Color Analysis on the LAMBDA PDA UV/Visible Spectrophotometers

Introduction

Using the Color Analysis mode of the UV Lab™ software, CIE L*,a*,b* values of liquid or solid color samples can be obtained. It is very useful in the quality control process of the dye or beverage industry because it is easy to compare product color to color standards.

L*, a* ,b* color space(CIELAB) is the most general color space for measuring color within industry. L* indicates the lightness and it may have values between 0 and 100. a* and b* may have values between around −80 and +80. Colors with no chroma always have the value a*=b*=0. Because the opponent color theory is used to develop the transformation, one of coordinates(a*) shows the redness or the greenness of color and the other coordinate(b*) shows the yellowness or the blueness. The greenness and blueness are given with negative sign whereas redness and yellowness are given with positive sign.

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L*, a*, b* color space and color differences that result form this color space are described with the following equations.

$$\Delta E^*{}_{ab} = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

$$\Delta E^*{}_{ab} = [(\Delta L^*)^2 + (\Delta C^*{}_{ab})^2 + (\Delta H^*{}_{ab})^2]^{1/2}$$

Where, L^* = Lightness

a^*, b^* = chroma coordinates

$\Delta C^*{}_{ab}$ = chroma

$\Delta H^*{}_{ab}$ = chroma

$$L^* = 116 \left(\frac{Y}{Y_n}\right)^{1/3} - 16$$

$$a^* = 500 \left[\left(\frac{X}{X_n}\right)^{1/3} - \left(\frac{Y}{Y_n}\right)^{1/3}\right]$$

$$b^* = 200 \left[\left(\frac{Y}{Y_n}\right)^{1/3} - \left(\frac{Z}{Z_n}\right)^{1/3}\right]$$

Where, $\dfrac{Z}{Z_n} > 0.008856$ $\dfrac{X}{X_n} > 0.008856$

$\dfrac{Y}{Y_n} > 0.008856$

Reagents and Apparatus

1. LAMBDA™ 265/465 UV-Vis Spectrophotometer
2. Advanced Transmission Holder
3. UV Lab software Color Analysis Mode
4. Color Filter Samples

Procedure

1. Open Color Analysis Mode.
2. Set parameters and click OK.
3. Measure Blank.
4. Measure Target.
5. Measure Samples.
6. Compare CIE color coordination.

Instrument Parameters

Parameter Setting		OK	
Instrument Setup			☆
Scan No.		10	
Integration No.		1	
Data Type		%T	▼
Color Measurement Setup			☆
Illuminant		D65	▼
Observer Angle		2 Deg	▼

Figure 1. Parameter Setting of Color Analysis Mode.
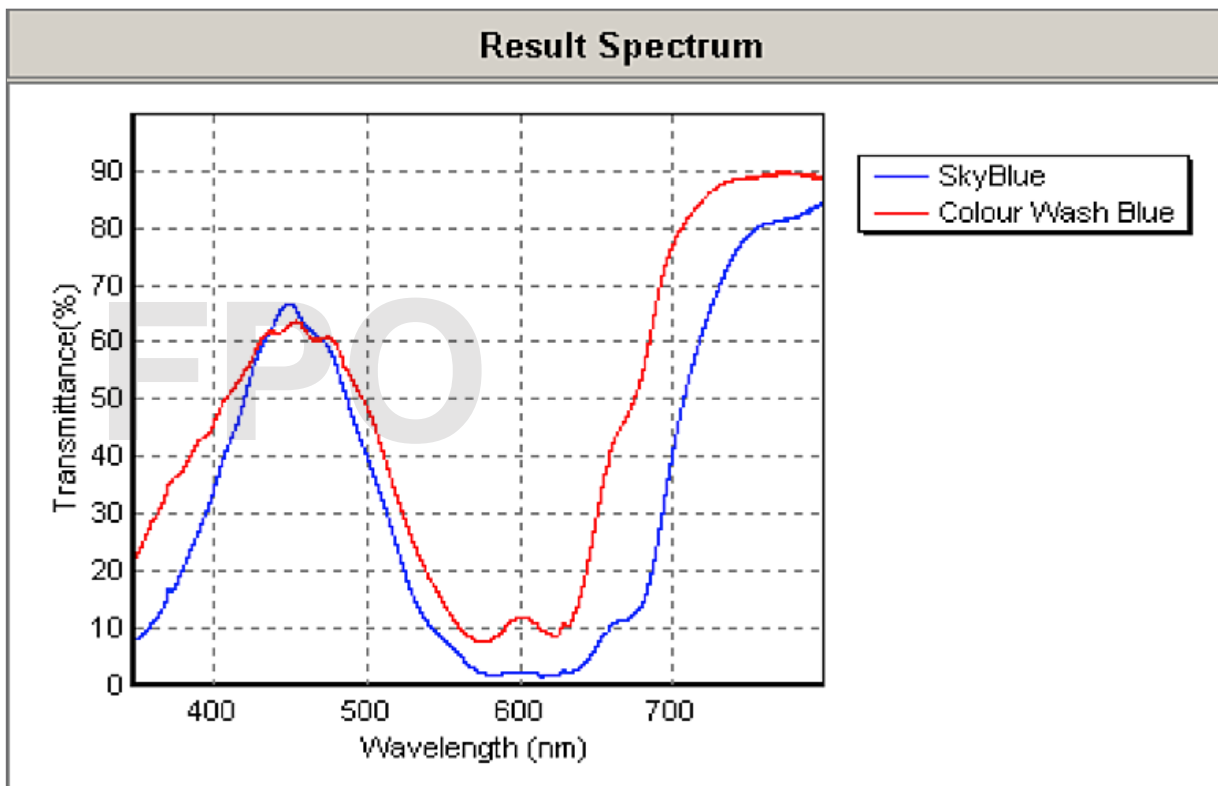

Figure 2. Transmittance spectrum of color filters.

The < Result Analysis Value> on the left side of Figure 3 shows the difference of color values between standard and sample and the <Result Colors> shows their colors.

					<Result Analysis Values>						<Result Colors>
Sample	dE*	dL*	da*	db*	dC*	dH*	L*	a*	b*		
SkyBlue	None	None	None	None	None	None	42.5449	12.0727	-66.5604	**Standard**	
Carbana Blue	37.5163	-10.59	33.4914	-13.1777	24.1918	19.4641	31.9549	45.5641	-79.7381		
Mikkel Blue	55.1397	-17.1813	48.3416	-20.2059	38.081	24.5685	25.3636	60.4143	-86.7663		
Colour Wash I	19.6373	9.7823	-4.7071	16.3638	-16.9123	-1.9328	52.3272	7.3656	-50.1966		
Durham Daylig	58.7501	-6.5926	-11.9404	57.1449	-58.23	-9.4755	35.9523	0.1323	-9.4155		
Berry Blue	27.0417	-11.7009	23.2242	-7.4149	14.3183	15.2274	30.844	35.2969	-73.9753		
Old Steel Blue	62.654	37.062	-27.7214	42.231	-38.7189	-223.0297	79.6069	-15.6487	-24.3294	**Sample**	
Deeper blue	32.4328	-21.6154	23.9951	2.9828	5.4494	19.2859	20.9295	36.0678	-63.5776		
Cold blue	32.6388	2.3139	-3.3165	32.3873	-32.3693	4.0912	44.8588	8.7562	-34.1731		
J.winter blue	47.5838	-31.2792	35.1318	7.1821	8.209	28.2034	11.2657	47.2045	-59.3783		
Moonlight blue	39.6692	9.3355	-35.8266	14.2459	-10.1916	-214.7014	51.8804	-23.7539	-52.3145		

Figure 3. CIE system coordination values and difference values of color filters and Result Colors.

Conclusion

Using the LAMBDA 265/465 and UV Lab software the color difference values of color samples were calculated. Rapid acquirement of spectra and good sensitivity were obtained using the LAMBDA instrument. The Color Analysis Mode of the UV Lab software was used effectively for this test and to process the data efficiently.

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