Reflectance and Color Measurement Differentiation of White Polyester Based Paint Blends

Background

Ten blend samples of white polyester based paints were supplied for testing, as shown in *Figure 1*. The customer requested specular reflection curves from 400 to 700 nm and the corresponding CIELAB color values in D65, A, and F11 of the samples in order to be able to differentiate between the paint samples.

Figure 1. Unsaturated polyester paint blend samples

Experimental Procedure

The samples were analyzed using a JAZ spectrometer (grating #2, 25μ slit, range 200-850 nm, L2 lens, optical resolution ~ 1.3 nm FWHM), HL-2000-HP tungsten halogen light source, and SPECTRASUITE software. For the reflection measurements a reflection probe *(QR400-7-SR)*, reflection stage *(STAGE-RTL-T)*, and the high reflectivity specular reflection standard *(STAN-SSH)* were utilized.

The fiber optic variable attenuator *(FVA-UV) and* an additional fiber *(QP-600-2-VISNIR)* was also needed to reduce the amount of light since before using the attenuator the reference standard saturated the spectrometer measurements.

Fixed-height containers were filled with each sample. The distance from the tip of the reflection probe to the surface of paint sample was measured at 3 cm for each.

Figure 2 shows the paint sample on the reflection stage below the reflection probe, which was adjusted for the height of the samples and reference standard. *Figure 3* shows the entire experimental setup.

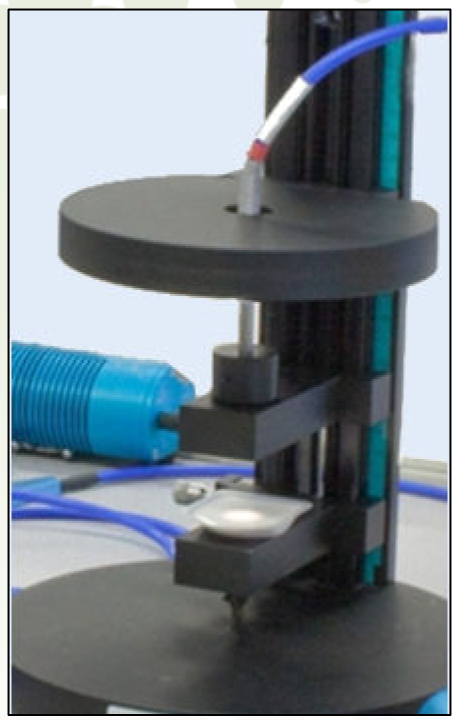

Figure 2. Reflection and color measurement experiment setup

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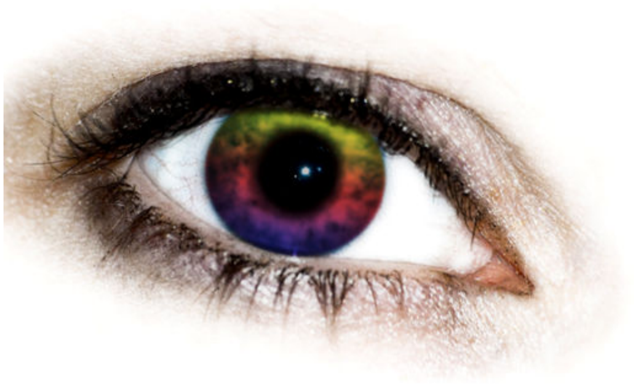

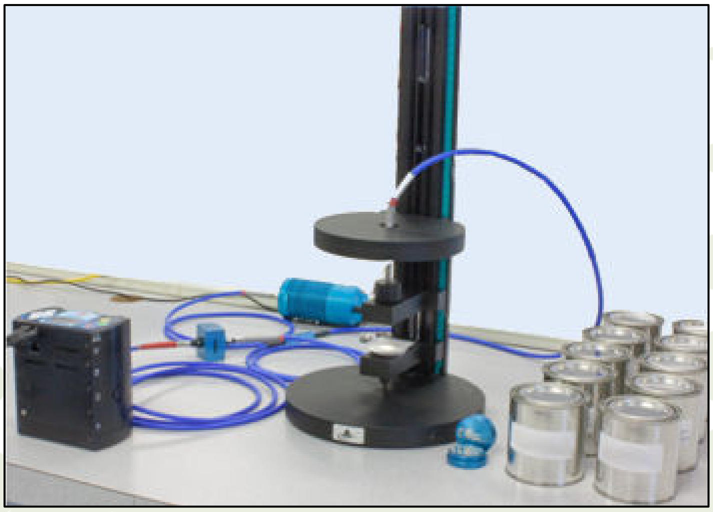

Figure 3. Reflection and color measurement experiment setup

All measurements utilized the same acquisition parameters of 9 ms integration time, 50 averages, and one boxcar.

Reflectance curves from 380-760 nm were generated in SPECTRASUITE for each paint sample. (See *Figure 4* .)

SPECTRASUITE also provided corresponding CIELAB color values for Illuminant A, D65, and F11. As an example, the x, y, and z color values for Illuminant D65 are listed in *Table 1*.

Color Values - Illuminant D65

	Blend 1	Blend 2	Blend 3	Blend 4	Blend 5	Blend 6	Blend 7	Blend 8	Blend 9	Blend 10
x	0.326	0.325	0.325	0.325	0.324	0.324	0.324	0.324	0.323	0.323
y	0.336	0.335	0.334	0.334	0.333	0.332	0.332	0.332	0.331	0.330
z	0.338	0.341	0.341	0.342	0.343	0.343	0.345	0.345	0.346	0.347

Table 1. . Reflective color values of ten blend samples with Illuminant D65 and 2-degree Observer

Results

The results of the reflectance testing for all ten blend samples are presented in *Figure 5*. Based on the setup of the reflection experiment, we would expect similar spectral shapes for the reflectance data.

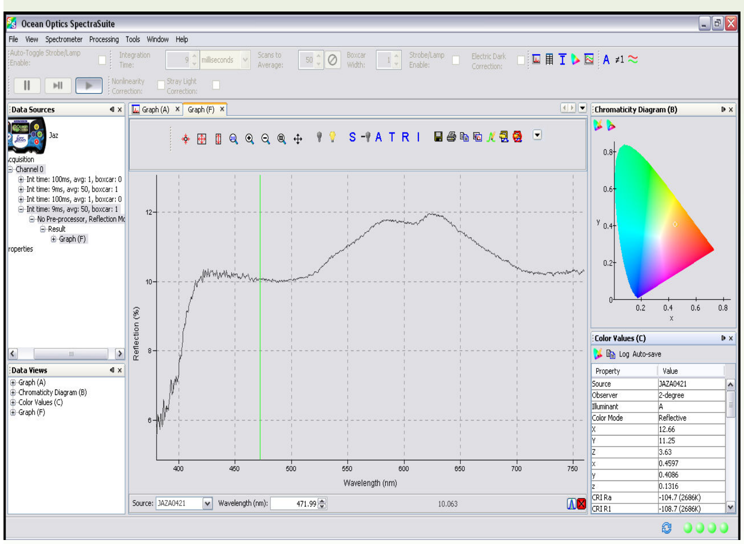

Figure 4. Reflectance and color measurement in SpectraSuite

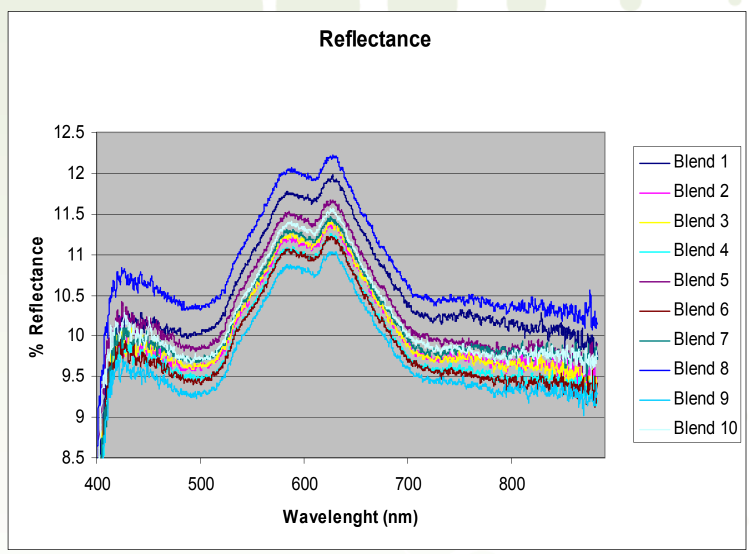

Figure 5. Reflectance curves for ten blend samples

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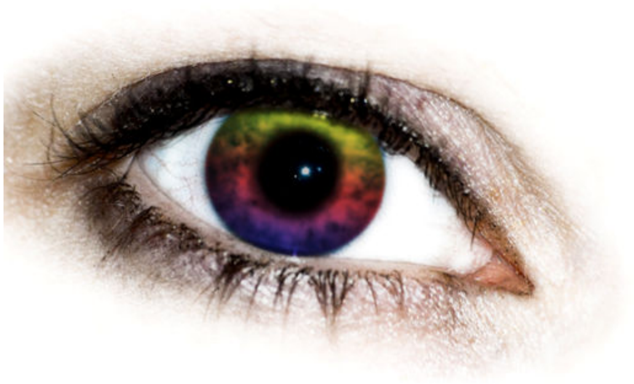

Conclusion

From the analyzed data we found distinct differences between the samples' reflectance spectra and in CIELAB color values. Therefore, the white paint blends could be differentiated between with the utilized Ocean Optics spectrometer and accessories.
Although, this equipment was successful in obtaining recognizable differences between the samples, even better results could be obtained if our higher grade equipment were to be used. For example, if the DH2000-BAL Deuterium Tungsten Halogen Light Source were used in place of the HL-2000, the results would be more precise and the differences between the curves could be more distinct depending on the sample's reflectance characteristics. The DH-2000-BAL combines the continuous spectrum of deuterium and tungsten halogen light sources in a single optical path, producing a powerful, stable output from 215-2000 nm. This light source creates less signal noise and drift, and better linearity of the signal over the spectral range. Furthermore, by utilizing an UV radiation light source we would be able to observe UV radiation reflectance in all of the samples, in the case of white based paints important characteristics provided by different fillers could only be identified in the UV spectral range. In addition, if a QE65000 (our most sensitive scientific grade spectrometer with 90% quantum efficiency and high signal-to-noise ratio) were to be used instead of the JAZ, we could obtain even cleaner spectra as well as being able to better identify spectral peaks characteristics thanks to the QE65000 high resolution optical bench design.

Related References

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