

PRÜFBERICHT

In vitro Bestimmung des UVA-Schutzes

COLIPA Ratio

nach COLIPA 2007a

Ort der Durchführung: **Institut Dr. Schrader Hautphysiologie
Max-Planck-Straße 6
37603 Holzminden - Deutschland**

Auftrags-Nr.: **295-HP-09-000-09-092**

Projekt-Nr.: **HP-09-040**

Berichtsdatum: **12.03.2013**

Kunde:

Testprodukt: **Sonnenschutzcreme UV 30
Entwicklungsnr. 468 (80427-01)
im Auftrag der
Adolf Würth GmbH & Co. KG
Reinhold-Würth-Straße 12-17
74653 Künzelsau-Gaisbach
Deutschland**

COLIPA Ratio

Zusammenfassung

Testprodukt: **Sonnenschutzcreme UV 30**

Entwicklungsnr. 468 (80427-01)
im Auftrag der
 Adolf Würth GmbH & Co. KG, Reinhold-Würth-Straße 12-17,
 74653 Künzelsau-Gaisbach, Deutschland

Zielsetzung: *in vitro* UVA-Schutz-Bestimmung einschließlich Vorbestrahlung

Projektdurchführung: Martina Fahlbusch

Testzeitraum: 19.02.2009

Gerät: Bentham Spectrometer SSUV300
 Atlas Sun Test CPS+

Referenz: Glycerin

Substrat: aufgerautes Plexiglas (PMMA 120), Schönberg GmbH & Co. KG

Eingang: 04.12.2008 neue Qualität seit Dezember 2008

Charge: 20081209-PI193

Anzahl Platten: 3 (4 Messungen pro Platte)

Auftragsmenge: 0.75 mg/cm²

UVA Dosis: 22 J/cm²

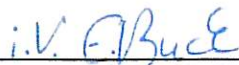
Abweichung vom Protokoll: keine

Ergebnisse:

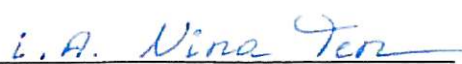
Testprodukt	SPF _{Label}	UVA Bilanz		in vitro UVA / COLIPA Ratio		
		Berechnung basierend auf DIN 67502		UV-Bestrahlung		
		UVA-PF ₀	UVA Bilanz	nach		
				vor	COLIPA Ratio	
				UVA-PF ₀	UVA-PF	SPF _{Label} /UVA-PF
Mittelwert von 3 Platten	30	20.1	65.8	18.4	16.8	1.8
Standardabweichung		0.45	1.56	0.45	0.99	0.10

In dieser Studie wird für das Testprodukt ein COLIPA Ratio von 1.8 ermittelt.


 Dr. Andreas Schrader


 Dr. Mathias Rohr (Direktor)


 Dr. Elke Buck (Leitung gerätetechnische Prüfung)


 Sandra Klawitter (Leitung Biometrie)

ANHANG 1

Daten - Statistik

In vitro Bestimmung des UVA-Schutzes / COLIPA Ratio

Institut Dr. Schrader Hautphysiologie

Zusammenfassung und Statistik

12.03.2013

Kunde: / Projekt-Nr.: HP-09-040

Sonnenschutzcreme UV 30 Entwicklungsnr. 468 (80427-01)							
SPF _{Label} :	30						
UVA Dosis:	22 J/cm ²						
	Auftrags- menge * [mg/cm ²]	UVA Bilanz Berechnung basierend auf DIN 67502		<i>in vitro</i> UVA / COLIPA Ratio			
		UVA-PF ₀	UVA Bilanz	Anpassungs- faktor	UVA-Bestrahlung		
					vor	nach	
					UVA-PF ₀	UVA-PF	COLIPA Ratio SPF _{Label} /UVA-PF
Platte 1	0.26	19.7	64.4	0.958	18.0	15.9	1.9
Platte 2	0.27	20.6	67.5	0.964	18.9	17.9	1.7
Platte 3	0.18	20.0	65.6	1.088	18.3	16.5	1.8
Anzahl	3	3	3	3	3	3	3
Mittelwert	0.24	20.1	65.8	1.004	18.4	16.8	1.8
Standard- abweichung	0.05	0.45	1.56	0.07	0.45	0.99	0.10
λ _C [nm]		381		381		381	

* nach Gleichgewichtseinstellung

In vitro Bestimmung des UVA-Schutzes / COLIPA Ratio

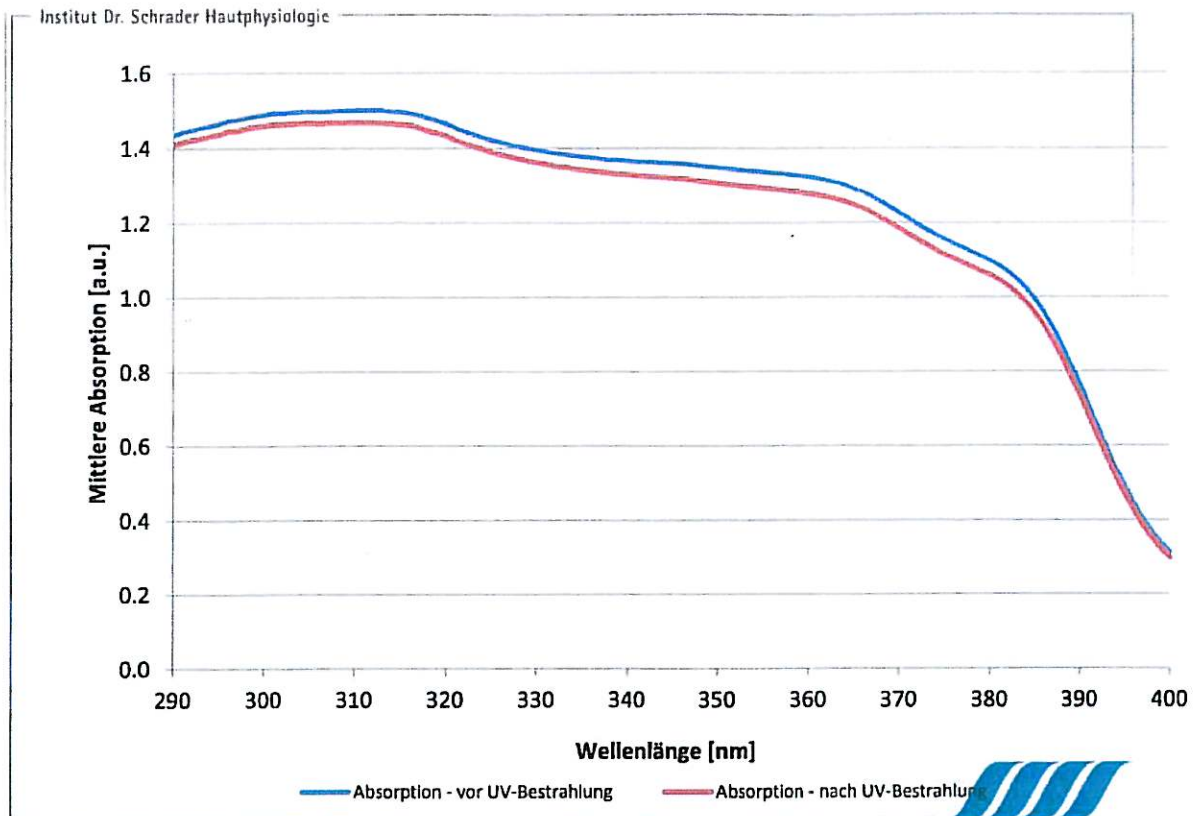
Absorptionsspektren

Institut Dr. Schrader Hautphysiologie

12.03.2013

Kunde: / Projekt-Nr.: HP-09-040

Produkt: Sonnenschutzcreme UV 30 Entwicklungsnr. 468 (80427-01)



In vitro Bestimmung des UVA-Schutzes / COLIPA Ratio

Institut Dr. Schrader Hautphysiologie

Absorption

12.03.2013

Kunde. / Projekt-Nr.: HP-09-040

Wellenlänge [nm]	Sonnenschutzcreme UV 30 Entwicklungsnr. 468 (80427-01)								
	Glyzerin [a.u.]	Absorption - vor UV-Bestrahlung				Absorption - nach UV-Bestrahlung			
		Platte 1	Platte 2	Platte 3	Mittelwert	Platte 1	Platte 2	Platte 3	Mittelwert
290	2.37E+03	1.50E+00	1.49E+00	1.31E+00	1.44E+00	1.44E+00	1.49E+00	1.28E+00	1.41E+00
291	2.53E+03	1.51E+00	1.50E+00	1.32E+00	1.44E+00	1.46E+00	1.50E+00	1.29E+00	1.42E+00
292	2.59E+03	1.52E+00	1.50E+00	1.33E+00	1.45E+00	1.47E+00	1.50E+00	1.30E+00	1.42E+00
293	2.66E+03	1.52E+00	1.51E+00	1.33E+00	1.46E+00	1.47E+00	1.51E+00	1.30E+00	1.43E+00
294	2.74E+03	1.53E+00	1.52E+00	1.34E+00	1.46E+00	1.48E+00	1.51E+00	1.31E+00	1.43E+00
295	2.82E+03	1.53E+00	1.52E+00	1.34E+00	1.47E+00	1.48E+00	1.52E+00	1.31E+00	1.44E+00
296	2.92E+03	1.54E+00	1.53E+00	1.35E+00	1.47E+00	1.49E+00	1.52E+00	1.32E+00	1.45E+00
297	2.98E+03	1.54E+00	1.53E+00	1.35E+00	1.48E+00	1.49E+00	1.53E+00	1.32E+00	1.45E+00
298	3.07E+03	1.55E+00	1.54E+00	1.36E+00	1.48E+00	1.50E+00	1.53E+00	1.33E+00	1.45E+00
299	3.14E+03	1.55E+00	1.54E+00	1.36E+00	1.49E+00	1.50E+00	1.54E+00	1.33E+00	1.46E+00
300	3.21E+03	1.56E+00	1.54E+00	1.37E+00	1.49E+00	1.51E+00	1.54E+00	1.33E+00	1.46E+00
301	3.28E+03	1.56E+00	1.55E+00	1.37E+00	1.49E+00	1.51E+00	1.54E+00	1.34E+00	1.46E+00
302	3.36E+03	1.58E+00	1.55E+00	1.37E+00	1.49E+00	1.51E+00	1.54E+00	1.34E+00	1.46E+00
303	3.43E+03	1.58E+00	1.55E+00	1.37E+00	1.50E+00	1.51E+00	1.54E+00	1.34E+00	1.47E+00
304	3.49E+03	1.57E+00	1.55E+00	1.37E+00	1.50E+00	1.51E+00	1.55E+00	1.34E+00	1.47E+00
305	3.55E+03	1.57E+00	1.55E+00	1.37E+00	1.50E+00	1.51E+00	1.55E+00	1.34E+00	1.47E+00
306	3.64E+03	1.56E+00	1.55E+00	1.38E+00	1.50E+00	1.51E+00	1.54E+00	1.34E+00	1.47E+00
307	3.72E+03	1.57E+00	1.55E+00	1.38E+00	1.50E+00	1.51E+00	1.55E+00	1.34E+00	1.47E+00
308	3.81E+03	1.57E+00	1.55E+00	1.38E+00	1.50E+00	1.51E+00	1.55E+00	1.34E+00	1.47E+00
309	3.89E+03	1.57E+00	1.55E+00	1.38E+00	1.50E+00	1.51E+00	1.55E+00	1.34E+00	1.47E+00
310	3.98E+03	1.57E+00	1.55E+00	1.38E+00	1.50E+00	1.52E+00	1.55E+00	1.34E+00	1.47E+00
311	4.08E+03	1.57E+00	1.55E+00	1.38E+00	1.50E+00	1.52E+00	1.55E+00	1.34E+00	1.47E+00
312	4.18E+03	1.57E+00	1.56E+00	1.38E+00	1.50E+00	1.51E+00	1.55E+00	1.34E+00	1.47E+00
313	4.29E+03	1.57E+00	1.55E+00	1.38E+00	1.50E+00	1.51E+00	1.55E+00	1.34E+00	1.47E+00
314	4.40E+03	1.56E+00	1.55E+00	1.38E+00	1.50E+00	1.51E+00	1.54E+00	1.34E+00	1.47E+00
315	4.47E+03	1.56E+00	1.55E+00	1.38E+00	1.50E+00	1.51E+00	1.54E+00	1.34E+00	1.48E+00
316	4.57E+03	1.56E+00	1.55E+00	1.37E+00	1.49E+00	1.51E+00	1.54E+00	1.34E+00	1.48E+00
317	4.65E+03	1.55E+00	1.54E+00	1.37E+00	1.49E+00	1.50E+00	1.53E+00	1.33E+00	1.45E+00
318	4.77E+03	1.54E+00	1.53E+00	1.36E+00	1.48E+00	1.49E+00	1.53E+00	1.33E+00	1.45E+00
319	4.89E+03	1.54E+00	1.53E+00	1.35E+00	1.47E+00	1.48E+00	1.52E+00	1.32E+00	1.44E+00
320	5.01E+03	1.53E+00	1.52E+00	1.35E+00	1.46E+00	1.48E+00	1.51E+00	1.31E+00	1.43E+00
321	5.13E+03	1.52E+00	1.51E+00	1.34E+00	1.45E+00	1.46E+00	1.50E+00	1.30E+00	1.42E+00
322	5.31E+03	1.51E+00	1.50E+00	1.33E+00	1.44E+00	1.45E+00	1.49E+00	1.29E+00	1.41E+00
323	5.54E+03	1.50E+00	1.49E+00	1.32E+00	1.44E+00	1.45E+00	1.48E+00	1.29E+00	1.40E+00
324	5.66E+03	1.49E+00	1.48E+00	1.31E+00	1.43E+00	1.44E+00	1.48E+00	1.28E+00	1.40E+00
325	5.79E+03	1.48E+00	1.48E+00	1.31E+00	1.42E+00	1.43E+00	1.47E+00	1.27E+00	1.39E+00
326	5.94E+03	1.47E+00	1.47E+00	1.30E+00	1.42E+00	1.42E+00	1.46E+00	1.27E+00	1.39E+00
327	6.08E+03	1.47E+00	1.47E+00	1.29E+00	1.41E+00	1.42E+00	1.45E+00	1.26E+00	1.38E+00
328	6.19E+03	1.46E+00	1.46E+00	1.29E+00	1.40E+00	1.41E+00	1.45E+00	1.25E+00	1.37E+00
329	6.35E+03	1.46E+00	1.46E+00	1.28E+00	1.40E+00	1.40E+00	1.44E+00	1.25E+00	1.37E+00
330	6.42E+03	1.45E+00	1.45E+00	1.28E+00	1.39E+00	1.40E+00	1.44E+00	1.25E+00	1.36E+00
331	6.51E+03	1.45E+00	1.45E+00	1.28E+00	1.39E+00	1.40E+00	1.43E+00	1.24E+00	1.35E+00
332	6.58E+03	1.44E+00	1.44E+00	1.27E+00	1.39E+00	1.40E+00	1.43E+00	1.24E+00	1.35E+00
333	6.61E+03	1.44E+00	1.44E+00	1.27E+00	1.38E+00	1.39E+00	1.43E+00	1.24E+00	1.35E+00
334	6.67E+03	1.44E+00	1.44E+00	1.27E+00	1.38E+00	1.38E+00	1.42E+00	1.23E+00	1.35E+00
335	6.62E+03	1.43E+00	1.44E+00	1.26E+00	1.38E+00	1.39E+00	1.42E+00	1.23E+00	1.34E+00
336	6.60E+03	1.43E+00	1.43E+00	1.26E+00	1.37E+00	1.38E+00	1.42E+00	1.23E+00	1.34E+00
337	6.53E+03	1.43E+00	1.43E+00	1.26E+00	1.37E+00	1.37E+00	1.41E+00	1.22E+00	1.34E+00
338	6.32E+03	1.42E+00	1.42E+00	1.25E+00	1.37E+00	1.37E+00	1.41E+00	1.22E+00	1.33E+00
339	6.32E+03	1.42E+00	1.43E+00	1.26E+00	1.37E+00	1.37E+00	1.41E+00	1.22E+00	1.33E+00
340	6.41E+03	1.42E+00	1.42E+00	1.25E+00	1.37E+00	1.36E+00	1.41E+00	1.22E+00	1.33E+00
341	6.52E+03	1.42E+00	1.42E+00	1.25E+00	1.36E+00	1.35E+00	1.40E+00	1.22E+00	1.33E+00
342	6.70E+03	1.41E+00	1.42E+00	1.25E+00	1.36E+00	1.35E+00	1.40E+00	1.21E+00	1.33E+00
343	6.87E+03	1.41E+00	1.42E+00	1.25E+00	1.36E+00	1.35E+00	1.40E+00	1.21E+00	1.32E+00
344	7.04E+03	1.41E+00	1.42E+00	1.25E+00	1.35E+00	1.36E+00	1.40E+00	1.21E+00	1.32E+00
345	7.30E+03	1.41E+00	1.42E+00	1.25E+00	1.35E+00	1.35E+00	1.40E+00	1.21E+00	1.32E+00
346	7.58E+03	1.41E+00	1.42E+00	1.23E+00	1.35E+00	1.35E+00	1.40E+00	1.21E+00	1.32E+00
347	7.86E+03	1.41E+00	1.41E+00	1.23E+00	1.34E+00	1.35E+00	1.39E+00	1.20E+00	1.32E+00
348	8.33E+03	1.40E+00	1.41E+00	1.24E+00	1.35E+00	1.34E+00	1.39E+00	1.20E+00	1.31E+00
349	8.53E+03	1.40E+00	1.41E+00	1.24E+00	1.35E+00	1.34E+00	1.39E+00	1.20E+00	1.31E+00
350	9.05E+03	1.40E+00	1.41E+00	1.24E+00	1.35E+00	1.34E+00	1.38E+00	1.20E+00	1.31E+00
351	9.59E+03	1.40E+00	1.41E+00	1.24E+00	1.35E+00	1.34E+00	1.38E+00	1.19E+00	1.30E+00
352	1.01E+04	1.39E+00	1.40E+00	1.23E+00	1.34E+00	1.35E+00	1.38E+00	1.19E+00	1.30E+00
353	1.07E+04	1.39E+00	1.40E+00	1.23E+00	1.34E+00	1.35E+00	1.38E+00	1.19E+00	1.30E+00
354	1.13E+04	1.39E+00	1.40E+00	1.23E+00	1.34E+00	1.35E+00	1.37E+00	1.19E+00	1.30E+00
355	1.19E+04	1.38E+00	1.40E+00	1.23E+00	1.34E+00	1.35E+00	1.37E+00	1.19E+00	1.29E+00
356	1.24E+04	1.38E+00	1.39E+00	1.23E+00	1.33E+00	1.32E+00	1.37E+00	1.18E+00	1.29E+00
357	1.29E+04	1.38E+00	1.39E+00	1.22E+00	1.33E+00	1.32E+00	1.37E+00	1.18E+00	1.29E+00
358	1.33E+04	1.38E+00	1.39E+00	1.22E+00	1.33E+00	1.32E+00	1.36E+00	1.18E+00	1.29E+00
359	1.37E+04	1.37E+00	1.39E+00	1.21E+00	1.33E+00	1.32E+00	1.36E+00	1.18E+00	1.28E+00
360	1.39E+04	1.37E+00	1.38E+00	1.22E+00	1.32E+00	1.31E+00	1.36E+00	1.17E+00	1.28E+00
361	1.40E+04	1.37E+00	1.38E+00	1.21E+00	1.32E+00	1.31E+00	1.35E+00	1.17E+00	1.27E+00
362	1.41E+04	1.35E+00	1.37E+00	1.20E+00	1.31E+00	1.30E+00	1.34E+00	1.16E+00	1.27E+00
363	1.40E+04	1.35E+00	1.36E+00	1.19E+00	1.30E+00	1.29E+00	1.33E+00	1.15E+00	1.26E+00
364	1.39E+04	1.34E+00	1.35E+00	1.19E+00	1.29E+00	1.28E+00	1.32E+00	1.14E+00	1.25E+00
365	1.38E+04	1.33E+00	1.34E+00	1.18E+00	1.28E+00	1.27E+00	1.31E+00	1.13E+00	1.24E+00
366	1.36E+04	1.33E+00	1.33E+00	1.16E+00	1.27E+00	1.25E+00	1.30E+00	1.12E+00	1.23E+00
367	1.35E+04	1.30E+00	1.31E+00	1.15E+00	1.25E+00	1.24E+00	1.29E+00	1.11E+00	1.21E+00
368	1.32E+04	1.28E+00	1.30E+00	1.14E+00	1.24E+00	1.23E+00	1.27E+00	1.10E+00	1.20E+00
369	1.31E+04	1.27E+00	1.28E+00	1.13E+00	1.23E+00	1.21E+00	1.26E+00	1.08E+00	1.18E+00
370	1.29E+04	1.25E+00	1.27E+00	1.11E+00	1.21E+00	1.20E+00	1.24E+00	1.07E+00	1.17E+00
371	1.27E+04	1.24E+00	1.25E+00	1.09E+00	1.19E+00	1.18E+00	1.23E+00	1.05E+00	1.15E+00
372	1.25E+04	1.22E+00	1.24E+00	1.08E+00	1.18E+00	1.17E+00	1.21E+00	1.04E+00	1.14E+00
373	1.23E+04	1.21E+00	1.23E+00	1.07E+00	1.17E+00	1.15E+00	1.20E+00	1.03E+00	1.13E+00
374	1.21E+04	1.19E+00	1.21E+00	1.06E+00	1.15E+00	1.14E+00	1.19E+00	1.02E	

ANHANG 2

Protokoll

***In vitro* Determination of UVA-Protection / COLIPA Ratio**

1 Determination of COLIPA Ratio

This protocol describes the *in vitro* determination of UVA-protection of sunscreen products according to COLIPA 2007a¹ taking into account possible photo-degradation. The test is based on the assessment of UV-transmittance through a thin film of sunscreen sample spread on a roughened substrate, before and after exposure to a controlled dose of irradiation from a defined source of sun spectrum.

1.1 Transmission Measurements

For the investigation a Bentham spectrometer system (SSUV300) is used. It allows measurements up to an optical density of 6 units. The detection unit for the transmitted light consists of an integrating sphere and a double monochromator with an additional photo multiplier. The arrangement allows to minimize the influence of scattered light and has a favourable effect to the results. The wavelength selective excitation of test product is achieved by a xenon arc lamp with a continuous spectrum in the UV range. To ensure a high reproducibility of the measurements the wavelength accuracy is checked regularly using a holmium per chlorate solution.

Transmission measurements are carried out in the range from 290 nm to 400 nm. The incremental wavelength step is 1 nm. A glycerine coated plate, not containing any light absorbing or scattering compounds, is used as reference. Transmission values of treated sample and reference serve as calculation base for the absorption of test product.

Each sample is placed directly at the integration sphere entrance and is measured at 4 incidentally selected points. Three plates are prepared per test product, thus for every test product 12 spectra are measured before and after UV irradiation, each.

1.2 Irradiation

An Atlas Sun Test CPS+ is used as source of sun spectrum. The sunscreen sample is exposed to an irradiation dose D proportional to the initial UVA protection factor UVA-PF_0 , calculated from the adjusted absorbance data of the non exposed sample (see calculations below).

$$D = \text{UVA PF}_0 \times D_0 \quad [\text{J/cm}^2]$$

D_0 is unit UVA dose per unit UVA-PF_0 and it is fixed at 1.2 J/cm² UVA. The irradiation dose D given in the report is based on the irradiation time taking into consideration the above given equation.

1.3 Product Application

A Plexiglas plate (PMMA 120) with an area of approximately 25 cm² is used as substrate.

For the reference 3 µl to 5 µl of Glycerine is spotted evenly across the plate surface using a micro-pipette. The applied spots are then distributed using a pre-saturated finger.

The test product (0.75 mg/cm² ± 10 %) is applied in the same way on the plate surface. After product application the plates are equilibrated in the dark for approximately 20 minutes at room temperature before the measurement is taken. The applied amount of test product is determined by an analytical balance weighing before and after product application as well as after equilibration time. The latter value is given in Annex 1 for each plate.

¹Method for the *in vitro* Determination of UVA Protection provided by Sunscreen Products, Guideline, COLIPA 2007a

1.4 Evaluation

1.4.1 Determination of Absorption and *in vitro* SPF

The calculation of absorption properties of test products generated from their transmission values is done by the following equation:

$$A = \log \left(\frac{C_{\lambda}}{P_{\lambda}} \right)$$

$$C_{\lambda} = \frac{\sum c_{\lambda} [x]}{n}$$

$$P_{\lambda} = \frac{\sum p_{\lambda} [x]}{n}$$

- $c_{\lambda} [x]$ = Transmission measurements at position x and wavelength λ of the reference plate
 $p_{\lambda} [x]$ = Transmission measurements at position x and wavelength λ of the product treated plate

The determination of *in vitro* SPF is done by using the following equation:

$$SPF_{in vitro} = \frac{\int_{290nm}^{400nm} E(\lambda) \times I_1(\lambda) \times d\lambda}{\int_{290nm}^{400nm} E(\lambda) \times I_1(\lambda) \times 10^{A_0(\lambda)} \times d\lambda}$$

- $E(\lambda)$ = Erythema action spectrum (CIE-1987)
 $I_1(\lambda)$ = UV-SSR source spectrum
 $A_0(\lambda)$ = Mean monochromatic absorbance of the test product layer before UV exposure
 $d\lambda$ = Wavelength step (1nm)

If the *in vitro* SPF is not equal to the *in vivo* measured SPF (SPF_{Label}), the absorption spectrum is aligned by varying the constant C (adjustment factor) until the *in vitro* SPF fits into the *in vivo* SPF. It is recommended that C falls within a range between 0.8 and 1.2.

$$SPF_{in vitro, adj} = SPF_{Label} = \frac{\int_{290nm}^{400nm} E(\lambda) \times I_1(\lambda) \times d\lambda}{\int_{290nm}^{400nm} E(\lambda) \times I_1(\lambda) \times 10^{A_0(\lambda) \times C} \times d\lambda}$$

1.4.2 Calculation of UVA-PF0 and UVA-PF

UVA-PF₀ is calculated for each plate individually by the following equation:

$$UVA PF_0 = \frac{\int_{320nm}^{400nm} P(\lambda) \times I_2(\lambda) \times d\lambda}{\int_{320nm}^{400nm} P(\lambda) \times I_2(\lambda) \times 10^{-A_0(\lambda) \times C} \times d\lambda}$$

- $P(\lambda)$ = PPD-action spectrum
 $I_2(\lambda)$ = UVA radiation source spectrum

UVA-PF is calculated for each plate individually using the mean monochromatic absorbance $A(\lambda)$ of the test product after UV exposure:

$$\text{UVA PF} = \frac{\int_{320\text{ nm}}^{400\text{ nm}} P(\lambda) \times I_2(\lambda) \times d\lambda}{\int_{320\text{ nm}}^{400\text{ nm}} P(\lambda) \times I_2(\lambda) \times 10^{-A(\lambda) \times C} d\lambda}$$

The coefficient of variation of absorbance between the five individual spots per plate must be below 50 %. The coefficient of variation between the UVA-PF's of the (at least three) individual plates must be below 20 %.

1.4.3 COLIPA Ratio

In order to characterize the UVA-protection properties of the test product the ratio of *in vivo* label SPF and *in vitro* UVA-PF is calculated. A ratio of ≤ 3 is recommended.²

$$\text{Ratio} = \frac{\text{SPF}_{\text{Label}}}{\text{UVA PF}}$$

2 UVA-Balance

The UVA-Balance³ is calculated as ratio of UVA-PF_{0, Balance} and SPF_{Label}:

$$\text{UVA Balance} = \frac{(\text{UVA PF}_{0, \text{Balance}} - 1)}{(\text{SPF}_{\text{Label}} - 1)} \times 100$$

UVA-PF_{0, Balance} = Persistent pigment darkening – *in vitro* determined factor from adjusted absorbance spectra
 SPF_{Label} = SPF, determined *in vivo*

The UVA-PF_{0, Balance} is calculated analogous to UVA-PF₀ described in chapter 1.4.2, but instead of the UVA-SSR source spectrum $I_1(\lambda)$ the COLIPA standard sun spectrum is used.

The adjustment factor is calculated on the analogy of C in chapter 1.4.1, taking into consideration the Multiport WG 335 UG11 spectrum instead of the UVA radiation source spectrum $I_2(\lambda)$.

² Commission of the European Communities, Commission Recommendation, Official Journal of the European Union, Sep. 2006

³ DIN 67502; Charakterisierung der UVA-Schutzwirkung von dermalen Sonnenschutzmitteln durch Transmissionsmessungen unter Berücksichtigung des Lichtschuttfaktors; 2004