

Application News

No. A472

Spectrophotometric Analysis

Introduction of UPF Excel-Based Macro Software

■ Introduction

With the end of the cold season, temperatures gradually rise as the hours of daylight lengthen. Along with this change in temperature, the garments that are worn gradually become thinner and briefer, exposing a greater percentage of skin to sunlight. Prolonged exposure of the skin to the ultraviolet rays that are present in sunlight causes erythema (sunburn), which can in some cases lead to skin cancer.

Various products for blocking UV rays are available on the market. UPF protective clothing may contain a label that displays a UPF value (Ultraviolet Protection Factor), which indicates the degree to which ultraviolet ray is blocked. This UPF value is a defined reference value that is supported in the United States, Europe and Oceania. Here, we introduce a UPF Excel-based macro software that can easily be used to calculate this UPF value.



Fig. 1 Photograph of Measured UV Protective Hat, Shawl and Umbrella Cloth

■ Spectra of Hat, Shawl and Umbrella Cloth Treated for UV Protection

Using the Shimadzu UV-2600 UV-VIS spectrophotometer and ISR-2600Plus integrating sphere, we measured the spectra of a commercially available UV protective hat, shawl and umbrella cloth, displayed in Fig. 1. Table 1 shows the analytical conditions used, and Fig. 2 shows the respective transmittance spectra that were obtained.

Table 1 Analytical Conditions

Instruments	Shimadzu UV-2600 UV-VIS spectrophotometer ISR-2600Plus integrating sphere
Measurement Wavelength Range	280 to 400 nm
Scan Speed	Medium
Sampling Pitch	1.0 nm
Measurement Value	Transmittance
Slit Width	5 nm

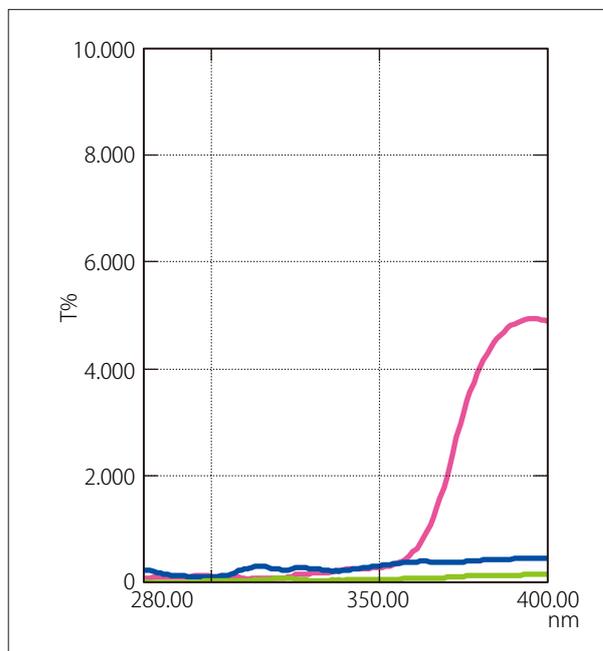


Fig. 2 Transmittance Spectra of UV Protective Hat, Shawl and Umbrella Cloth (Red: Umbrella Cloth, Blue: Shawl, Green: Hat)

■ UPF Excel-Based Macro Software

After converting the measurement value obtained with the Shimadzu UV-VIS spectrophotometer to CSV-format, the UPF Excel-Based Macro Software calculates instantaneously the UPF value in accordance with the selected official method.

The measurement data file and standard selection window of the UPF Excel-Based Macro Software is shown in Fig. 3. Selection of the appropriate official method can be made from among the German/UK standard specified as "EN 13578-1," the United States "AATCC 183" standard, and the Australia/New Zealand "AS/NZ 4399" standard. For the details regarding each of the standard methods, please refer to Application News No. A450.

After selecting the measurement data file and appropriate standard method as shown in Fig. 3, the calculation process is executed by just clicking the [Calculate] button. An example of the generated results is shown in Fig. 4. In addition to UPF value, the UVA value, UVB value, and the transmittance spectrum from 280–400 nm are also displayed at the same time. There are also title and comment fields that can be freely edited by the user.

The measurement results obtained here in accordance with each standard method for each of the samples are shown in Table 2.

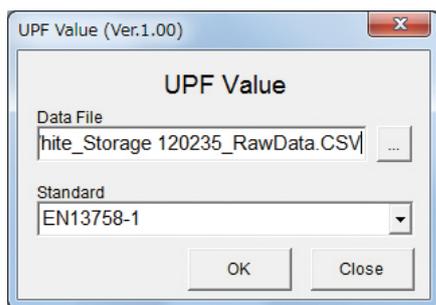


Fig. 3 Window for Selecting Measurement Data and Standard

■ Conclusions

The samples measured here were not especially thick, but a significant percentage of UV radiation was obviously blocked. In addition, it was possible to calculate the UPF values according to the appropriate standard without having to use special software, which typically would have required considerable time and effort. The UPF Excel-Based Macro Software introduced here allows results to be obtained instantaneously. However, it is recommended to verify the current method when conducting measurement according to an official standard.

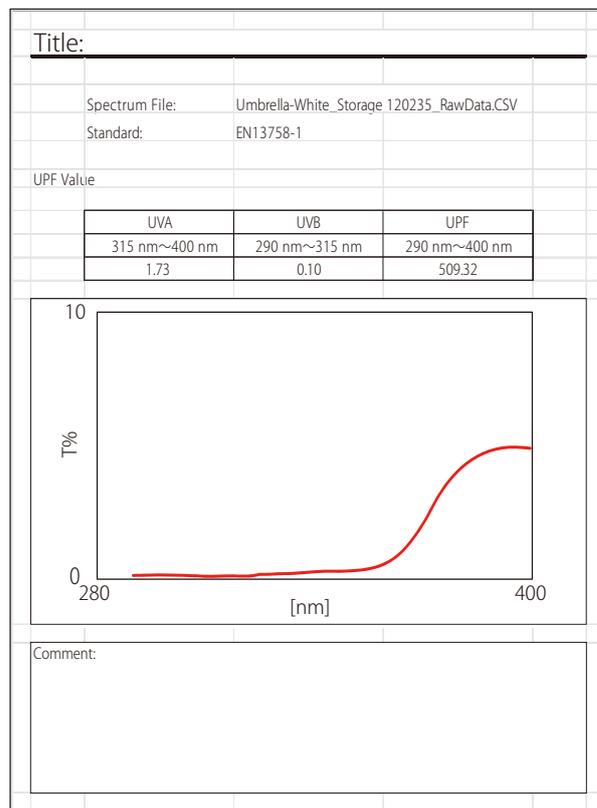


Fig. 4 Window Displaying the UPF Calculation Results

[References]

- DIN EN13758-1
Textile Solar UV protective properties-
Part1: Method of test for apparel fabric (includes Amendment A1:2006)
English version of DIN EN 13758-1:2007-03
- BS EN 13758-1
BRITISH STANDARD
Textiles-Solar UV protective properties-
Part1: Method of test for apparel fabrics
- AATCC Test Method 183-2010
Transmittance or Blocking of Erythemally Weighted Ultraviolet Radiation through Fabrics
- Australian/New Zealand Standard
Sun Protective clothing-Evaluation and classification

Table 2 UPF Values for UV Protective Garments

	Germany/UK DIN EN 13758-1 BS EN 13758-1	United States AATCC 183	Australia/New Zealand AS/NZS 4399
UV Protective Hat	UPF>50 (2896)	50+ (2932)	50+ (3202)
UV Protective Shawl	UPF>50 (490)	50+ (489)	50+ (437)
UV Protective Umbrella Cloth	UPF>50 (509)	50+ (516)	50+ (899)