



# SOLASTAY<sup>®</sup> S<sub>1</sub>

Extremely powerful photostabilizer for organic and inorganic UV filters and anti-photoaging active ingredients.

**HALLSTAR**   
B E A U T Y

# SOLASTAY<sup>®</sup> S<sub>1</sub>

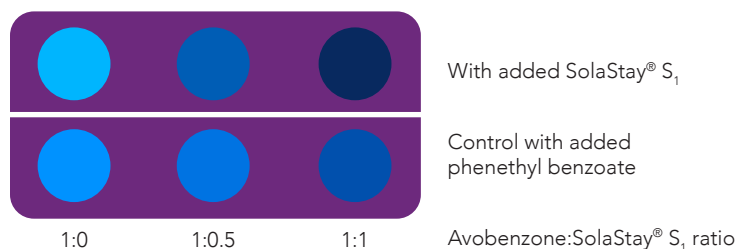
- Acts as a highly efficient photostabilizer for organic UV filters, inorganic mineral oxide UV filters, and other photolabile cosmetic active ingredients
- Quenches singlet excited state and triplet excited state of butyl methoxydibenzoylmethane (avobenzene)
- Mitigates photocatalytic reactions and reactive oxygen species (ROS) generation from mineral UV filters and cosmetic colorants
- Substantially stabilizes photolabile active ingredients such as resveratrol, retinol, and retinyl palmitate

## Technical data

- INCI name: Ethylhexyl Methoxycrylene
- Appearance: golden yellow liquid
- Recommended dosage: 1-3%

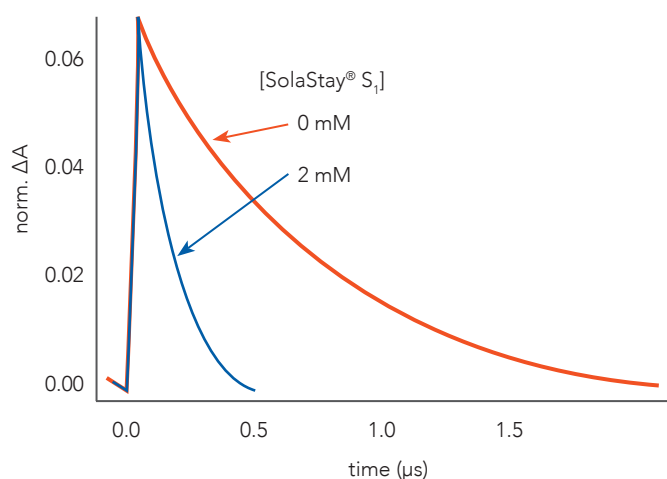
Avobenzene is the only globally approved chemical UVA1 filter, providing effective broad-spectrum protection against UVA irradiation (320nm – 400nm). Avobenzene, known to rapidly convert from the effective enol form to the short-absorbing and photoactive keto form upon exposure to UV irradiation, is not photostable, which leads to sun protection that is not long-lasting. Because SolaStay<sup>®</sup> S<sub>1</sub> is a highly effective photostabilizer of avobenzene, the combination of avobenzene and SolaStay<sup>®</sup> S<sub>1</sub> enables robust, long-lasting, and economic UVA protection.

## SolaStay<sup>®</sup> S<sub>1</sub> effectively quenches the singlet excited state of avobenzene

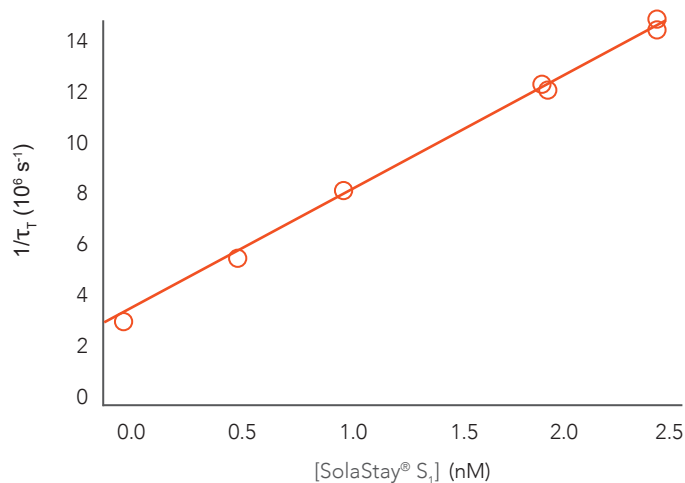


Fluorescence emission is an indicator of the singlet state lifetime. In the presence of SolaStay<sup>®</sup> S<sub>1</sub>, the singlet excited state of avobenzene is rapidly quenched so it doesn't have the opportunity to exhibit fluorescence.

## SolaStay<sup>®</sup> S<sub>1</sub> also effectively quenches the triplet excited state of avobenzene

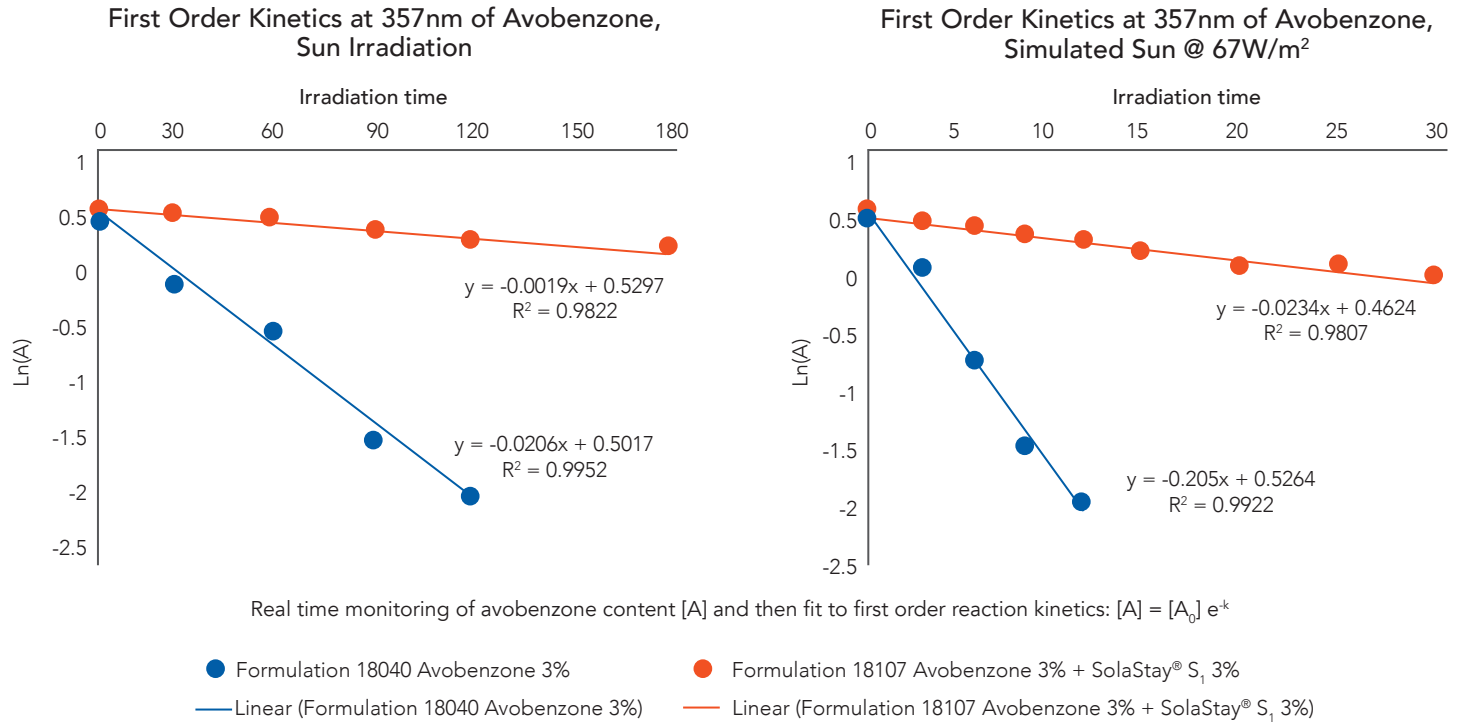


Avobenzene triplet decay trace in laser flash photolysis. The triplet decays faster in the presence of SolaStay<sup>®</sup> S<sub>1</sub> in a dose-dependent fashion.



Avobenzene triplet lifetime as measured from the triplet decay trace at different SolaStay<sup>®</sup> S<sub>1</sub> levels. The higher the SolaStay<sup>®</sup> S<sub>1</sub> concentration, the faster the triplet quenching, the shorter the triplet lifetime.

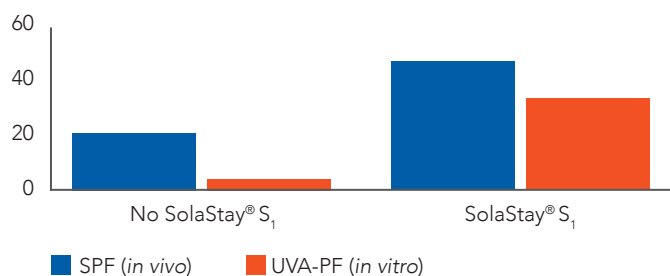
SolaStay® S<sub>1</sub> can effectively stop the photodegradation of avobenzone in 9µm thick sunscreen film under natural sunlight irradiation and simulated sunlight irradiation.



The photodecomposition rate constant of avobenzone without SolaStay® S<sub>1</sub> is about 10 times faster than that in the presence of SolaStay® S<sub>1</sub>.

### Comparative study based on specific sunscreen formulation

Oil Phase Ingredients	JZ5-66	JZ5-67
C12-15 alkyl benzoate	4.00%	4.00%
Caprylic/Capric triglyceride	4.00%	1.00%
SolaStay® S <sub>1</sub>	0.00%	3.00%
Homosalate	7.00%	7.00%
Avobenzone	3.00%	3.00%
HallBrite® BHB	5.00%	5.00%
Cetearyl alcohol	0.50%	0.50%
Styrene/Acrylates Copolymer	3.00%	3.00%
VP/Eicosene copolymer	1.00%	1.00%
Potassium Cetyl Phosphate, Hydrogenated Palm Glycerides	2.20%	2.20%
Glyceryl stearate & PEG-100 stearate	1.70%	1.70%
Average SPF ( <i>in vivo</i> )	19	45
UVA PF ( <i>in vitro</i> )	3	32



### SolaStay® S<sub>1</sub> photostabilizes and improves mineral filter efficacy.

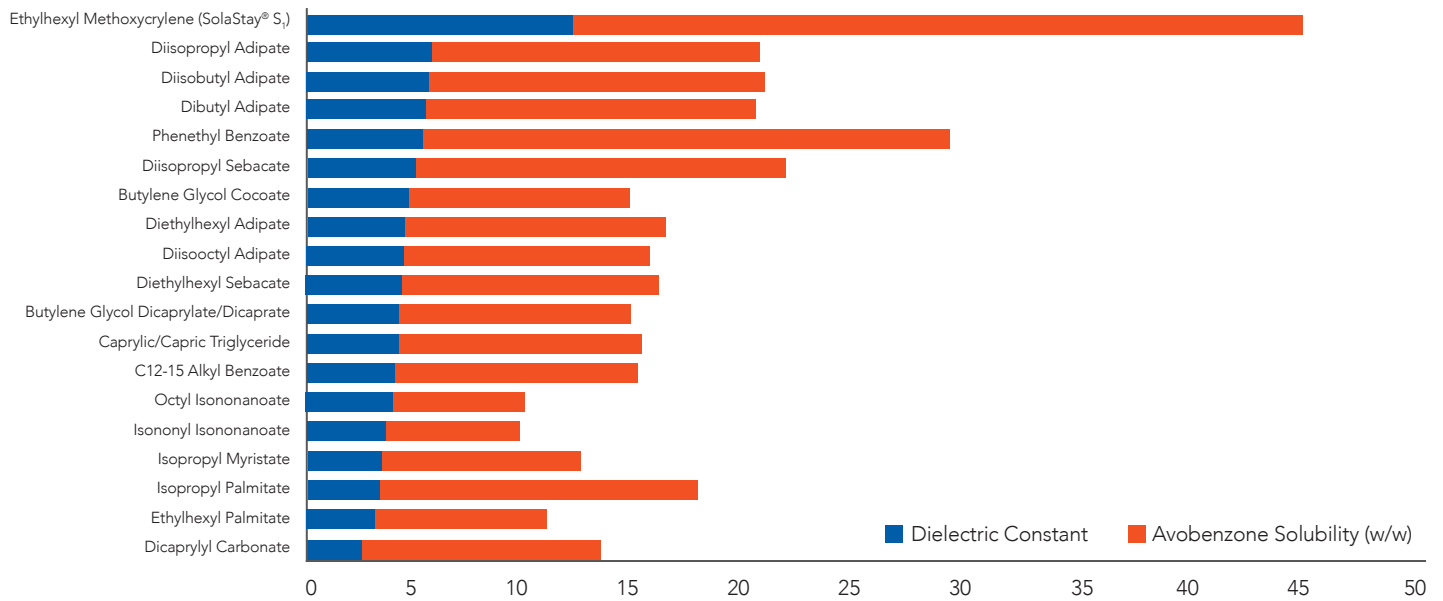
Metal oxides are photoactive and generate Reactive Oxygen Species (ROS) under UV radiation. To reveal and monitor the photoactivity of inorganic filters, Hallstar proposes a test utilizing DPPH (2,2-diphenyl-1-picrylhydrazyl) as a free radical indicator.



1:1 DPPH and ZnO in ethanol at 0.01% (w/w)

The unreacted DPPH is deep violet in solution. When it reacts with ROS and is neutralized by other radicals, the solution becomes pale yellow to colorless.

## Dielectric Constant and Avobenzone Solubility

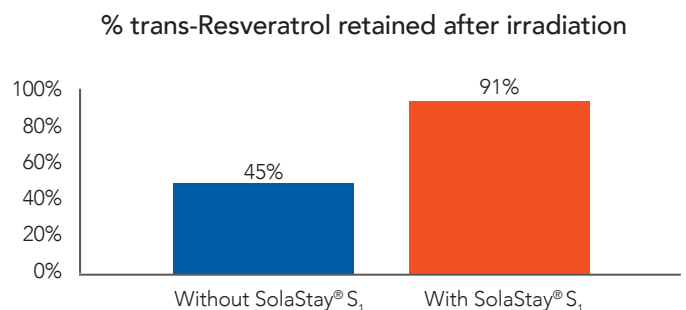
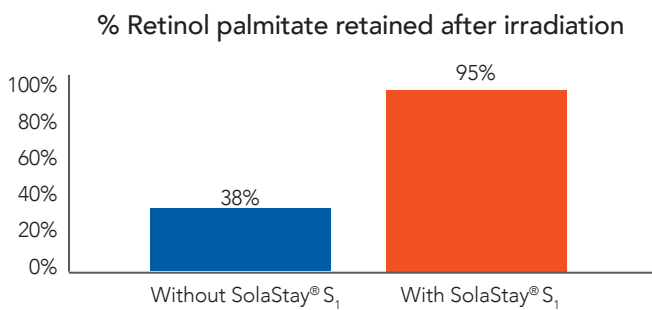
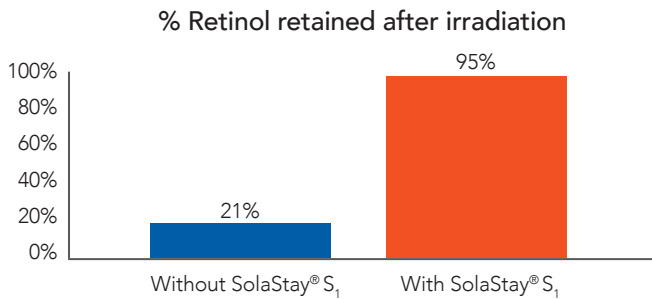


Solubilizing UV filters is crucial in achieving both efficient sun protection performance and increased physical stability of formulations. Increased solubility can prevent solid UV filters from recrystallizing during the aging process. The graph shows the superiority of SolaStay® S<sub>1</sub> as a solvent for Avobenzone compared to common sunscreen emollients.

Solvent polarity can have a positive impact on the photostability of UV filters. In particular, ester-based solvents with higher polarity provide increased photostabilization of Avobenzone. A dielectric constant higher than 5 is considered polar.

Overall the combined effects of dielectric constant and solubility are an important consideration in selecting the best solvents for a sunscreen formulation.

## SolaStay® S<sub>1</sub> photostabilizes active ingredients, such as Retinol, Retinyl palmitate and trans-Resveratrol.



30°C + flowing air in Q-Sun with 5MED irradiation