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Application News

Spectrophotometric Analysis

Measuring the "Color" of Glass Plates

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No. UV-014

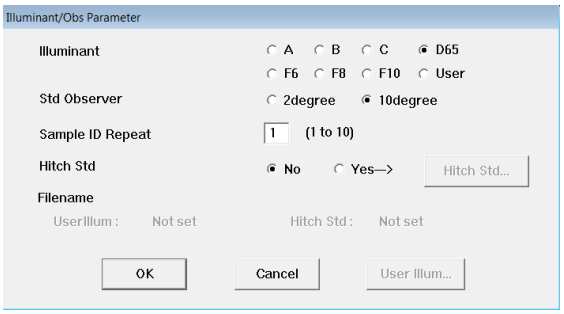
■ Introduction

Color measurement is important to many industries with applications in food, textiles, pharmaceuticals, and glass works, to name a few. All humans see color differently, and in many cases, color perception can vary between eyes of the same individual. Furthermore, the color of an object perceived is also dependent upon the spectral irradiance of the illuminant used to view the object. Because of these differences, the ability to quantify a given color value becomes very important.

One way of achieving this quantitation is by the use of color space analysis. In color space, a spectral scan of a given color is integrated with both standard observer responses for red, green, and blue and with standard responses for various illuminants. The final result provides a set of distinct values that represents the color of the object.

To demonstrate the measurement of color on two different Shimadzu UV-Vis spectrophotometers, spectra were acquired of a set of glass filters. Scans were acquired with a Shimadzu UV-1800 spectrophotometer and a Shimadzu UV-2600 spectrophotometer equipped with and without an ISR-2600Plus Integrating sphere. The spectral scans were acquired as transmission scans between 400 and 800 nm and analyzed using the Shimadzu Color Analysis Software. The CIELAB color space was selected for comparison using a D65 selection (Midday light) as illuminant.

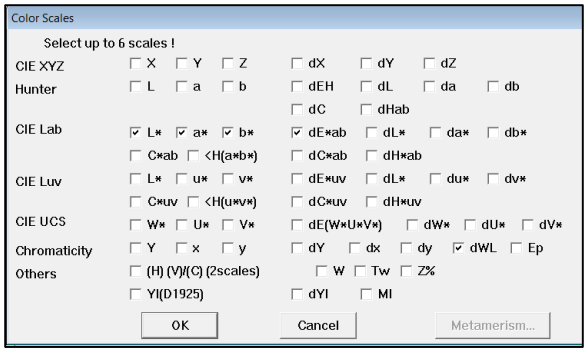
Filter samples used for testing;
Shimadzu PN: 204-04691-00



Illuminant Parameter Table from Shimadzu's Color Software

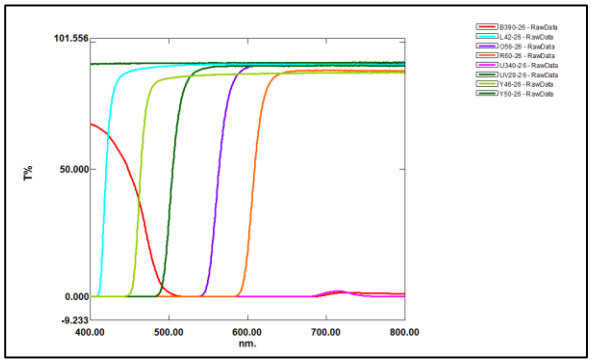
The CIELAB color space was selected because of its wide applicability in industry. CIELAB provides color parameters of L*, a*, and b*. Because red and green are color opposites as well as is blue and yellow, a sample cannot have both red and green or blue and yellow attributes simultaneously, but will lie more to one color than the other.

In CIELAB (1976) the "a" parameter is used to distinguish red and green character with positive a-values having more red character and negative a-values more green character. Similarly the "b" parameter is used to define the blue/yellow character of a sample with positive b-values being more yellow, and negative b-values more blue. The "L" value is defined as "lightness" and gives an indication of the "depth" of color observed in the sample. In this way, using the CIELAB colorspace, the color of a given sample can be represented numerically by three parameters, namely L*, a*, and b*.



Color space selection in Shimadzu's Color Software

The graph below shows the spectra acquired with the Shimadzu UV-2600 spectrophotometer (no sphere attachment) for the glass filter samples.



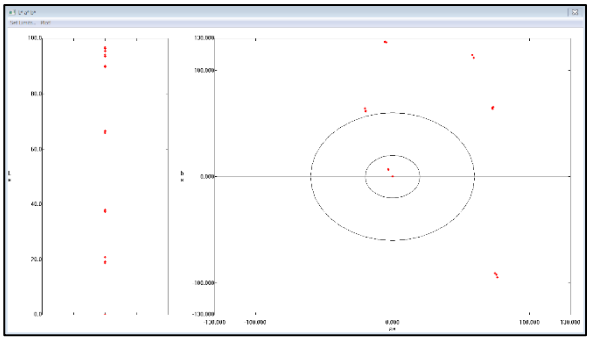
Spectra of glass filters acquired with the Shimadzu-UV-2600 (no sphere)

Using the Shimadzu Color Software package (pn 206-67449-00) and the above selected calculation parameters, the following CIELAB color information was obtained.

Standard		0.00	0.00	0.00	
Seq No.	Sample ID	L×	a×	b×	FileName
1	1	19.21	75.97	-91.98	B390T_18
2	2	18.75	74.93	-90.74	CA_B39~1
3	3	20.91	76.70	-94.61	CA_B390S
4	4	96.40	-2.99	6.46	L42_18
5	5	96.40	-3.04	6.49	CA_L42~1
6	6	96.38	-3.36	7.14	CA_L42S
7	7	66.47	58.33	114.43	O56_18
8	8	66.53	58.20	114.64	CA_O56~1
9	9	65.76	59.32	111.76	CA_O56S
10	10	38.02	73.45	65.53	R60_18
11	11	37.54	72.91	64.71	CA_R60~1
12	12	37.28	72.97	63.87	CA_R60S
13	13	0.00	0.07	0.06	U340_18
14	14	0.01	0.08	0.02	CA_U34~1
15	15	0.01	0.07	0.02	CA_U340S
16	16	96.81	-0.04	0.25	UU29_18
× 17	17	96.78	-0.03	0.19	CA_UU29S
18	17	96.79	-0.05	0.20	CA_UU2~1
19	19	94.03	-19.72	61.82	Y46_18
20	20	93.55	-19.56	61.57	CA_Y46~1
21	21	95.40	-20.30	64.07	CA_Y46S
22	22	89.98	-5.81	126.83	Y50_18
23	23	89.86	-5.70	126.98	CA_Y50~1
24	24	89.76	-4.56	126.29	CA_Y50S
25	25				

CIELAB calculations for the acquired glass color samples.

In the above table, color data from the UV-1800 are marked with a "_18". Color data from the UV-2600 without the sphere are marked as "~1". And color data acquired from the UV-2600 with integrating sphere are marked with an "s".



Plot of the Data in CIELAB color space coordinates

■ Conclusion

CIELAB color space analysis using Shimadzu UV-Vis spectrophotometers and the Shimadzu Color Software package offers an ideal method to quickly and easily quantify color values for samples including glass materials.

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