Application Note

Materials Testing & Research

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Revealing Colors of Concealers using the Cary 60 UV-Vis DRA

Coupled with an internal diffuse reflectance accessory, the Agilent Cary 60 UV-Vis quickly and accurately pinpoints color characteristics

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Abstract

Visual appeal and skin-tone matching are key factors in how consumers choose cosmetic products, so accurate quantitation of color is of the utmost importance in the industry. The dyes or pigments used can have thousands of variations, so accurate differentiation and categorization is extremely valuable for marketing, quality control, and new product design.

In this application note, the Agilent Cary 60 UV-Vis spectrophotometer fitted with an internal diffuse reflectance accessory (DRA) and the Agilent Cary WinUV Color software were used to measure the color coordinates of several differently colored concealers.

Introduction

Cosmetic products such as makeup, soaps, or lotions commonly require the addition of coloring agents to achieve a particular effect when applied or to improve their appearance on store shelves. Dyes and pigments are constantly being developed to improve product stability, boost color saturation, ensure consumer safety, and lower production costs. Quality control tests must be conducted on new raw materials to ensure color consistency throughout product lines. For each of these industrial needs, the analytical methodologies for characterizing these products must be robust. One of the key metrics for coloring agents is their response to UV-visible light. Cosmetics such as makeup can have complex interactions with light, including absorption, specular reflectance, and diffuse transmission and reflectance, which influence characteristics such as color, shine, and UV protection.

A powerful technique used to analyze these interactions is UV-Vis spectroscopy with an integrating sphere such as an internal UV-Vis DRA. The Cary 60 UV-Vis DRA is an attachment fitted inside the Agilent Cary 60 UV-Vis spectrophotometer (Figure 1) with a spherical cavity coated in diffuse reflective polytetrafluoroethylene or PTFE, entrance and exit ports for the UV-Vis beam, and its own detector (Figure 2).

Figure 1. Agilent Cary 60 UV-Vis spectrophotometer.

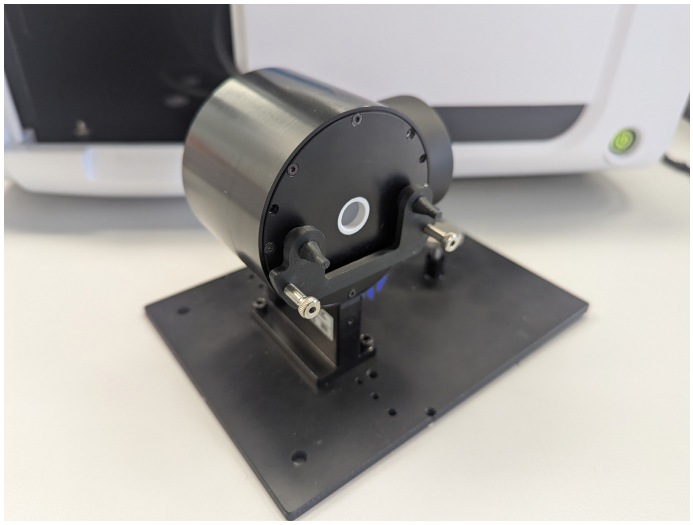

Figure 2. Diffuse reflectance accessory for the Agilent Cary 60 UV-Vis spectrophotometer with thin film holder.

If the sample is positioned at the entrance port, light that is diffusely transmitted through the sample can be collected with minimal loss compared to a traditional transmission measurement. Similarly, positioning the sample at the exit port allows the specular and diffusely reflected light to be measured by the integrating sphere.

In this application note, diffuse reflectance of several differently colored, powdered concealers is measured to accurately determine their color coordinates using an Agilent Cary 60 UV-Vis spectrophotometer equipped with an internal DRA and the Agilent Cary WinUV Color software.

Experimental

Sample preparation

Six samples of powder concealers in different colors were prepared from a commercially available concealer kit by using a Kimwipe to spread them on a transparent plastic sheet (Figure 3).

The sheet has a rough surface on one side that was used to better hold the concealer. The samples were measured in reflection mode using the solid film sample holder positioned at the reflection port of the DRA, as shown in Figure 4. A reflectance baseline was collected using a blank plastic sheet without any concealer placed at the reflection port.

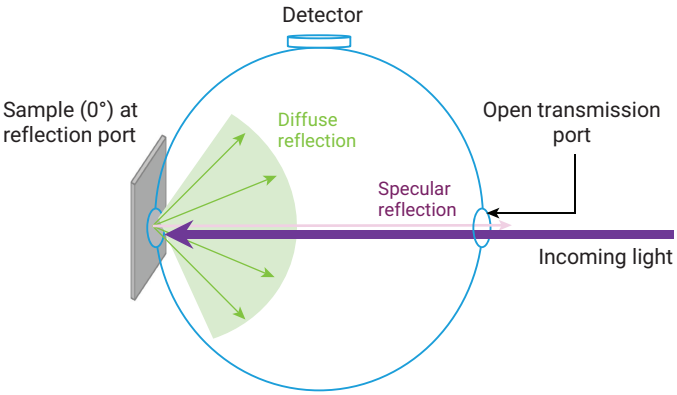

Figure 4. Diagram of the diffuse reflection of light in the DRA for the Agilent Cary 60 UV-Vis spectrophotometer.

The settings in Table 1 were used in the Color application to collect relative reflectance spectra and calculate color coordinates.

Table 1. Agilent Cary WinUV Color software settings for concealer analysis.

Parameter	Value
Scan Range	830 nm to 360 nm
Data Interval	1 nm
Y Mode	%R
SBW	1.5 nm
Av. Time	0.100 s
Beam Mode	Double
CIE Illuminants	CIE A
Observers	2 degrees
Color Spaces	Tristimulus, Chromaticity xyz, and CIE L*a*b*

The Cary WinUV Color software allows the user to select multiple calculation options for color coordinate systems including standardized color systems such as the Commission Internationale de l'Eclairage (CIE) system. The method creator in the software application allows for the simultaneous calculation of multiple color spaces with different illuminants. In this application note, CIE illuminant A is selected, and Tristimulus, Chromaticity, and CIE L*a*b* color space values are calculated.

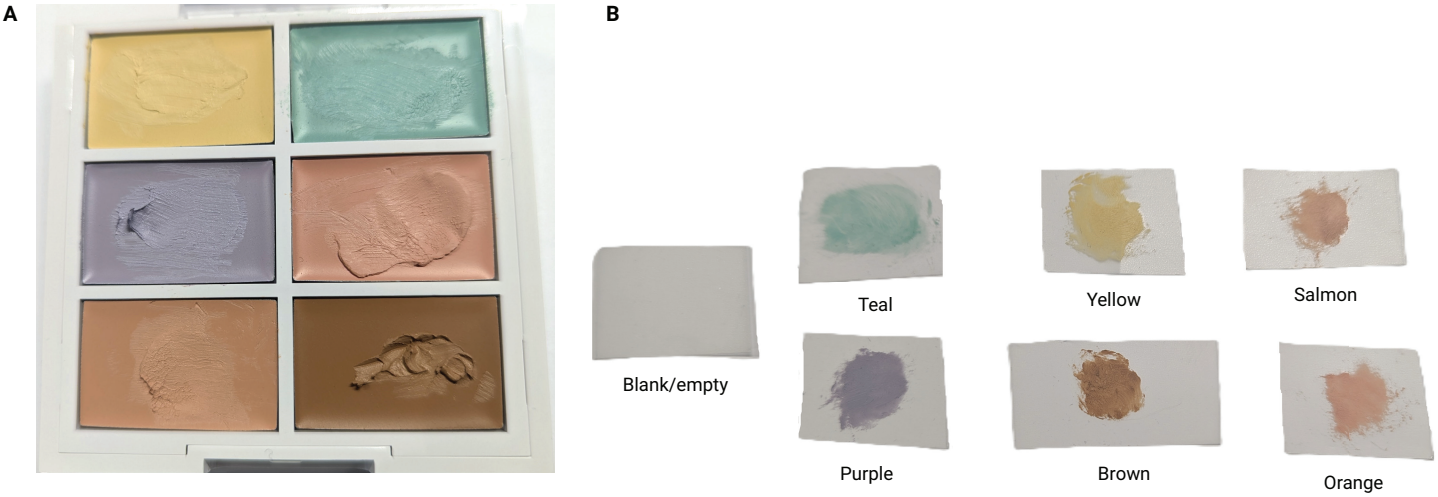

Figure 3. Concealer product (A) and samples of concealer spread on plastic sheets (B).

Results and discussion

The spectra in Figure 5 were obtained from the six concealer samples.

Table 2 lists the Tristimulus, Chromaticity, and CIE L*a*b* values for the spectra collected from each concealer that have been calculated automatically by the software. The software will also generate graphs with the color coordinate data such as the Chromaticity plot shown in Figure 6.

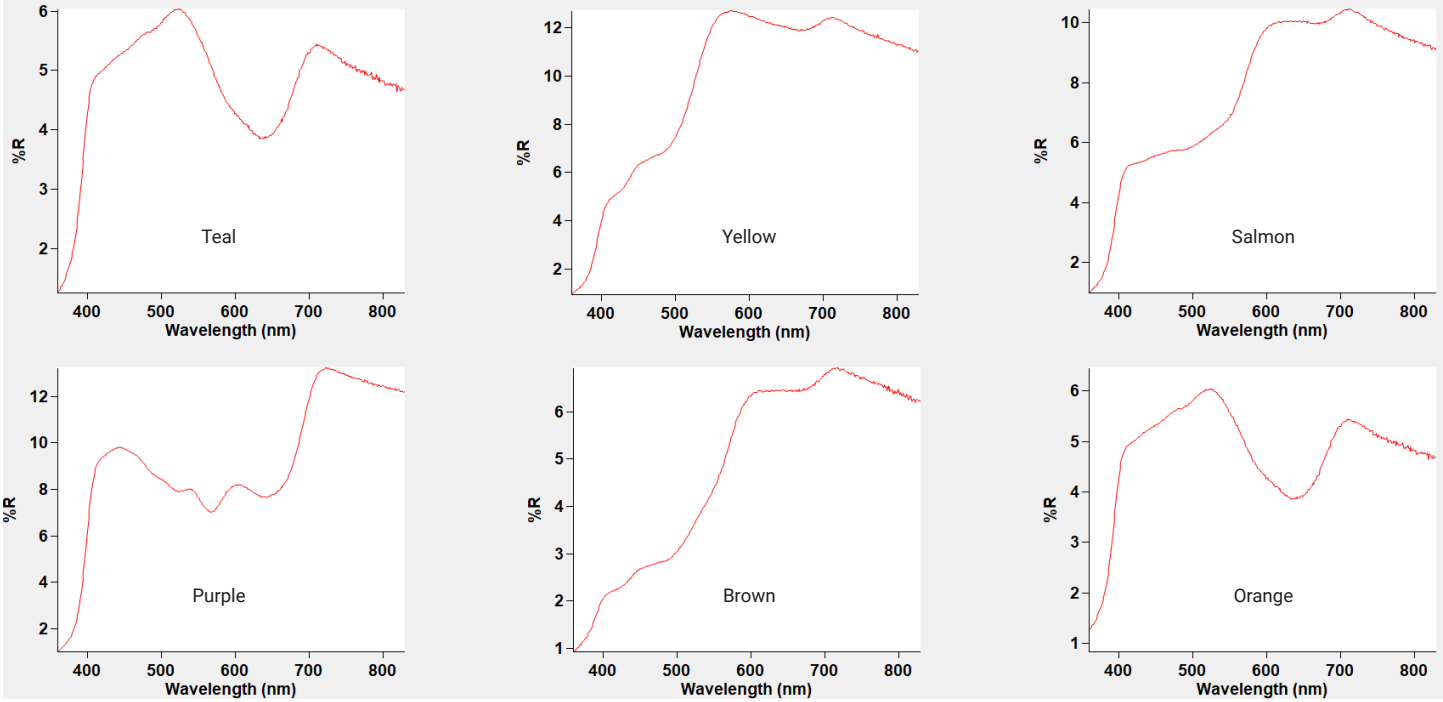

Figure 5. Reflectance spectra of differently colored concealers (%R).

Table 2. Calculated color values for six concealer samples.

Sample	Tristimulus (x, y, z)	Chromaticity (x, y, z)	CIE L*a*b* (L*, a*, b*)
Teal	4.9249, 4.9781, 1.9306	0.4162, 0.4207, 0.1631	26.6723, −6.3083, −2.1414
Yellow	13.1737, 11.6452, 2.3054	0.4857, 0.4293, 0.0850	40.6466, 2.4029, 17.3391
Salmon	9.9893, 8.1510, 2.0011	0.4960, 0.4047, 0.0994	34.2953, 8.0542, 10.0900
Purple	8.6970, 7.7909, 3.3097	0.4393, 0.3935, 0.1672	33.5436, 1.1472, −5.1980
Brown	6.3888, 5.1562, 0.9691	0.5105, 0.4120, 0.0774	27.1752, 7.6206, 14.2657
Orange	10.9768, 8.7634, 1.8243	0.5090,0.4064, 0.0846	35.5246, 9.9324, 14.5368

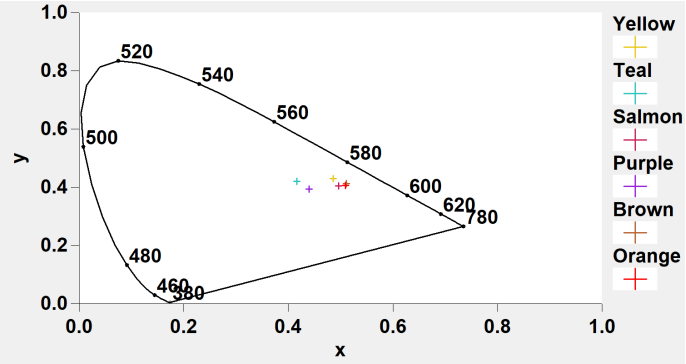

Figure 6. Chromaticity values of concealer samples plotted in Agilent Cary WinUV Color software.

Conclusion

The Agilent Cary 60 UV-Vis spectrophotometer with DRA and the Agilent Cary WinUV Color software is a simple but powerful solution for analyzing the reflectance properties of cosmetics. The DRA is an ideal tool for measuring a range of cosmetic samples in both transmission and reflection modes, and alternative sample holders are available that allow liquids, powders, and gels to be measured. Data collection is fast and reliable, and the software allows the analysis of measurements with multiple illuminants and in many color coordinate systems by simply recalculating the data, making this combination well suited to color-based quality control and color-matching applications.

Further information

- Agilent Cary 60 UV-Vis Spectrophotometer
- Cary 60 UV-Vis Diffuse Reflectance Accessory
- Color Measurements by Agilent UV-Vis and UV-Vis-NIR Spectrophotometers
- Cary WinUV Software for UV-Vis Applications
- UV-Vis Spectroscopy and Spectrophotometry FAQs
- UV-Vis Applications Guide

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