PHOTOCHROMIC CARDS FOR INDICATION OF SOLAR UVR

Marko Weber[1], Karl Schulmeister[1] und Helmut Brusl[2]

[1] Seibersdorf Labor GmbH, Seibersdorf, Austria, [2] Austrian Social Insurance for Occupational Risks (AUVA), Vienna, Austria

ABSTRACT

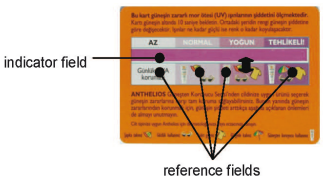
The properties of a number of different types of photochromic cards were characterised which would provide an attractive means to roughly indicate the instantaneous erythemal solar UV irradiance. Several parameters which may influence the colour of the cards were examined with both outdoor trials under solar UV as well as indoor trials using a filtered xenon arc lamp. The findings show that the tested cards do not give an appropriate estimation of the effective irradiance due to their spectral sensitivity and their temperature dependence.

PHOTOCHROMIC CARDS

Photochromics are used to generate the alteration of colour in the indicator field. Ideally, the reversible change of colour should be related to the erythemally weighted effective irradiance.

Application of photochromic cards:

- Expose the card to solar UVR
- Compare the colour of the indicator field to the colours of the reference fields
- Take the personal protection against solar UVR given in the appropriate reference field into account

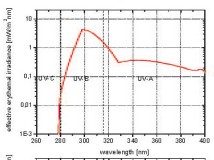
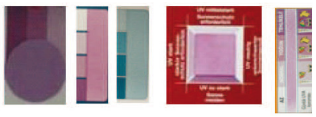
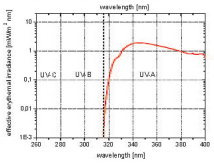
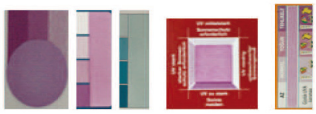
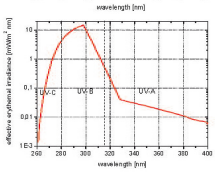
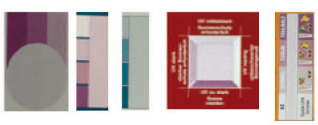


METHODS

The spectral irradiance was measured at the location of the card with a double monochromator, weighted with the erythemal action spectrum and integrated over the wavelength to obtain the effective irradiance. From the effective irradiance the UV index (UVI) was calculated to characterise the dependency of the colour change on the UVI. The colour change of the indicator fields was visually estimated and compared to the colour of printed reference fields, which are linked to advice concerning personal protection. Additionally, the cards were photographed with a digital camera under reproducible lighting conditions.

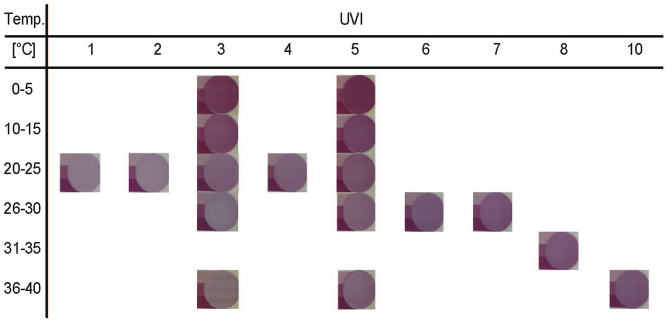
RESULTS

Spectral sensitivity:

UVI	effective spectrum	colour of indicator field	remark
4			good indication of UVR on cards
4			mainly UVA → good indication
11			mainly UVB → little or no indication

The tested erythemal UV irradiance indicator cards are mainly sensitive to UVA and show only very little sensitivity to UVB. The spectral sensitivity of the tested cards corresponds badly with the action spectrum for the UV erythema since UVB is much more effective than UVA in causing erythema. For irradiation with a given UVI, the discoloration of the indicator fields depends on the ratio between UVA and UVB.

Temperature and UVI:



The matrix above shows that the ambient temperature has a stronger impact on the discoloration of the indicator field than the UVI. The following figure shows that the lower the ambient temperature the more intense is the discoloration at the same UVI. At high UVI (≥ 8) and high temperatures (≥ 30°C) the colour of the indicator field does not correlate well with the UV exposure, as the colour of the indicator field gradually fades due to the increasing temperatures.

UVI	temperature	colour of indicator field	remark
5	0°C		danger is overestimated
5	20°C		good indication
5	40°C		danger is underestimated

CONCLUSIONS

- At low ambient temperatures the tested cards tend to overestimate the potential erythemal hazard, while they underestimate it at higher temperatures.
- Due to the spectral sensitivity of the cards the potential hazard of the solar UV is overestimated in the morning, in the late afternoon and in spring and autumn in mid-latitudes.
- The highest underestimation of the potential hazard will occur at high temperatures with UVB dominating sources.
- The highest overestimation of the erythemal hazard occurs at low environmental temperatures and with a low ratio of UVB in the radiation.

In summary, the application area of the tested erythemal UV irradiance indicator cards is limited as they might not give an appropriate estimation of the potential erythemal hazard for some environmental conditions.

CONTACT
DI Marko Weber, marko.weber@seibersdorf-laboratories.at

Note: This poster was originally published under our company's former name Austrian Research Centers