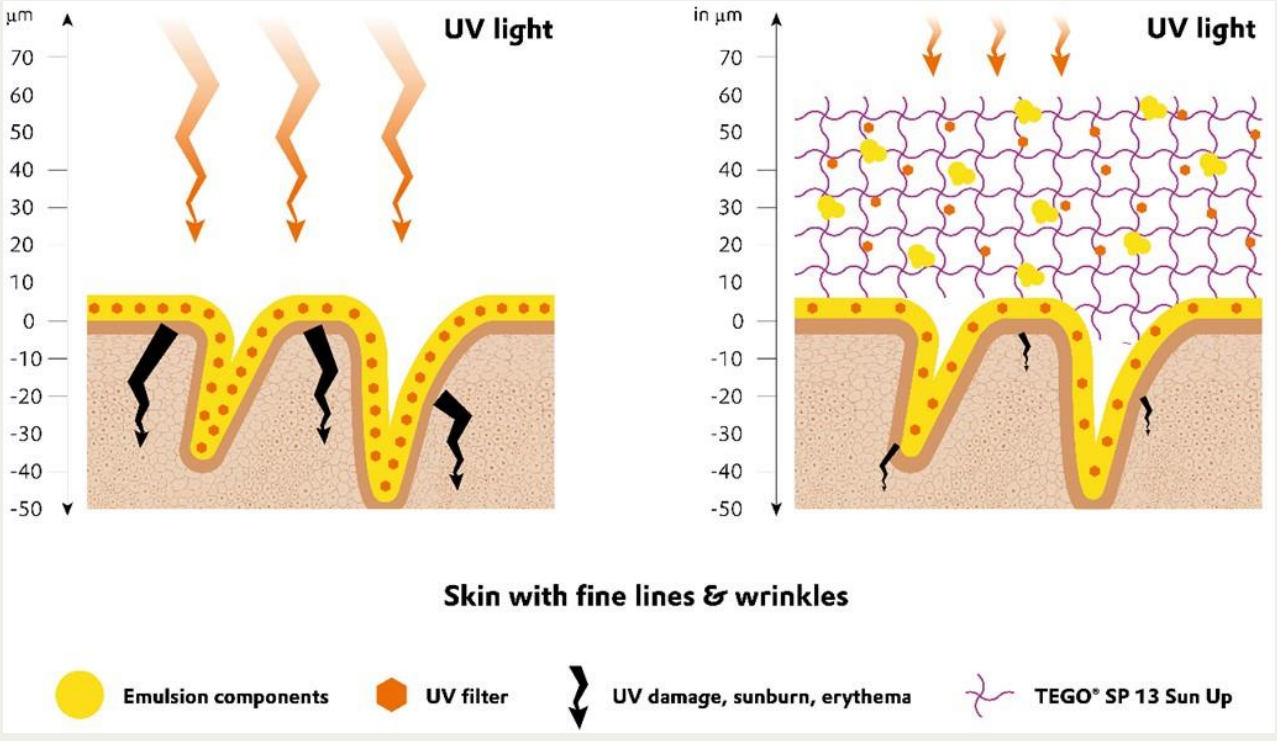
VITRO-SKIN (IMS Inc.) was used as a model substrate that effectively mimics the surface properties of human skin. It has been formulated to have topography, pH, critical surface tension, chemical reactivity and ionic strength that is similar to human skin (https://www.ims-usa.com/vitro-skin-substrates/vitro-skin/). 3D light microscopy shows VITRO-SKIN surface with indentations up to ~50 µm depth, similar to human fine lines and wrinkles. Fluorescent test formulations were gently applied and let dry for 30 min at 30 °C. 3D fluorescence imaging (non-confocal microscopy) reveals film topography by fluorescent signal above the VITRO-SKIN surface.

Using vehicle formulation, no fluorescence signal can be detected above VITRO-SKIN surface, only little on surface and in indentations. Using 1.5% TEGO® SP 13 Sun Up, a film is indicated by fluorescence signal widely scattered up to 70 µm above VITRO-SKIN surface.

Height information can be used to construct a mechanistic model. Use of TEGO® SP 13 Sun Up leads to formation of a particularly broad film thickness (up to 70 µm). This film is the reason for the observed SPF boosting effect (according to Lambert Beer's law).

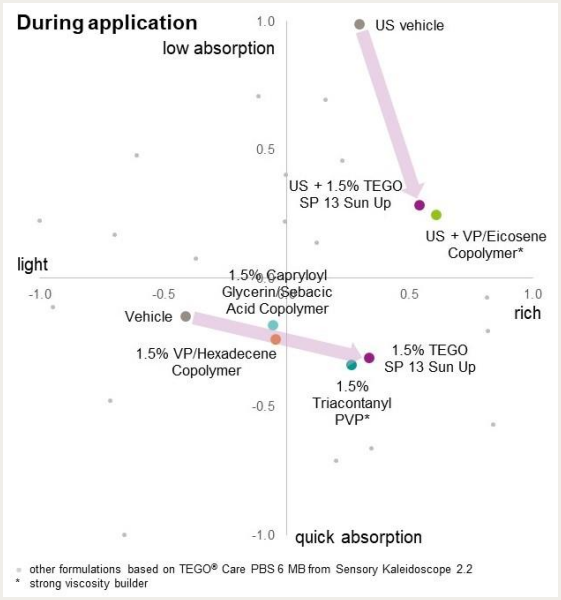


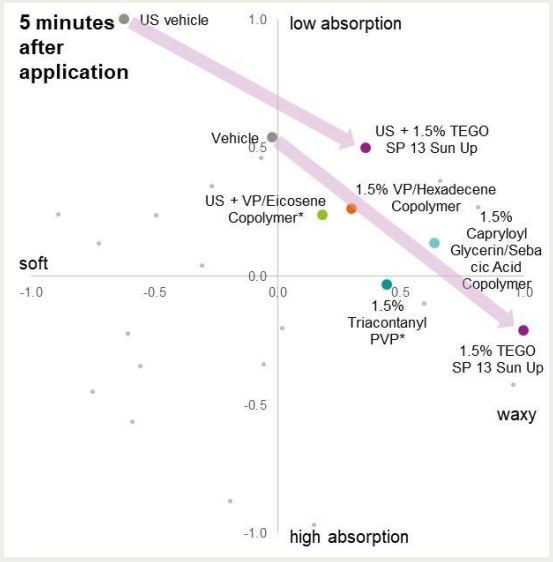




Sensory profiling

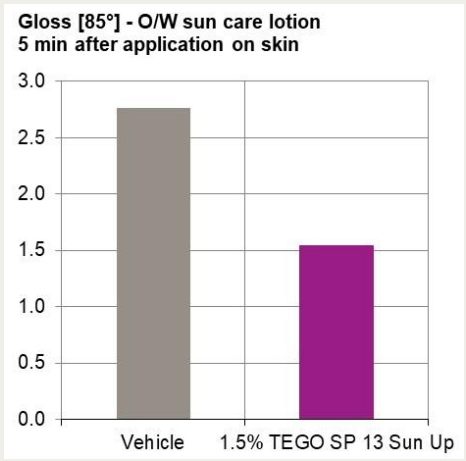
Test formulations from *in vivo* SPF study (test I – US test formulation, 28.0% organic UV filters) and from *in vitro* SPF boosting study (20.5% organic UV filters) were evaluated by our in-house sensory panel and sensory mapping was performed.
TEGO® SP 13 Sun Up improves absorption during application and provides a nice "dry" (high absorption / low oiliness, waxy) afterfeel. Good absorption during application is essential for an efficient film formation ("intact" film).





Gloss measurement

Test formulations from *in vitro* SPF boosting study were evaluated with respect to gloss reduction effect. Five minutes after application onto the volar forearm of nine panelists, gloss values were determined with a Zehntner ZGM 1130 glossmeter.



TEGO® SP 13 Sun Up perceivably reduces the gloss of an O/W sun care lotion on skin.

Suggested usage concentration

1.5% in emulsions
Up to 10% in special applications (e.g. sticks).

Preparation

TEGO® SP 13 Sun Up 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® SP 13 Sun Up. 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® SP 13 Sun Up is added to the oil/wax mixture which is heated until uniformly molten, before pouring into the mold.

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

If you are interested in guideline formulations please visit our homepage https://personal-care.evonik.com.

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