Applications Note

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Ultraviolet-Absorbing Filters and Fluorescent Whites

We all recognize fluorescent objects that are bright and glowing, such as safety orange signs. But did you know that many white products, especially papers and textiles, are also fluorescent? This is because fluorescent brighteners or whitening agents are often used to make these products look "whiter than white." It is important when measuring this type of sample to know if fluorescence is a factor.[1] Fluorescence is the process by which electromagnetic radiation of one wavelength is absorbed and re-radiated at another wavelength. Sometimes a fluorescent material will absorb nonvisible light and emit it as visible light. This *Note* will focus on whitened samples that absorb ultraviolet light and fluoresce it as visible light.

Measuring Fluorescence - Overview

Fluorescence and ordinary reflectance of radiation take place simultaneously and at the same wavelengths. When the color of a fluorescent sample is measured, the fluoresced light is added to the reflected light at those wavelengths. Therefore, reflectance can exceed the 100% that is normally possible. This makes obtaining instrumental values that correlate well with visual observations tricky. In order to properly examine fluorescent samples, the visible and near-UV light shining onto the sample must be carefully controlled. "D" illuminants, such as D65, are generally preferred for making such measurements. The 45°/0° or 0°/45° instrument geometry is also usually preferred over the sphere geometry. Additionally, UV-excited fluorescence can be a cause of serious metamerism since the fluorescence contribution to total reflectance is very low under illuminant A, but high under daylight illuminants. It is preferable to minimize the fluorescent contribution to measurements of such products, as described below.

Using Ultraviolet-Absorbing Filters When Measuring Fluorescent Whites

When fluorescence is caused by a UV-excited whitening agent, you can remove the fluorescent aspect of the reflectance from a measurement in order to get a clearer picture of the sample's color. The easiest way to do this is to filter out the UV component of the light source. This is done by inserting a UV filter into the light path of the source.[2] The HunterLab ColorQuest 45/0 LAV, D25A/L/M, ColorQuest XE, LabScan XE, UltraScan XE, UltraScan PRO, and UltraScan VIS all offer UV filters as a factory-installed option. When the filter is placed in the light source, the energy present in the lamp below a cut-off wavelength is virtually eliminated and the sample does not receive the wavelengths of light that

[1] Tests such as ASTM E1247 allow you to determine whether a sample exhibits fluorescence.
[2] Comparing measurements made without a UV filter to measurements made with a UV filter in the source path is also a simple way to determine if UV fluorescence is a factor in your sample measurements.

cause it to fluoresce. The cut-off wavelength is 418 nm for the ColorQuest 45/0 LAV and D25A/L/M. The ColorQuest XE, LabScan XE, and UltraScan XE options include two filters, one with a cut-off of 460 nm (420 for the LabScan XE), and the other with a cut-off of 420 nm (380 for the LabScan XE). The filters can be placed in the source path, out of the source path, or partially in and partially out. The UltraScan PRO and UltraScan VIS's one 400-nm filter can be placed in the source path, out of the source path, or partially in and partially out.

When a UV filter is to be used, the instrument must be standardized in this configuration before measurements are made. For stability, the filter of a ColorQuest 45/0 LAV or D25A/L/M should be in the source path for ten minutes prior to standardization. After all measurements are made, the ColorQuest 45/0 LAV or D25A/L/M filter should be removed from the path so that it doesn't degrade. (These precautions are not required for xenon flash instruments.) The UV filter will be moved manually for a ColorQuest 45/0 LAV or D25A/L/M or through the software for xenon flash instruments. If you opt to use the UV filter, refer to your instrument's User's Manual for instructions.

References

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For Additional Information Contact:

Technical Services Department
Hunter Associates Laboratory, Inc.
11491 Sunset Hills Road
Reston, Virginia 20190
Telephone: 703-471-6870
FAX: 703-471-4237
www.hunterlab.com