Measuring the reflectance of very small samples using the Agilent Cary 60 Remote Diffuse Reflectance Accessory (DRA)

Application note

Materials

Authors

Dean Logan and Dr. Ursula Tems

Agilent Technologies
Mulgrave, Victoria, Australia

Introduction

There are many industrial applications that require precise and time efficient measurement of solid samples. Applications include:

- Quality control in commercial printing
- Process control in the automotive industry
- Quality control in the manufacturing of paints or inks
- Forensic testing for counterfeit currency and examination of documents[1]
- Non-destructive art restoration and conservation[2]

Analysis of solid samples can be challenging and the results compromised if the samples do not fit correctly into the sample compartment of a spectrophotometer. Many samples are too big to be placed into the sample compartment, while others are too small to be held correctly in the instrument.

This study will demonstrate that the Agilent Cary 60 with Remote DRA can be used to accurately measure reflectance data from small solid samples. Specifically, it can be used to correctly differentiate the spectra of colored ink samples applied to paper by an inkjet printer.

Experimental

Equipment

- Agilent Cary 60 UV-Vis spectrophotometer
- Agilent Cary 60 Remote DRA
- Agilent Cary 60 fiber optic coupler
- HP C6270 Inkjet printer
- White printer paper
- Agilent Cary WinUV software

Instrument parameters

Table 1. Instrument parameters

Setting	Value
Start (nm)	800.0
Stop (nm)	360.0
X Mode	Nanometers
Y Mode	%R
UV-Vis Data Interval (nm)	2.00
UV-Vis Average Time (sec)	1.0
Baseline Correction	On

Method

Two grids of square shapes of various size and color were created using drawing software (Figure 1 and Figure 2). These grids were then printed onto paper using an inkjet printer. The printed samples were left to air dry for 30 minutes. Once dried, the sample squares were measured manually, to confirm they were the correct dimensions.

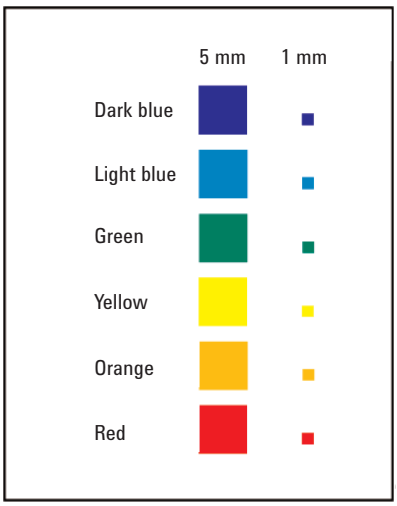

Figure 1. Color and size grid

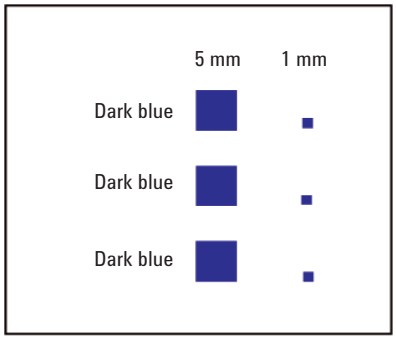

Figure 2. Dark blue size grid

To perform the data collection, the Cary 60 UV-Vis was fitted with the fiber optic coupler and the Cary 60 Remote DRA.

When the samples were ready for measurement, a baseline was performed on an unprinted portion of the white paper. To ensure the DRA was positioned correctly, the DRA's integrated video camera was used to determine the optimal location for data collection. Reflectance data from the 1 mm colored squares and from the 1 mm and 5 mm dark blue samples were then collected with the Cary 60 Remote DRA, using the Scan application of the Cary WinUV software.

Results

Using the Cary 60 Remote DRA integrated video camera, the 1 mm square ink patch was easily placed in the field of view (Figure 3).

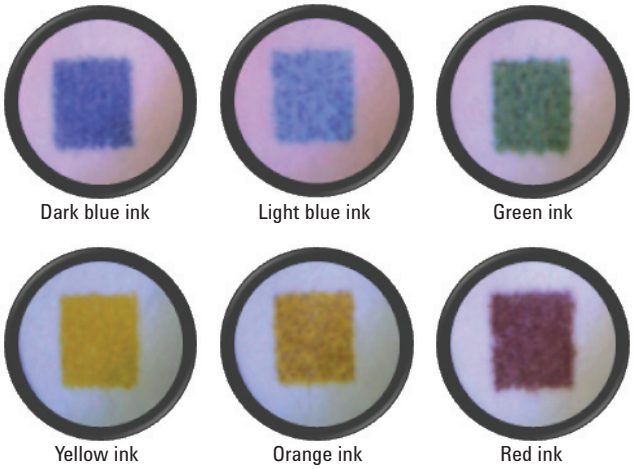

Figure 3. 1 mm square color ink samples

The complete scans of the 1 mm ink samples (Figure 4), show very good differentiation of the six color samples. Even the two blue spectra are easily identified by their distinctive spectra profiles. The scans show very low noise.

The pictures generated by the Cary 60 Remote DRA video camera (Figure 5), clearly show the difference between the 1 mm and 5 mm samples.

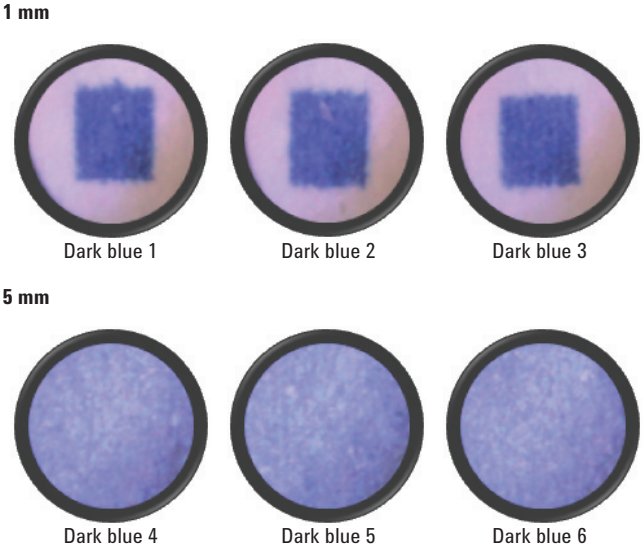

Figure 5. 1 mm and 5 mm dark blue ink samples

To examine the reproducibility of scans on the same sample, Dark Blue 1 (1 mm) and Dark Blue 4 (5 mm), were each measured three times in succession. The triplicate readings of Dark Blue 1 (Figure 6a) and Dark Blue 4 (Figure 6b) show very good correlation and overlay perfectly. Figure 7a and 7b show the excellent reproducibility when the graphs are resized to view the peak in more detail.

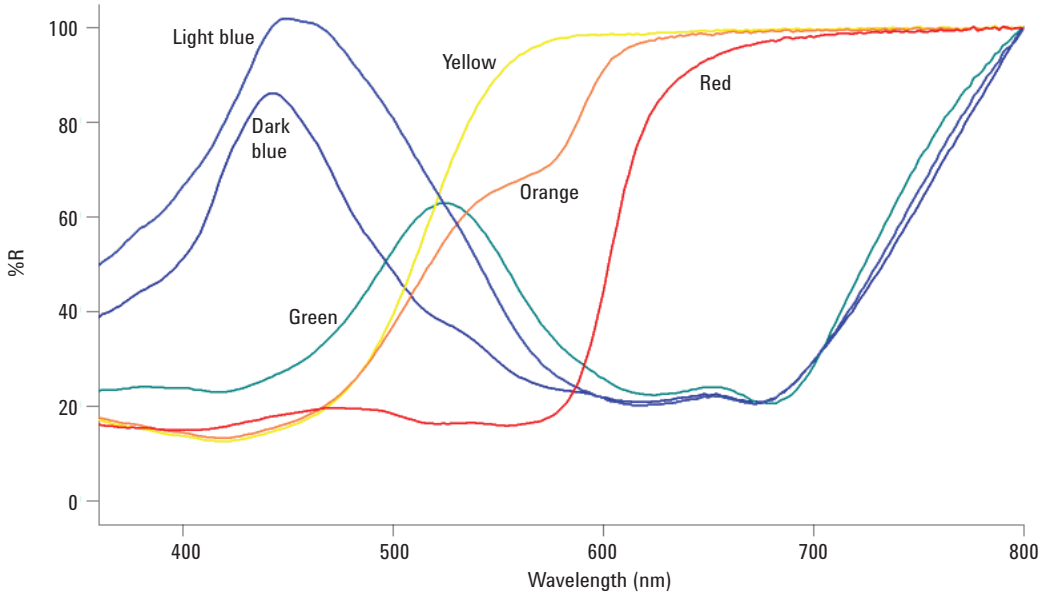

Figure 4. Reflectance spectra of different colored 1 mm ink samples

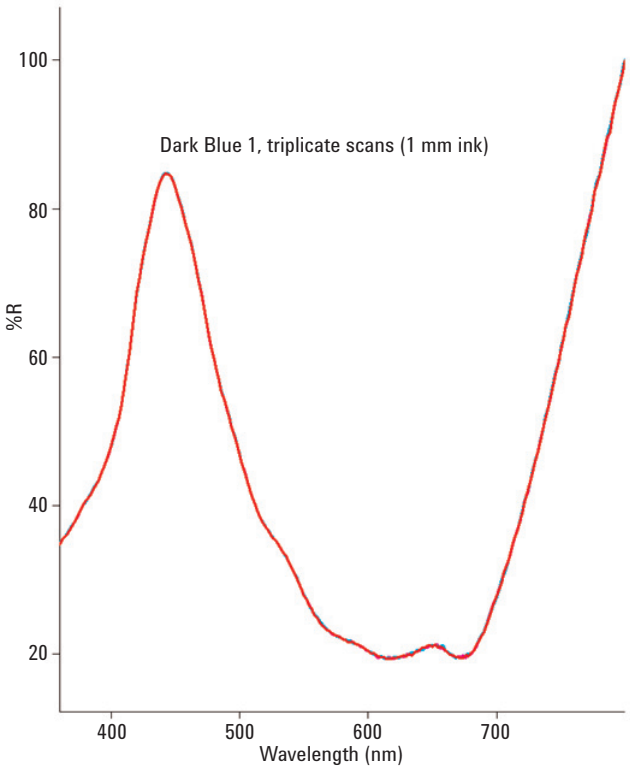

Figure 6a. 1 mm Dark Blue 1 triplicate scans

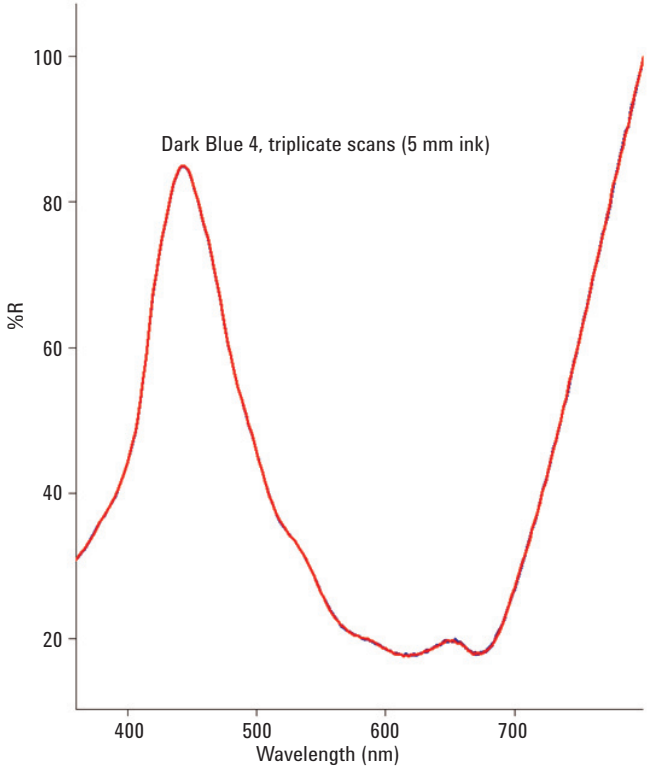

Figure 6b. 5 mm Dark Blue 4 triplicate scans

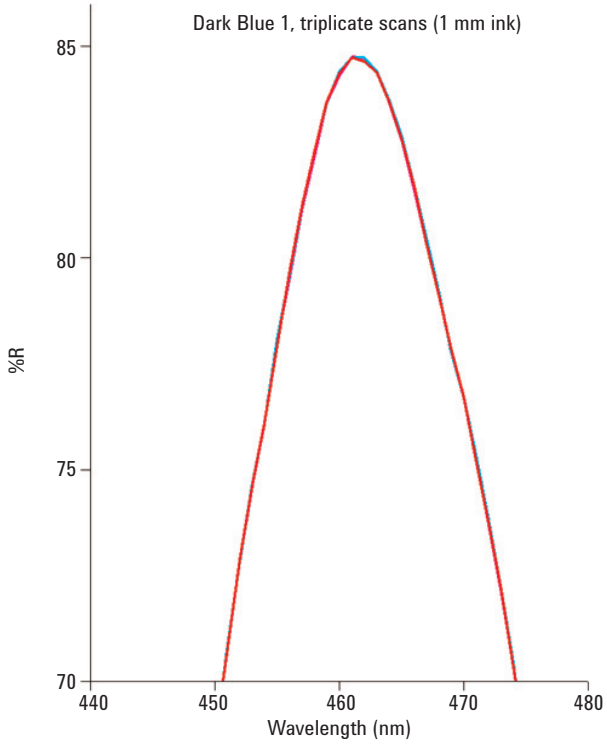

Figure 7a. 1 mm Dark Blue 1 triplicate scans, close-up view

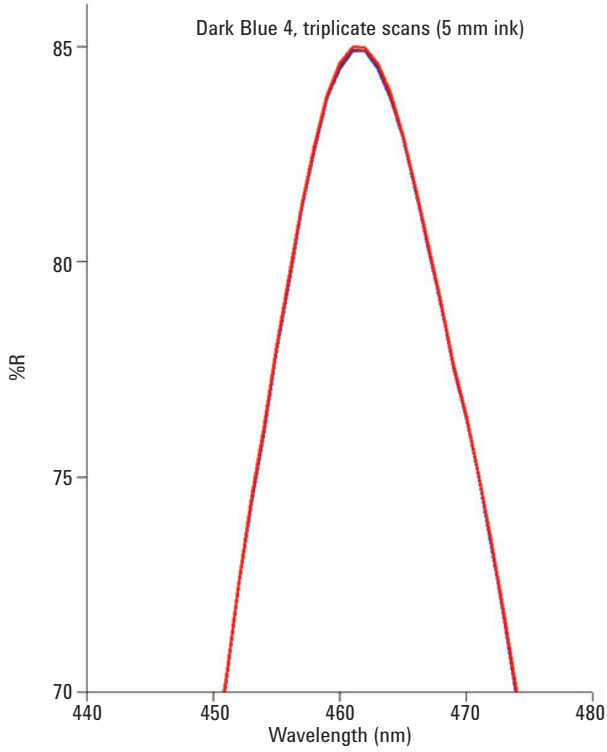

Figure 7b. 5 mm Dark Blue 4 triplicate scans, close-up view

Conclusion

The Agilent Cary 60 Remote DRA showed excellent performance when measuring solid sample reflectance data with sample sizes as small as 1 mm. The video camera output makes it extremely easy to select the appropriate position on the sample from which to collect data.

Very high quality scans were collected using the Cary 60 Remote DRA. The spectra showed very little noise and sample traces were easily differentiated.

The Agilent Cary 60 Remote DRA displayed very good reproducibility of results when comparing multiple reads on the same sample.

References

1. F Somma, P Aloe and G Schirripa Spagnolo, *Defects in UV-vis-NIR reflectance spectra as method for forgery detections in writing documents*, 2010 J. Phys.: Conf. Ser. 249 012060.

2. Marco Leona, Francesca Casadio, Mauro Bacci and Marcello Picollo, *Identification of the Pre-Columbian Pigment Maya Blue on Works of Art by Noninvasive UV-Vis and Raman Spectroscopic Techniques*, Journal of the American Institute for Conservation, Vol. 43, No. 1 (Spring, 2004), pp. 39-54

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