Application Guide 109

ATLAS MATERIAL TESTING SOLUTIONS
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Practical Guide to Stability Testing of Cosmetics & Packaging

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MATERIAL TESTING SOLUTIONS
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Atlas SUNTEST®

A practical guide to light stability testing of Cosmetics & Packaging

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- **The Cosmetics Market**
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Global Cosmetic Market

Annual Global Sales:

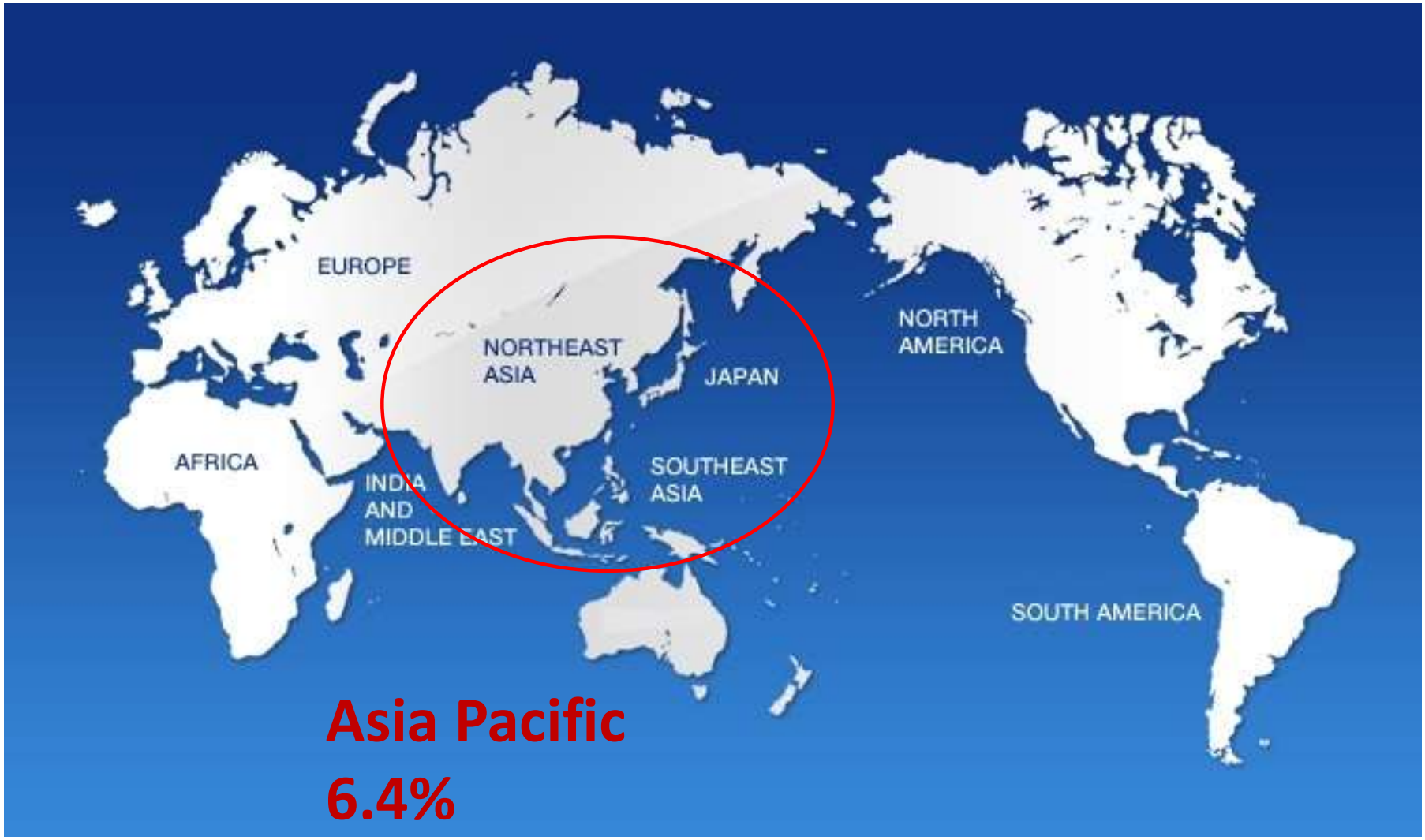
1.	L´Oréal	$ 29.7 billion
2.	Unilever	$ 23.9 billion
3.	P&G	$ 20.0 billion
4.	Estée Lauder	$ 10.2 billion
5.	Avon	$ 7.6 billion
6.	Johnson & Johnson	$ 7.4 billion
7.	Shiseido	$ 7.2 billion
8.	Beiersdorf	$ 6.7 billion
9.	Kao	$ 5.1 billion
10.	LVMH	$ 4.8 billion
Others:		about $ 50 billion

Source: Perry Romanowski, Cosmetic Science Webinar, Feb. 25, 2016

Source: alliedmarketresearch.com

➔ Approx $350-400 billion market, continously growing

Asia Pacific Skin Care Market



Forecast 2017-2022, % CAGR (in-cosmetics asia 2018, Bangkok)

China 8.6%; Hong Kong 6.9%, India 7.8%; Thailand 7.4%; Malaysia 11.3%; Japan 3.4%; South Korea 0.8%; Indonesia 9.9%; Vietnam 12.6%

Ingredients – What is the Problem?

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Trend towards natural cosmetics

- Naturally occuring cosmetic ingredients that may **not be light stable** include: oils, colors, pigments and scents.
- Added ingredients like stabilizers, emulsifiers, UV-filters or other components that **may not be light stable**.
- Photocatalytic ingredients contributing to product degradation may also be involved.
- **Individual product ingredients** are often light test**ed** for relative light stability, however testing is more common to understand **the combined factors that contribute to instability such as light + pH + oxidation + hydrolysis** in research trials.
- Ultimately, **the final product formulation must also be tested in the product packaging** to determine photostability under various light exposures.

Source: http://theindianspot.com/best-ingredients-to-look-for-in-natural-skin-care-products/, Nov 29, 2018

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Packaging – What's the Problem?

- Brand design, signature colors and packaging contribute to the value of cosmetic products. At the same time they should protect and should extend their shelf life.

Printed graphics, labels or containers can fade or change. Plastics can become permeable.

Transparent packaging can cause degradation of ingredients resulting in color and appearance change, loss of active ingredients, off-odor, etc…

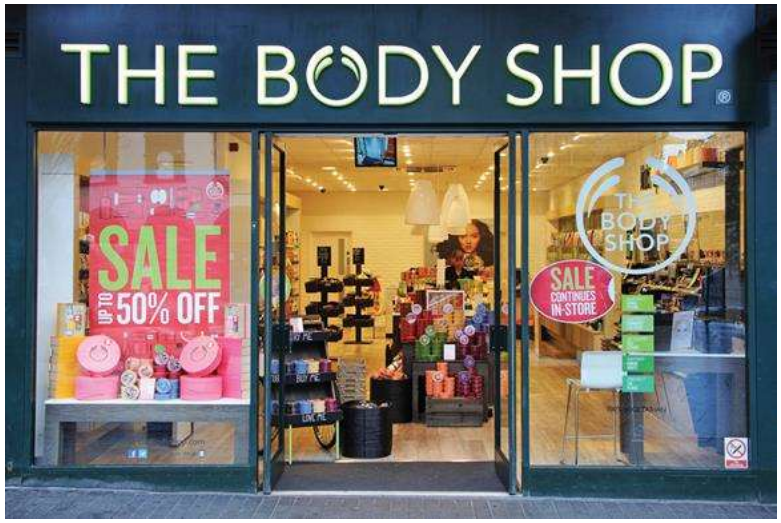
Barrier/ stabilised packaging (ClearShield, ect…) may be evaluated for product shelf life.

Source: https://allaboutthegloss.com/hair-color-levels/264, Nov 29, 2018

Photodegradation of Cosmetics

- Cosmetic products see plenty of natural & artificial radiation
  - *under storage conditions (artificial light)*
  - *At point of sale (artificial light / sunlight behind window glass)*
  - *In use (outdoor sunlight)*

Storage



Selling

Using

Source: https://www.thirdsector.co.uk/analysis-turbulent-end-body-shop-foundation/governance/article/1438950, Nov 29, 2018

Standards for Cosmetics Testing

- **Cosmetics - Guidelines on the stability testing of cosmetics products:** ISO/CD TR 18811
  - determine the effect of light the unprotected product (if packaged in clear or semi-transparent packaging) and the effect on the package (discoloration, stress cracking)
  - The lighting used can simulate the intensity/spectrum to which the cosmetic will likely be exposed during storage on store shelves or in consumers' homes.
  - The ICH Q1B photostability guideline *may be used as a reference for testing cosmetic products and packaging.*

- **Printed Matter**: ASTM D3429, ISO 12040, ISO 105 B02, AATCC TM16; ➔ lightfastness testing (window glass filter) is generally applicable.

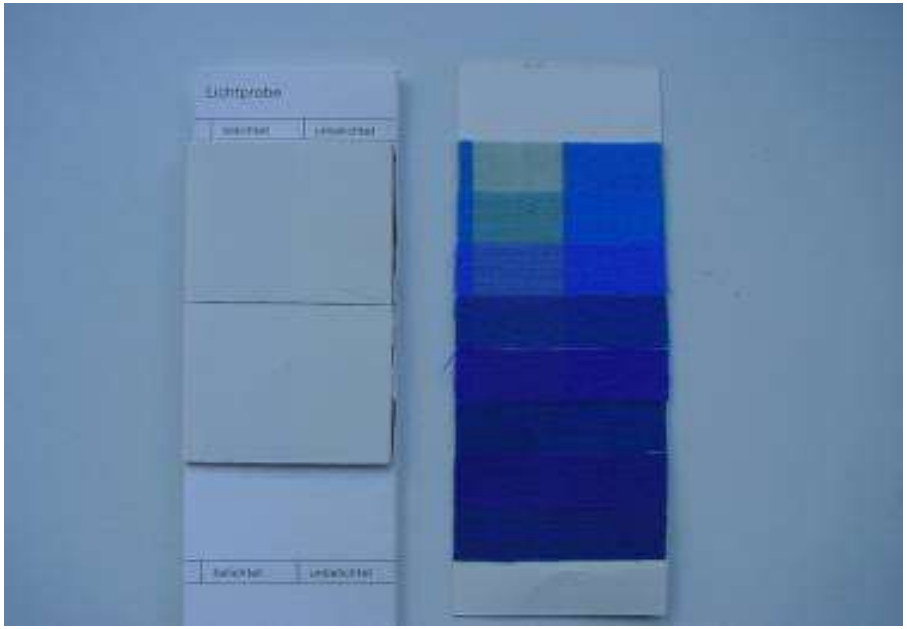
- **Plastic packaging**: ASTM D2565 without water sprays (daylight), ASTM D4459 (window glass / daylight), ASTM G155 (Cycles 4,6 ➔ window glass); ISO 4892-2 (Window glass / daylight)

- **OEM Specifications**: L´Oréal, P&G, Boots, J&J, …

Testing Printed Matter: ISO 12040

- Simmilar to ISO 105-B02
  - *Window glass filter*
  - *ISO Blue Wool scale as reference*
  - *half-masked specimens*
  - *BST < 45 °C (RH/CHT not defined)*

- Test method
  - *Exposure until grey scale rating **3***
  - *Lightfastness rating according to the corresponding ISO Blue Wool*



Clariant (Produkte) Schweiz AG, BU Paper Specialties, Customer Information, 1.12.2010, Copyright by Clariant

Blue Wool Rating vs Durability

- Expected color lightfast after ISO 12040 testing

Rating	Lightfastness	Expected Durability under Solar Radiation [h]	Typical Applications*
WS 1	very low	20	Paper and plastic bags, napkins, bulk mail
WS 2	low	40	
WS 3	moderate	80	Flyers, catalogues, journals, not exposed to direct daylight
WS 4	relatively good	160	
WS 5	good	380	Packaging with higher demand, for **pharmaceuticals, cosmetics**, cigarettes, food,… book covers
WS 6	very good	720	Packaging with highest demand, displays,… maps and posters
WS 7	excellent	1500	Outdoor posters and stickers, decorative colors, wallpapers
WS 8	outstanding	1500+	

) www.ricken-druck**.de/tl_files/inhalte/downloads/**Lichtechtheit**.pdf*

OEM / Atlas advice

a) A **specific filter for UV** for components directly exposed to the action of sunlight such as sun screen products.

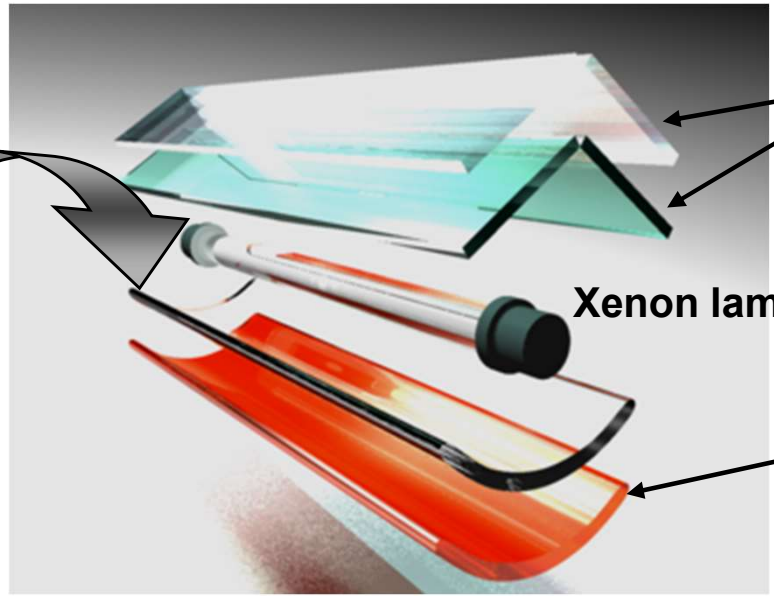
b) A **glass filter** for components not directly exposed to sunlight during distribution or use (e.g.: components displayed in a window).

Atlas SUNTEST CPS+ Optical system

a) Daylight filter

or

b) Window Glass filter



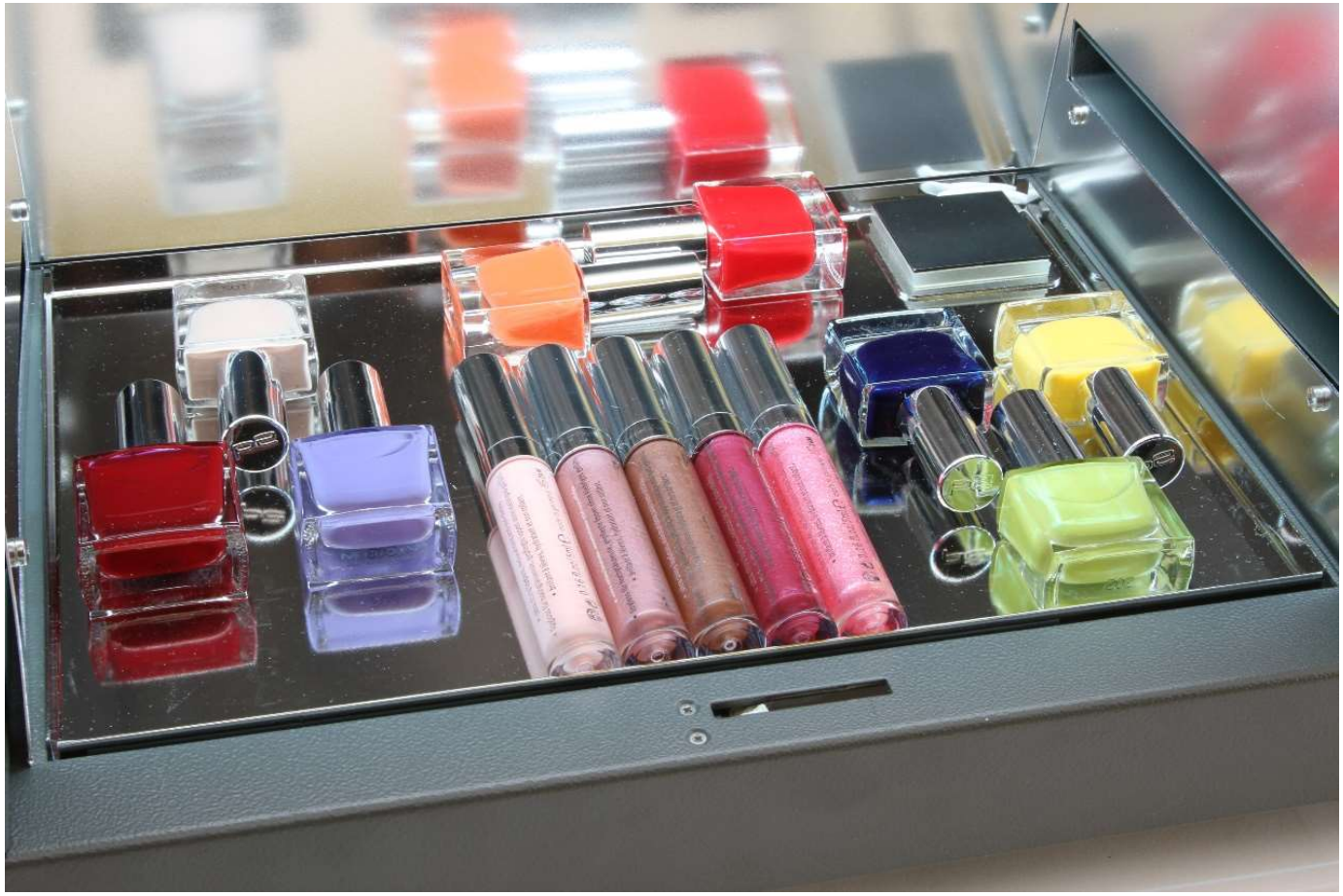
OEM / Atlas advice

- Select an illumination of 765 W/m² on the suntest apparatus.
- Place all the samples on the horizontal position in the suntest apparatus fitted with the glass filter or the specific filter for UV. Fix them if necessary.

a)
Daylight

b)
Window glass

Atlas SUNTEST CPS+ with cosmetic samples

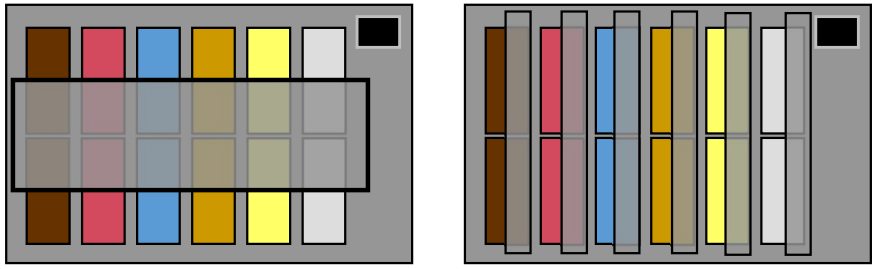


OEM / Atlas advice

Defects observed after 24 h test inside SUNTEST have shown to correlate with defects obtained after a 6 months exposure to artificial light in stores.

Notes:

- Always keep reference samples
- Use cover masks where useful ➔ easier evaluation
- Evaluate shade drifts or degradation



Examples of 50% masking samples inside a SUNTEST with covers plates

OEM Test

- Instrument: SUNTEST CPS+

- **Filter: Daylight / WG**
- **E: 765 W/m^2 (300-800nm)**
- **BST: as low as possible (laboratory temperature 20-22°C)***
- **SunCool: No*; Yes****
- **Test duration: 24h ±1 hour**

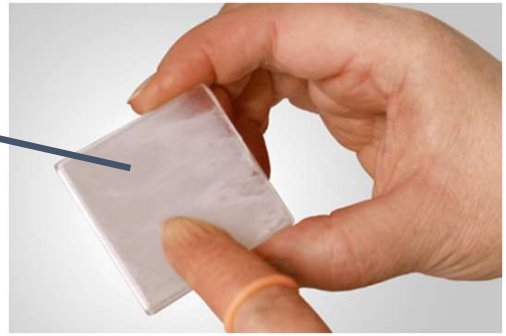
** SunCool chiller must be used when testing temperature sensitive products or alcohol containing products

Atlas SUNTEST XLS+ often used with similar test set-ups

Sunscreen products

- SPF Testing (in vitro UVA) using SUNTEST CPS+

Test Parameter	COLIPA (2011)	ISO 24443 (2012)
Plates	PMMA	PMMA
Replicates	4	4
Pre-Irradiation Spectrum	close to COLIPA (1994)	close to COLIPA (1995)
Pre-Irradiation Spectrum requirements	UVA/UVB 8-22	UVA/UVB 8-22
UV Irradiance (290-400nm)	50-140 W/m^2	40-200 W/m^2
Sample Temperature	< 40 °C	25-35 °C
Recalibration	18 mths or 3000 h	18 mths or 3000 h
Uniformity of test positions:	±10 %	±10 %



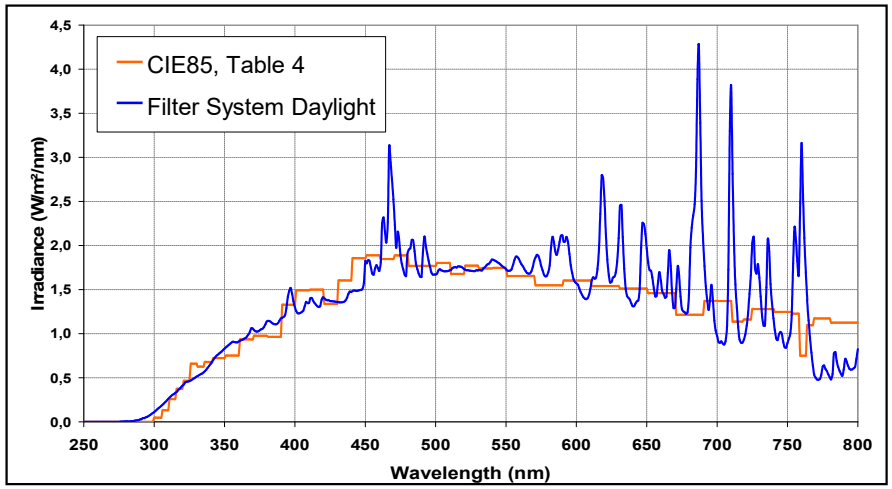
Source: https://www.labsphere.com/labsphere-products-solutions/components-accessories/spf-upf-testers/helioscreen-helioplates-hd6/, Nov 29, 2018

Ingredients – What is the Problem?

*… need **realistic** light stability test methods …and **short** test times.*

Source: http://www.talkativeman.com/advantages-disadvantages-research-methods/, Nov 29, 2018

Atlas ingredient screening in 12 hours



Stability Screening of: colors, pigments, scents, emulsifiers, antioxidants, ect…

Worst-case = Daylight

Parameter settings for Photostability testing:

Filter:	**Daylight**
E:	**60 W/m² = 550W/m²**
BST:	**35-55 ° C *(Surface Temp.)***
CHT:	**20-35 ° C *(Product Temp.)***

Irradiance = natural max.

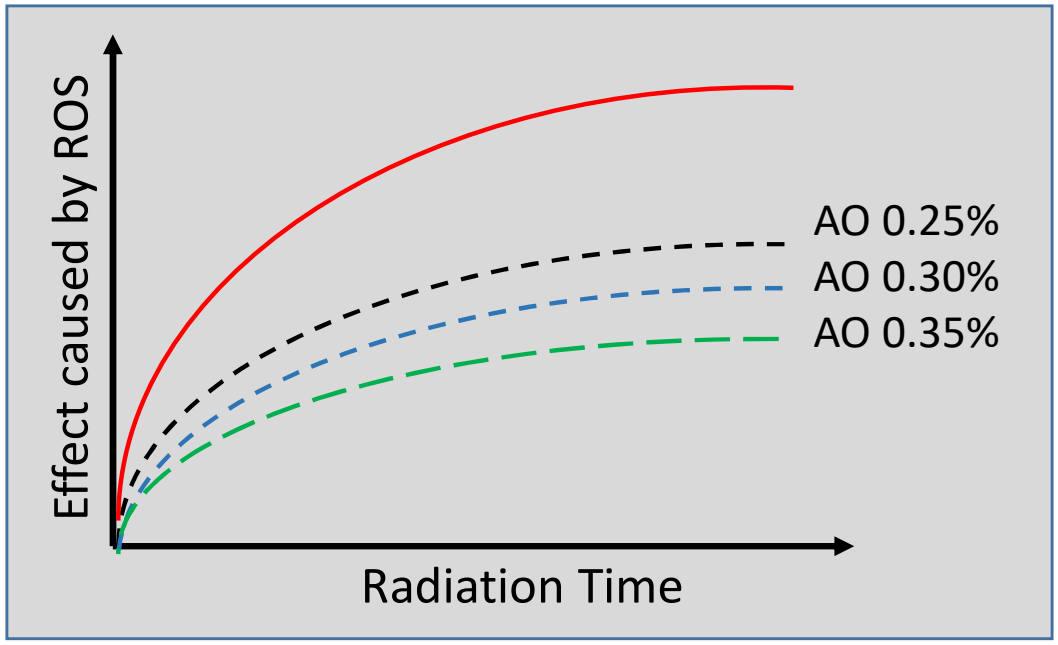
Temp. = summer day max.

Test Time: 12 hours

xenon test ≈ 5 days summer time.

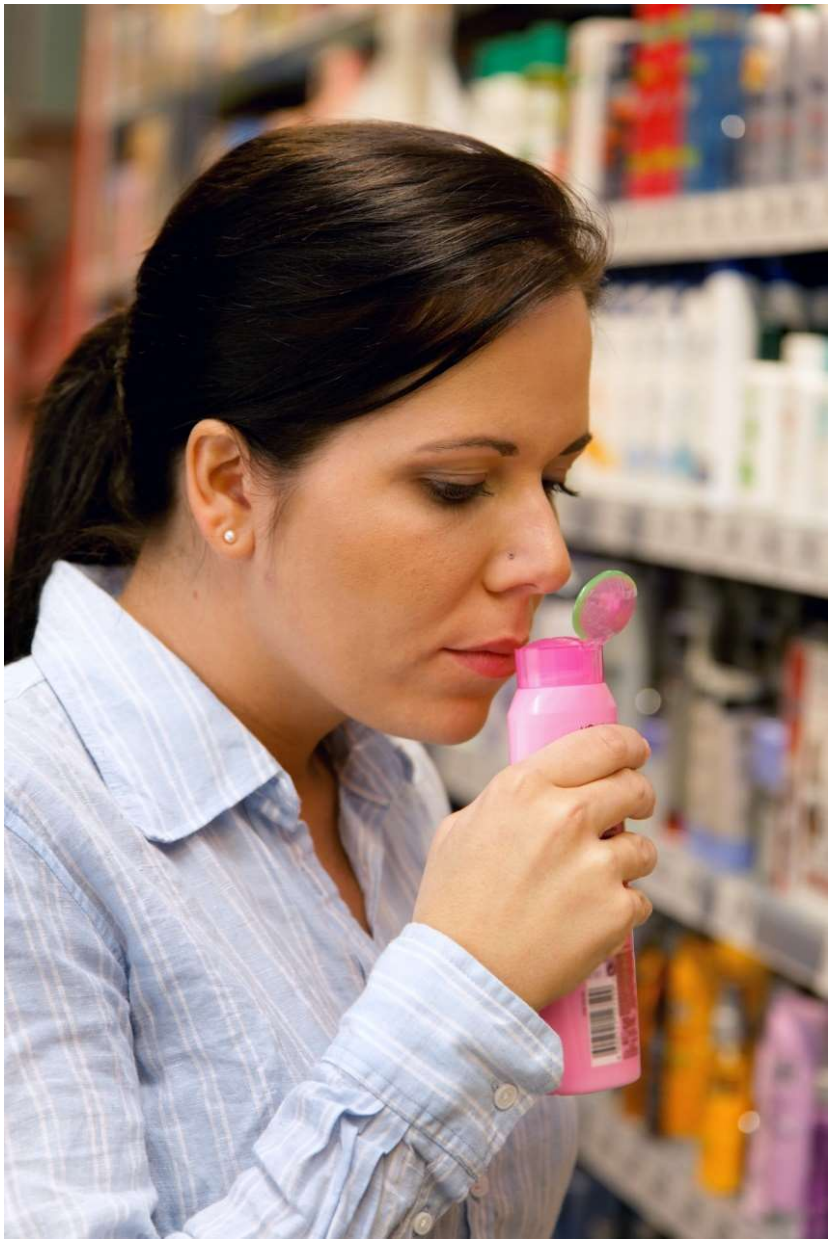
Example: Antioxidant screening

- Antioxidants are needed in many cosmetic products such as skin care / sun protection products to slow down formation of Reactive Oxygen Species (ROS) caused by sunlight. ➔Use SUNTEST for antioxidant (AO) studies and determine appropriate AO-type and level



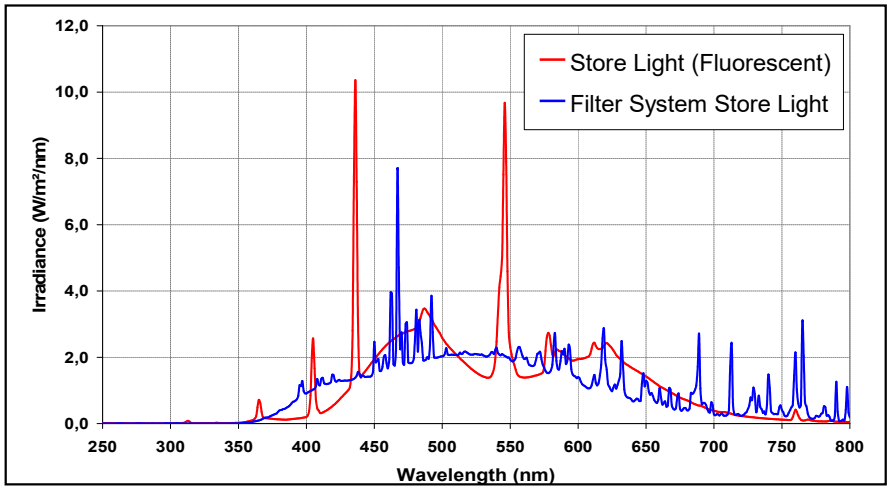
Fictive example for an antioxidant level study

Accelerated Shelf-life Testing (ASLT)



“How long is it good?”

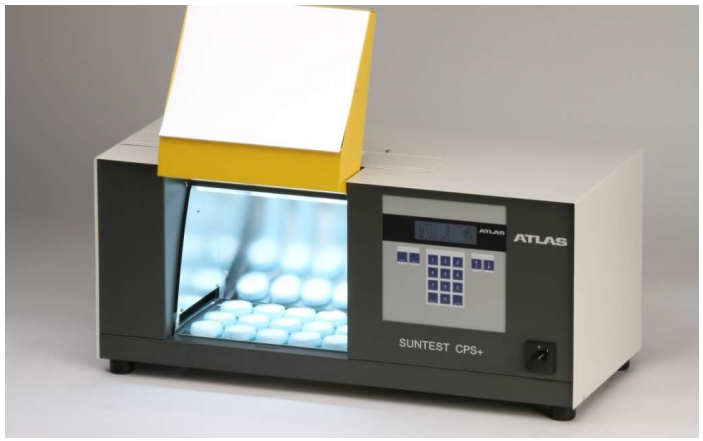
Atlas ASLT: fast & realistic



Realistic light = StoreLight™

Parameter settings for Shelf-life testing:

Filter:	**StoreLight™**
E:	**470 W/m² (300-800nm)**
BST:	**30-35 ° C *Surface Temp.)***
CHT:	**20-25 ° C *Product Temp.)***



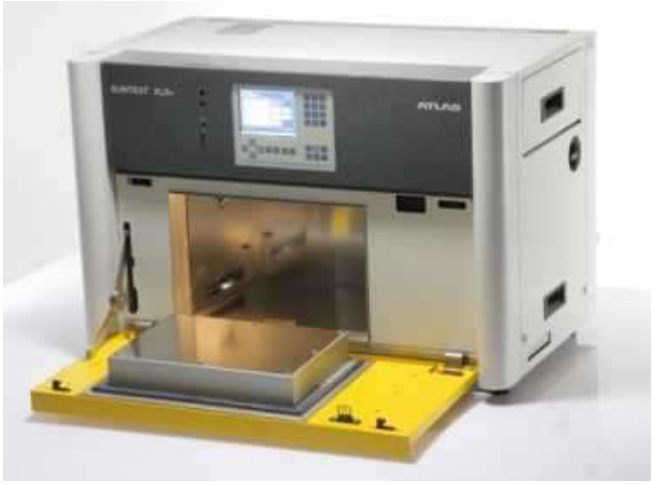
0,5 hours testing at 470 W/m² simulates approx. 1 day shelf-life in a supermarket.

...ACCELERATION 50x vs Realtime! Test 1 year shelf-life in only 1 week!

SUNTEST: ASLT Testing in 5 Days

- **ASLT**
  - ***Comparison to competitive equipment with respect to test durations to simulate 7 months of realtime storage***

ASLT inside climate chamber
with white fluorescent light, CHT 30 °C:
Test Duration: 8 Weeks*



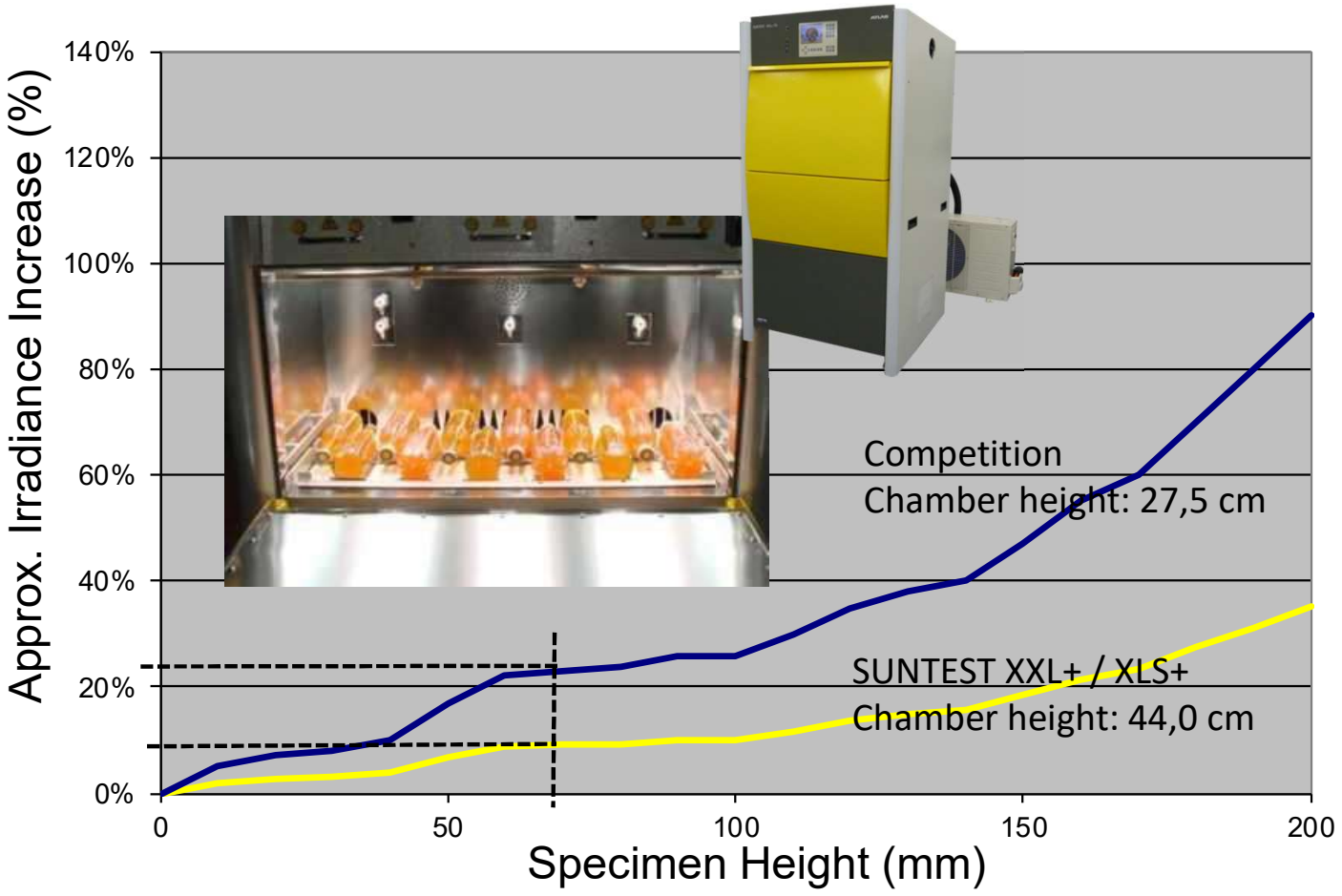
ASLT inside Atlas SUNTEST XLS+
with StoreLight filter, CHT 22 °C:
Test Duration: **5 days**

Picture Source: BINDER Data Sheet | As of: 13.10.2016

* Source: Teoh A., Subramaniam P.: "Forum Project Report No.952, Stability of Natural Colours in model Food systems", October 2011, leatherhead Food research

XXL+FD and XLS+ for 3-D Specimens

- Tallest xenon test chamber favourable for packaging testing



- Large capacity for ISO 12040 testing

Summary

- Atlas understands stability issues of ingredients, cosmetics products, and packaging
- There are standards, guidelines and Atlas advices for cosmetics and packaging testing
- Atlas offers complete test set-ups for SUNTEST instruments including application support for realistic testing conditions (outdoor, indoor, indoor on shelves)
- SUNTEST CPS+ can test UVA SPF (COLIPA, ISO 24443)
- Atlas provdes unique StoreLight™ for extra fast ASLT
- SUNTEST XLS+ and XXL+FD are best-in-class for 3-D specimens testing (tallest xenon test chambers)