John Kuczala, Getty.

Achieving Color Consistency in Textiles

Maintaining color continuity means understanding the different factors in digital textile printing.

By Ray Weiss,
Director of Digital Print Programs, PRINTING United Alliance

Textile printing can be challenging, and achieving consistent color can be even more so. However, a good process for achieving consistent color is not only possible but achievable with solid color management principles. It comes down to managing the myriad variables that are inherent in printing on such a wide variety of substrates that in turn have a variety of textures and gloss levels. The following will focus on dye-sublimation, as that process holds the lion's share of digital printing in the U.S., though many of these principles will hold true across other textile printing technologies as well.

Environment and Material Variables

Most often overlooked, yet a very important aspect in printing, is the environmental settings in the print room. As a good rule of thumb, the humidity level should not be below 50%. Each manufacturer will have relative humidity recommendations for their printers and printheads, and it's important to monitor this in the print room. Allowing the humidity level to fall below 50% will dry out the printheads and potentially cause nozzles to drop out, leading to problems when trying to achieve consistent color.

Many textiles stretch when heat is applied — a necessary step in dye-sublimation printing — and this stretch needs to be managed. While this stretch is more of a problem for sizing, it can affect color and is something to manage. Typically, printing a predetermined size graphic — say, a 24x24" square — and then measuring after heat pressing will show what the stretch factor is, and most RIP software has a function to manage this so printers end up with the size they intended.

Another challenge this can bring to color management comes when attempting to read color patches with a spectrophotometer. A fabric that has a lot of stretch can move when trying to read a set of patches, giving inconsistent color readings. Using a measurement device with an electrostatic base or an automated device that is set with a slight gap to avoid contact (thereby avoiding the pulling and stretching) will help. Another option is larger ▸

patches, so that if they do distort slightly, the spectrophotometer device can achieve multiple readings across the patch, achieving a better average reading. It is important to note that many spectrophotometer devices use what is called a "virtual" aperture, which takes multiple readings when going across a patch of color.

Textiles have a variety of weaves, textures, and gloss, and a spectrophotometer using a wider aperture (typically in the 6-8 mm range) will usually be necessary to compensate for this. The weave and texture in a textile can create shadows when the spectrophotometer shines a light to take the color reading, and a wider aperture will allow more of that reflected light back to the instrument for more consistent readings. Whenever possible, take multiple readings and then average those readings — this is a must if the device used has a smaller aperture.

The spectrophotometer's light source and number of lights is an additional consideration. Some devices use multiple lights arranged around the inside of the device, which help to cut down on the shadows that can be created by a single light source. Others use a single light source and a series of mirrors to create a similar effect. Do the homework when purchasing a spectrophotometer for use with textiles — light source and aperture size will play a big role.

Another variable at play is the optical brightening agents (OBA) in many fabrics. These absorb light in the ultraviolet region (around 340-370 nm) and re-emit that light in the "blue" region (usually around 420-470 nm). They make the fabric appear to be whiter to the eye, and therefore more appealing. Some fabrics have so much of these OBAs that a polarization filter is needed to cut down on the light that is coming back to the spectrophotometer device. A polarization filter is used with a spectrophotometer much like polarized sunglasses are used to look up at a bright sky: It cuts down on the light coming back into the device so that the actual color can be read.

Some high-gloss polyesters can also be difficult to read, and the polarization filter comes into play with those as well. These OBAs can make it difficult to achieve that near-neutral standard that many printers are shooting for as they try to achieve similar color appearances across a variety of devices; the main challenge is the white point of the fabrics themselves. However, it is possible to achieve gray balance with dye-sublimation printing using the same principles in near-neutral printing by focusing on the primaries (CMYK), and the overprints (RGB) to achieve a gray-balanced print.

When discussing spectrophotometers, the measurement conditions must be mentioned. Without going into an entire article on measurements, note that M1 defines that the light source should have UV consistent with D50, whereas M2 excludes UV (either with a filter or mathematically removed). M3 excludes UV and adds a polarization filter. Because of the OBA content in many fabrics, most people will use either M2 or M3 to exclude the UV; not doing this can allow the blue in the fabric (from the OBAs) to cause highlights to turn yellow.

Heat Press and Ink Factors

For good dye-sublimation transfer to occur, the appropriate temperature, time, and pressure need to be dialed in for each material. As noted, most manufacturers will have recommendations for this, and testing is a must. Before doing any color-critical work, test each ink, paper, and textile option, and keep good notes, making sure to note the environmental conditions as well as the heat and pressure settings for the heat press. Test strips can be purchased to make sure the heat press is delivering consistent heat across the entire platen or drum and that the heat is as expected. Just setting the heat to 400 degrees and then not testing is a recipe for trouble.

Ink plays a large role in textile printing, as it impacts several parts of the process. When considering an ink, keep in mind the substrate that it is designed for; the stability and shelf life; at what temperature it achieves full "bloom"; its compatibility with the printer's printhead; whether it is designed for rigid substrates or textiles; etc. It's rare to find a single ink that will work for all applications equally well.

As an example of printhead compatibility, the PRINTING United Alliance lab had a printer a few years ago with a particular brand of printhead. The humidity levels in the lab were fairly consistent with regularly performed maintenance, and yet I had a lot of trouble keeping all the nozzles firing. When the manufacturer representative visited for a class, he checked the dye-sublimation ink in the printer and noted that it was the wrong ink for the printhead on that device. I had not heard of this before, and once we switched inks — which is not terribly difficult in dye-sublimation — the problem was solved. So, always investigate compatibility issues before switching inks.

It is important to understand the ink's makeup. Aqueous dye-sublimation inks are 60-70% water, depending on printhead type, and they also contain humectant to control evaporation, surfactant to help with wetting, biocide to kill bugs, colorant (the active ingredient), and other additives. There are also fluorescent inks, which have their own long list of makeup and profiling considerations. Though a quality ink could cost slightly more, it may save quite a bit of money in the long run due to better consistency and easier application.

Paper for Transfer

A good dye-sublimation paper is designed to handle water-based inkjet ink without cockling, and absorb it properly into the coating. When heated by the press, it is designed to release all or most of the dye into the textile (or substrate). A great paper is one that achieves maximum release and does it consistently, the latter being a big challenge for dye-sublimation papers. Any change in the characteristics of the paper will require reprofiling. Spending a little extra for a quality product will go a long way for good color consistency. Look for a paper in the 90-110 gsm range as these papers will usually give better performance and consistency. And when it comes to tacky versus non-tack paper, the latter will interfere less with color transfer.

Textiles have a variety of weaves, textures, and gloss, and a spectrophotometer using a wider aperture (typically in the 6-8 mm range) will usually be necessary to compensate for this.

Profiling, Proofing, and Color Tools

When profiling, it is important to remember to profile as if in production. In other words, don't take shortcuts to create a profile that has not been created just as when in a production environment. So, if someone prints across the entire bed of the printer (and who doesn't), then they should run color patches ▸

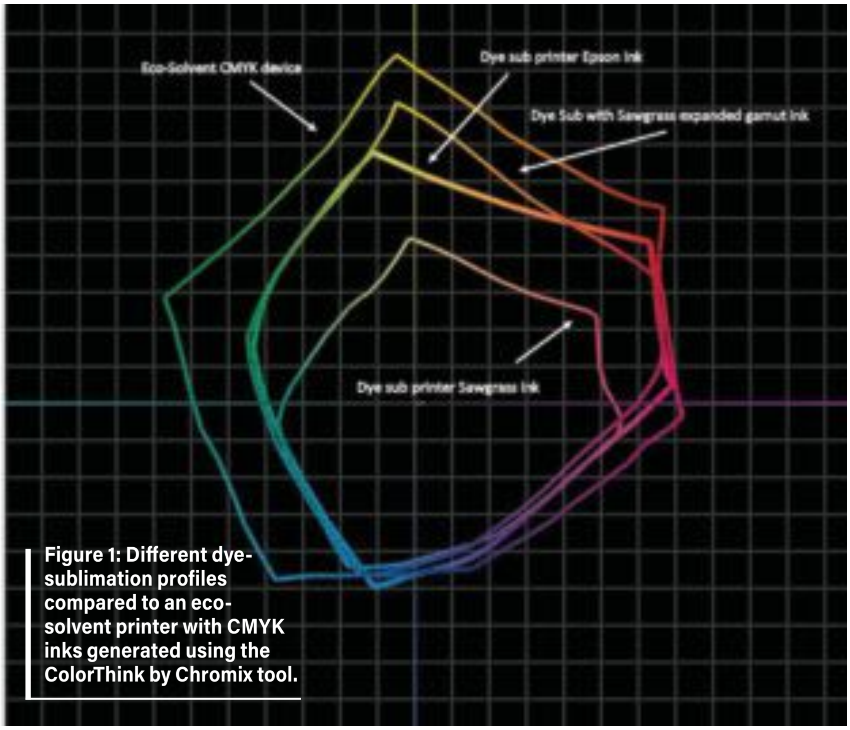

Figure 1: Different dye-sublimation profiles compared to an eco-solvent printer with CMYK inks generated using the ColorThink by Chromix tool.

across the entire bed of the printer. And, when it comes to dye-sublimation, that means press every chart just as if producing a piece to sell.

Gray component replacement (GCR) takes on a larger import when profiling for dye-sublimation printing. Metamerism (when colors appear different under different lighting conditions) can be improved if a higher GCR level can be used when profiling. Looking at the linearization target will help to determine where to start using black ink only for neutral grays instead of a combination of CMY to make the same gray. Because cyan, magenta, and yellow do not have the same lightfastness, non-neutral output can be seen over time — particularly when profiling for outdoor apparel, flags, and banners.

If proofing for a textile profile, either select a paper that has a similar OBA content (determined by measuring the white point of the paper and the textile), or make sure to use the absolute colorimetric rendering intent so that the printer will attempt to simulate the blue cast that the fabric will have due to the OBA content.

ColorThink from Chromix is a powerful tool for all color management applications. This software allows not only the ability to view color gamuts, but multiple gamuts from devices and targets such as GRACol and AdobeRGB 1998. Figure 1 shows a few different dye-sublimation profiles compared to an eco-solvent printer with CMYK inks. The smallest gamut is a dye-sublimation printer using Sawgrass ink with CMYK only. The next one shows a dye-sublimation printer using Epson inks, also with CMYK only. (Notice how it is larger than the other dye-sublimation printer; this could be from a number of factors, such as textile composition, or the measurement device used to build the profile.) The third dye-sublimation profile is using Sawgrass expanded gamut inks. Note how they all have the same challenge in the greens and blues; this is very common in dye-sublimation printing, and does not mean a "bad" profile has been built. If one were trying to "match" (a word that tends to be avoided with prints and color as it is a setup for failure) colors across devices, they would shoot for a neutral gray balance so that they could achieve a common visual appearance. Another good use for a gamut viewer is testing for ink-bloom. The bloom difference can be charted by printing the linearization chart and then comparing dwell times on the heat press. As one advances the time, they should see the gamut pushed out further and further until there is no more benefit, which will show the ideal dwell time for setup.

There are quite a few variables that need to be considered and managed to achieve consistent color with textile printing. Establishing a process that can be followed across all print devices will ensure that a printing operation will be able to hit color consistently with confidence. ■

Having joined PRINTING United Alliance in 2014, Ray Weiss provides solutions and technical information on digital printing, equipment, materials, and vendor referrals. A Color Management Boot Camp instructor, Weiss oversees several workshops, the association's digital equipment evaluation program, and both the PDAA and Digital Color Professional Certification programs. Weiss regularly contributes to the PRINTING United Journal and has won a Swormstedt Award. His 25-plus years in the graphics industry have spanned owning his own prepress and offset business to digital wide-format sales, training, support, and service.

Take the digital textile conversation further this Dec. 8-9 at the sixth annual Digital Textile Printing Conference in Durham, N.C. This event, co-sponsored by PRINTING United Alliance and American Association of Textile Chemists and Colorists, explores key trends and technological developments accelerating the digitally printed textile market. Join industry experts and peers for this can't-miss educational and networking opportunity that will cover a multitude of textile printing topics including:

- Global market conditions and economic forecasts
- On-demand printing
- Latest developments in design software, design considerations, and best practices
- Technology advances in digital textile printers, inks and production/RIP software
- Digital textile workflows
- Textile finishing and cut-and-sew
- Automation in digital textile manufacturing
- Testing methods
- Emerging business models
- Digital transformation and its influence on supply chain relationships

Learn more about the Digital Textile Printing Conference at sgia.org.