Profiling through Laminate

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Introduction

In the past decade, large-format inkjet printers have become increasingly popular for printing photographs, fine art reproductions, point-of-purchase displays, signs and banners, and other applications. Due to the wide variety of inks, media, printers, and software raster image processors (RIPs) available, inkjet printing depends upon ICC color profiling to get an accurate match from digital file to print.

The longevity and durability of inkjet prints can be extended by lamination, which involves the application of a heat- or pressure-sensitive clear plastic overlay. However, due to the adhesives, laminates can impart a color cast that is especially apparent with black-and-white photographs viewed under different lighting conditions where metamerism influences color perception. According to Brian Gibson, national technical and applications manager at Neschen Americas in Toronto, Canada, cast-free laminates are available but are more expensive than ordinary laminates. Thus the large format industry could benefit from a method of controlling color casts from less-expensive laminates.

Figure 1. *The Celebrity Persona Exhibition.*

Laminates' color casts were readily apparent in preparations for a 2007 photo exhibition, "The Celebrity Persona" (Figure 1), coordinated by Valérie Boileau-Matteau, exhibitions coordinator at the Mira Godard Study Centre, Ryerson University School of Image Arts. After lamination, the prints had a reddish cast. However, it's also possible that the color cast could have been reduced by "profiling through the laminate," meaning to laminate the ICC test chart before reading it.

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Procedure

1. Four X-Rite ProfileMaker IT8.7/3 test charts were printed on Epson Semi-Matte Proofing Paper on an Epson Stylus 4800 inkjet printer using the ColorBurst RIP set to 720x720-dpi resolution and with ICC profiles turned off.

2. One of the targets was kept as a control, or unlaminated, target. The other three targets were laminated with gloss, semi-gloss, and matte laminates at Toronto Image Works, a technically advanced service provider in Toronto.

3. After lamination of the three targets, all four targets were measured with an X-Rite i1 instrument mounted on an IO scanning table. The measurements were saved and used to create 4 ICC profiles, one for the control and one for each of the three laminates.

4. The three laminate profiles were each used to print two visual test forms on the same Epson 4800 printer. One of the two test forms was laminated, and the other was left unlaminated.

5. The laminated test forms were compared with the unlaminated form to see if the ICC profile compensated adequately for the laminates' color casts.

6. The 12 grayscale patches from the IT8.7/3 form were graphed in LAB color space using RedRock DeltaGraph software.

Test Form

The printed test forms were observed under a Graphic Lite standard viewing booth. The laminated versions of all 3 test forms (glossy, satin, and scuff) showed a yellowish color cast that was most visible the highlights of the grayscale and of the Printing Industries of America High-Key test photo. The cast was less apparent in the shadows.

Original

This is the original test chart without a laminated profile.

Glossy

In the glossy laminated print a yellow color cast was much more noticeable in the highlight areas of the gray scale and the high-key image than in the shadows or the low-key image. Spectrophotometer measurements showed that the glossy layer will decreases the lower L* values slightly.

Satin

The great details are visible in the low-key area after the laminate profile is applied. In shadow areas below about 50% reflectance, the cast is not as noticeable in general. Similar to the glossy material, the satin profile is a bit off from the original print especially between 50 and 100 K value.

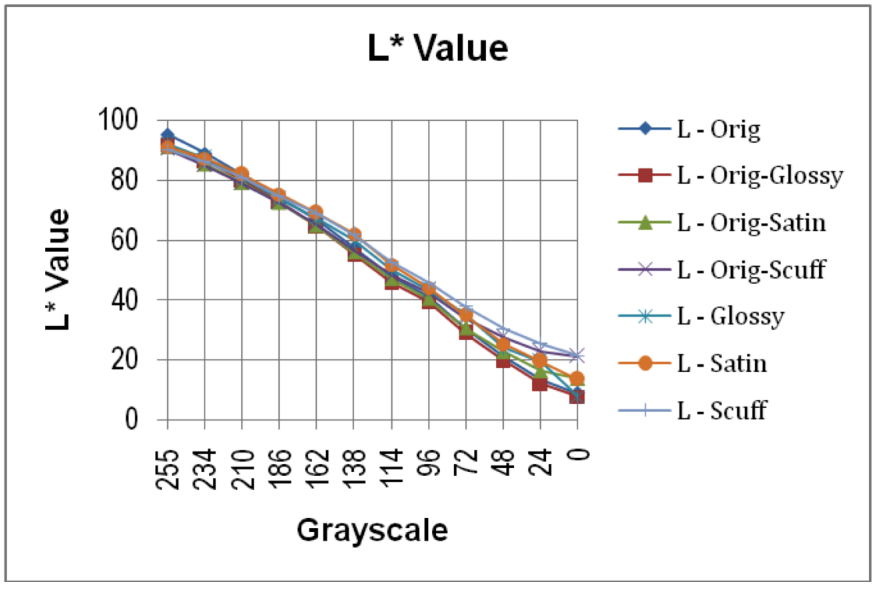
Scuff

It is shown that with lamination, the images are flattened. The details in the shadow area are lost. For example, the cupboard from the low-key image cannot show the detail of the shadow area.

Graphs

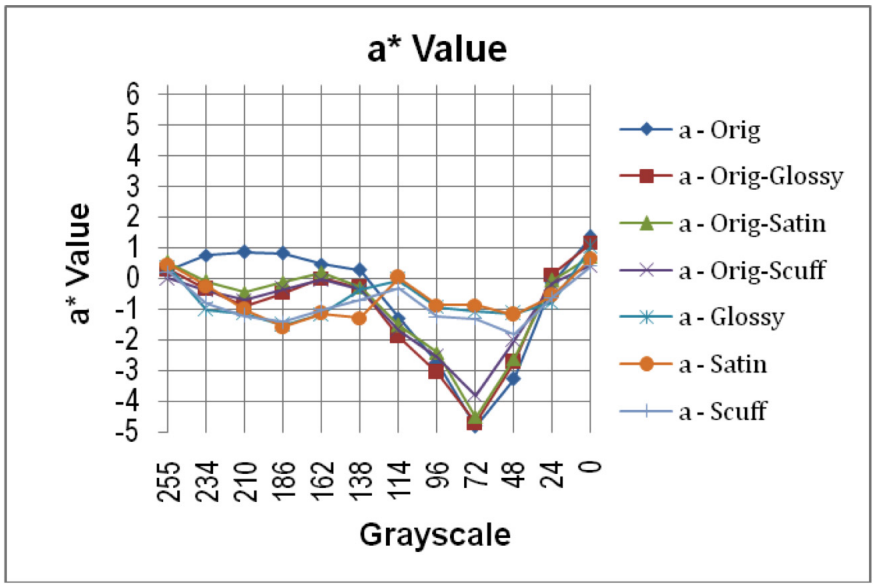
Separate graphs of L*, a* and b* grayscale values show that all the laminates, with or without the profile, cannot precisely match the unlaminated original. In general, lighter areas of the profiled prints have a higher yellow cast than non-profiled prints. Profile editing would be required to match laminated proof with the unlaminated proof.

L* Value



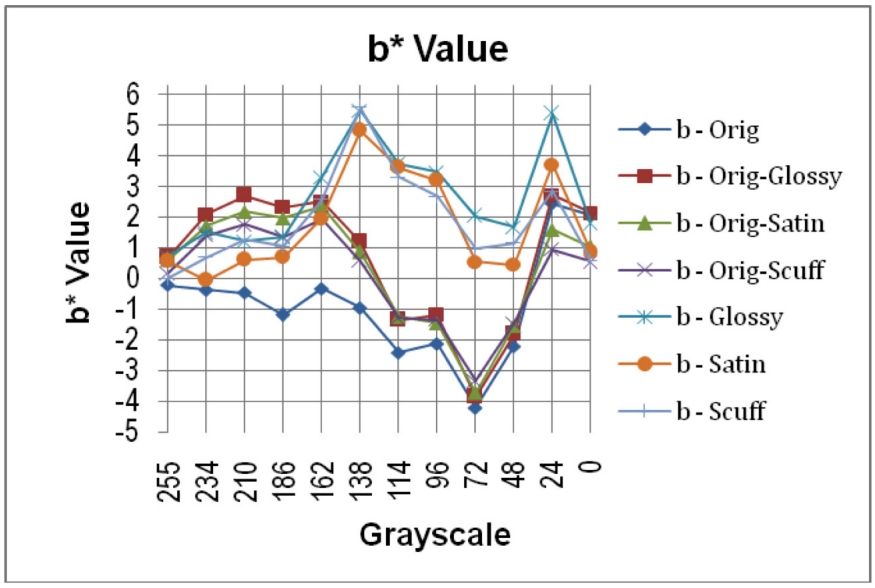
As L* values increase, the profiled laminate prints tend to match the unlaminated original better than the non-profiled prints. As L* value decreases, the non-profile prints are closer to the original. As shown from the graph, darker areas are harder to achieve using the automatic profile.

a* Value



All the profiled prints are very far from the original a* value. The original with and without laminate has a much dramatic curve ranging from 1 to –5 while the profiled prints are very stable between 0 and –1. This means the a* value became more neutral with the custom profile There is an indication that after the mid-point, the original has a higher a* value than the other prints with a laminated layer.

b* Value



As the graph illustrates, the profiled laminated test form shows higher b* value indicating the sign of color cast. Since the L* value gets darker, it is not that noticeable to the eye. Even thought the darker area of the profile prints have a higher yellow cast than the non-profile print, it is not that obvious when the darkness covers most of the yellowness.

Discussion & Conclusion

Laminated inkjet prints are much more durable and long-lasting than printed materials without a top coating. However, most laminates' adhesives can impart a color cast that is important to eliminate in color-critical printing, such as photography. This study examined three laminates which each imparted a yellowish color cast to prints. Results showed that creating a profile "through the laminate" decreased, but did not completely eliminate, the amount of visible yellow cast. To further reduce the cast, profiles could be edited in a profile-editing program.

Lamination also affects a print's contrast by changing the substrate's surface properties and reflectivity. This study showed that adding a laminate layer on top of the substrate changed the L* values and color gamut of the prints.

In conclusion, to avoid the higher cost of cast-free laminates, companies can try using a laminated profile to control color cast.

Ideas for Future Research

- Role of different media, laminates, and inks. How strong and what hue of color cast is imparted by different laminates on different substrates and with different inks?

- Role of different ink combinations. What color cast is imparted by laminates to prints made with 4-, 6-, 8-, and 12-color printers? Usually, the greater the number of inks, the greater the potential for color casts due to light effects of metamerism.

- Influence of ambient light. The color cast of a print (laminated or unlaminated) is affected by the ambient light and metamerism. Profiling software can compensate for ambient light, and it would be interesting to study the effects of incorporating ambient light readings into laminate profiles.

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