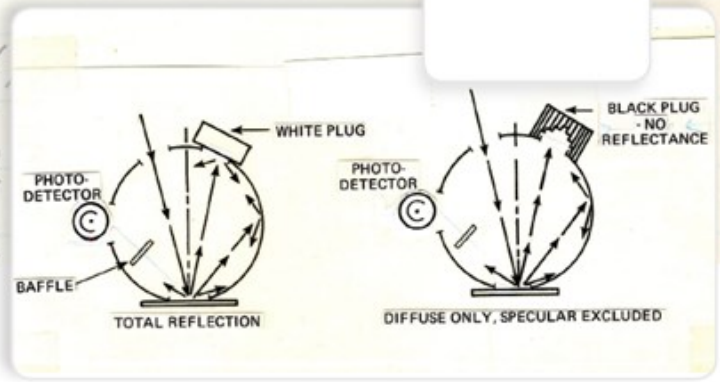
Applications Note

AN 1077



Fluorescent Whites

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Abstract

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.

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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 Agera, 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 cause it to fluoresce. 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. The Agera offers UV Included and Excluded with automated comparative data viewing and reporting.

When a UV filter is to be used, the instrument must be standardized in this configuration before measurements are made. . I f you opt to use the UV filter, refer to your instrument's User's Manual for instructions.

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[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 measurement

Value	C/2°	D50/2°	D65/2°	C/10°	D50/10°	D65/10°
T_x	1000	1000	1000	900	900	900
X_n	0.3101	0.3457	0.3127	0.3104	0.3477	0.3138
Y_n	0.3161	0.3585	0.3290	0.3191	0.3595	0.3310

Tint GANZ = mx + ny + k

Where,

$$m = \frac{-\cos(\alpha)}{BW} = -937.588$$

$$n = \frac{\sin(\alpha)}{BW} = 826.697$$

$$k = -m\bar{x} - n\bar{y} = 21.352$$

x and y are the CIE chromaticity coordinates.

Typical Applications

Products that can be considered white, such as paint, plastics, paper, and textiles.

A few caveats regarding measurement of tint:

- The application of the tint indices is restricted to samples that are called “white” commercially, that are similar to each other in color and fluorescence, and that are measured on the same instrument at the same time. Under these conditions, their use should give relative, but not absolute, evaluations of tint that are adequate for commercial use.
- The more positive the value of tint, the greater is the indicated greenish tint of the sample. The more negative the value of tint, the greater is its reddish tint. Lines of equal tint are approximately parallel to the line of dominant wavelength 466 nm. For perfect white, tint = 0.
- Equal differences in tint values do not always represent equal perceptual differences in tint.
- Tint index should only be used for samples having tint values between -3 and +3. Outside this range, the chromatic content is considered to be beyond where tint can be used effectively and L*a*b* should be reported instead.

References

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About HunterLab

HunterLab is the technology leader in color measurement solutions, providing instruments, software, knowledge and service to a wide variety of industries.
With over 5 decades of experience in more than 65 countries, HunterLab applies our leading edge technology to your products helping you measure and communicate color simply and effectively.

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