Applications Note

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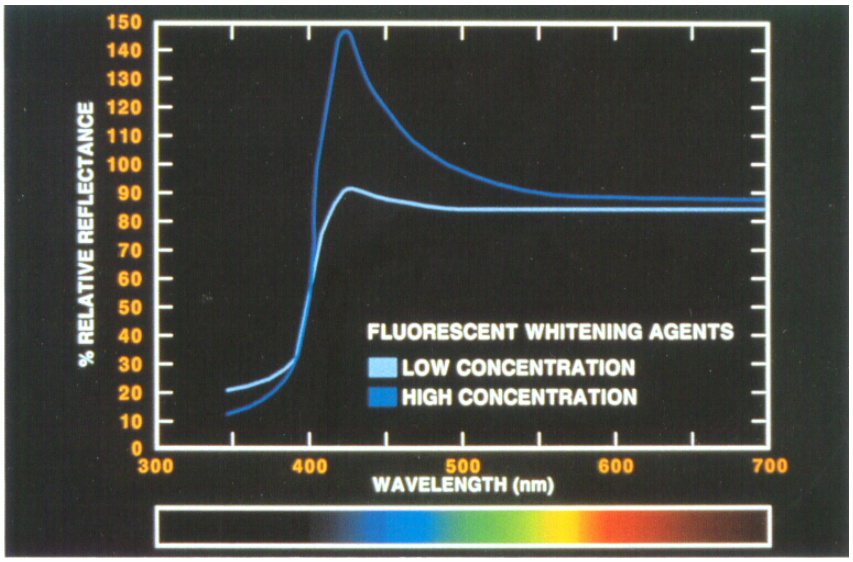
Simulating Daylight Using UV Control

Why Use UV Control?

Fluorescent whitening agents (FWAs) are often used in the textile, paper, and plastic industries to make products appear more brilliantly white when viewed in sunlight or other light sources containing UV light. The graph below illustrates the spectral effect of such whitening agents. Note that the high concentration of FWA boosts the spectral reflectance well over 100% at about 420 nm.



HunterLab ColorQuest XEs, LabScan XEs, SpectraProbe XEs, UltraScan XEs, UltraScan PROs, and UltraScan VISes may be purchased with an ultraviolet (UV) control option that permits the measurements obtained with the instrument to more closely match visual evaluations made under daylight illumination and allows the instrument to more repeatably measure FWA-enhanced samples over time.

Although the xenon light source used in the ColorQuest XE, LabScan XE, SpectraProbe XE, UltraScan XE, UltraScan PRO, and UltraScan VIS more closely resembles natural daylight than the tungsten-halogen lamps used in older instruments like the ColorQuest 45/0, ColorQuest II Sphere, LabScan, and SpectraProbe, the spectral distribution (specifically, the ratio of UV light to visible light) of the xenon lamp can still be adjusted to more closely match that the D65 daylight illuminant using motorized UV

filters and a calibrated fluorescent white standard. This permits measurements of whitened products to more closely match the color seen outdoors by eye, improves agreement of the illumination of different instruments, and compensates for the aging of the lamp, since regularly performed UV calibration continually adjusts the properties of the light striking samples to a consistent level even as the lamp itself changes. The spectral properties of the source light can be kept consistent throughout its lifetime—a valuable feature for a lamp with a lifetime of over a million flashes!

How is UV Control Performed?

The UV control process begins at HunterLab before your instrument is even shipped to you. HunterLab maintains a master UV control instrument, as well as current sets of bleached, white cotton standards obtained from the Hohenstein Institute in Germany. HunterLab uses those cotton standards and the master instrument to apply a calibrated Ganz whiteness value to a fluorescent transfer standard that will then be given to you with your instrument. For the ColorQuest XE, UltraScan XE, UltraScan PRO, and UltraScan VIS, this standard is stable white plastic. The LabScan XE and SpectraProbe XE standards are Spectralon mounted in standard holders.

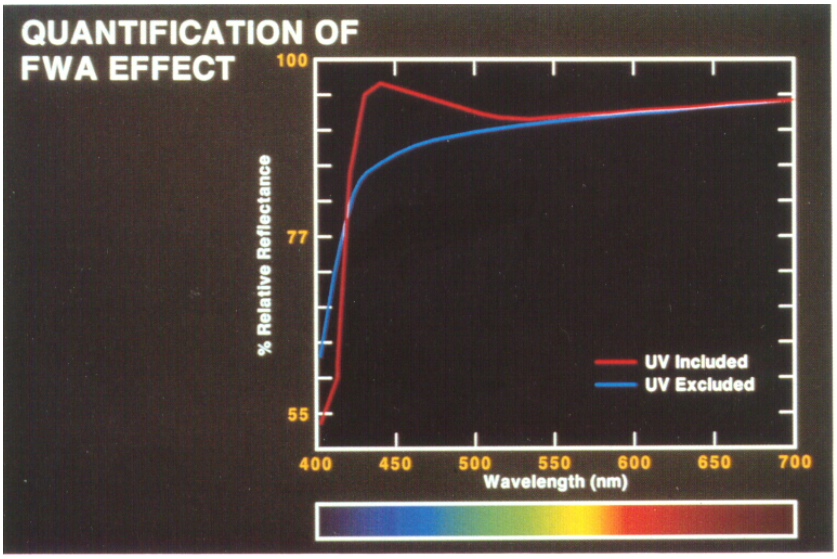
After you receive your instrument standardize it first, indicating that you wish to use the calibrated UV filter position, and then initiate UV calibration after standardization is completed. Read the fluorescent transfer standard and indicate the calibrated value to the software. Then, the software automatically adjusts the position of the motorized UV filter(s) until the whiteness value read by the sensor matches the calibrated value for the fluorescent standard. That UV filter position is then maintained until the next time UV calibration is performed. Specific instructions on performing UV calibration are given in the User's Manual for your software, since control of the UV filter motor is achieved through the software.

The UV calibration procedure should be repeated weekly, as well as whenever the instrument lamp is changed. The fluorescent standard should also be replaced periodically, as it will fade with repeated exposure to UV light. The ColorQuest XE, UltraScan XE, UltraScan PRO, and UltraScan VIS fluorescent standards allow you to periodically assess the degradation of the area of the standard used in calibration by comparison to an untouched area of the standard. Follow the instructions in your User's Manual to perform this comparison. The Spectralon standards of the LabScan XE and SpectraProbe XE are much more stable, and need only be replaced if they are broken.

If you choose to use a calibrated UV filter position for some measurements, it should be used for all routine measurements made with that instrument.

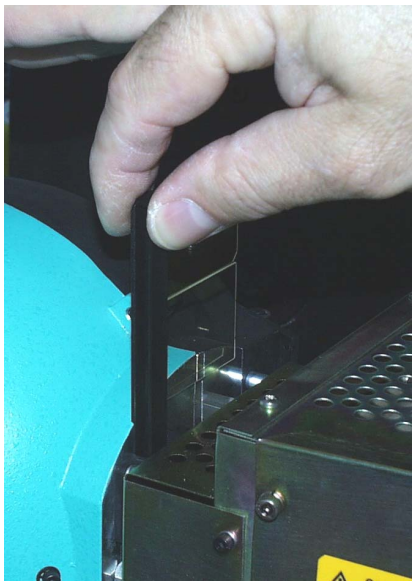
You may also completely eliminate the UV component from your source light by inserting the UV filter(s) all the way. This eliminates all UV-induced fluorescence, since no UV light can then reach the sample to excite it. If you compare a reading of the sample with the UV filter all the way in to a reading of the sample with the UV filter in its nominal[1] position, you can quantify the effect of your FWAs. A method for doing so is described in ASTM Method E1247, "Standard Test Method for Identifying Fluorescence in Object-Color Specimens by Spectrophotometry." Example spectral curves with UV included and excluded (the UV filter out and in, respectively) are shown below. The UV excluded curve drops well below the UV included curve at lower wavelengths.

[1] The nominal UV filter position is the partially-in position determined (and set) at the factory as providing the best and most consistent approximation of D65 daylight for measuring non-fluorescent samples.



The UV Filters

The ColorQuest XE and UltraScan XE each contain two UV filters for controlling the UV content of the source lamp, a 460 nm cut-off filter and a 420-nm cutoff filter. The 460-nm filter is placed in the light path to reduce the source light to the degree that the internal transmission is only 50% at 460 nm or is left out of the light path for no effect on the light. It is the 420-nm filter that is used for UV control, and it can be fully in the light path, partially in the light path (calibrated), or in the position set at the factory that approximates daylight (nominal). The LabScan XE contains a 380-nm UV control filter and a 420-nm UV cutoff filter that operate primarily as a pair. The 420-nm filter may be placed in or out of the light path by itself, or the two filters may be controlled together using the nominal and calibrated UV choices. The SpectraProbe XE employs a single 420-nm filter for UV control and the UltraScan PRO and UltraScan VIS use a single 400-nm filter.



The UV filter assembly of an UltraScan XE.
Note the two separate filters, above and below.

References:

"Ultraviolet-Absorbing Filters and Fluorescent Whites," *HunterLab Applications Note*, Volume 6, No. 4, February, 1995.

Griesser, Rolf, "Assessment of Whiteness and Tint of Fluorescent Substrates with Good Interinstrument Correlation," *Color Research and Application*, **19**, 446 (1994).

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