THE SECOND C: From Inspiration to Replication

By Keith Hoover

In the previous installment, we discussed creating palettes full of color inspiration. Now, we will move from inspiration to replication. This process of transforming a color idea into a specification has been in place since the mass production of apparel began. Though technology has changed, most of the industry is still following "the way it's always been done"—lab dipping.

On the Origin of Lab Dips

Yes, it is kind of a dopey-sounding name and no, it does not refer to a lab technician mouth-pipetting caustic. In this article, I will distinguish between "lab dip" and "lab dyeing" as follows. A brand's lab dip process is time set aside in the product development calendar to negotiate color acceptability with mills by sending swatches of color on trips around the world. A lab dyeing is a precise color dyed on a specific fabric at the mill to assure that the first lot of production is onshade. Secondarily, that swatch is sent to the brand as a part of their lab dip process. Who came up with this? Some might suspect global couriers started it, since it drives so much revenue. However, this anachronistic process has a simpler origin.

In the mid-twentieth century, many apparel brands were vertically integrated; that is, the same company that employed designers and merchants to develop apparel also owned manufacturing facilities to spin the yarn, knit or weave the fabric, dye the goods, and cut and sew finished fabric into garments. I started my color career working for Ben Bell, who developed color for Burlington Industries, an old American vertically integrated apparel powerhouse. Roland Connelly, past president of AATCC, was a pioneer in digital color management with Burlington Industries, as well. I also oversaw color development at Fruit of the Loom when they were a vertically integrated brand with US manufacturing.

Color development in a vertically integrated apparel company started with color inspiration and moved to color replication, just like today. Designers in the headquarters office selected either legacy colors (shades that had been developed and run in the past) or new color inspirations (fabric cuttings, leaves, frozen chicken parts, paint chips, and other found objects). These inspiration samples were sent to the mill's color development dye lab, usually situated in the Southeast United States.

It was up to the designer and the color lab technician to agree on an acceptable interpretation of that color on the intended fabric. There was a direct line of communication between headquarters and the mill, although regional dialects could make communication somewhat of a challenge. Think "Sea Mint" versus "Cement."

Commercial feasibility was a key issue for the dye lab since it was responsible for setting up colors that could be run consistently in large-scale production. Not only did a color have to match the designer's inspiration, but it also had to be optimized to run smoothly in production,

pass fastness requirements, (largely a function of dyestuff selection) and meet cost targets. So, the power to determine an "acceptable match" was largely in the hands of the dye lab manager.

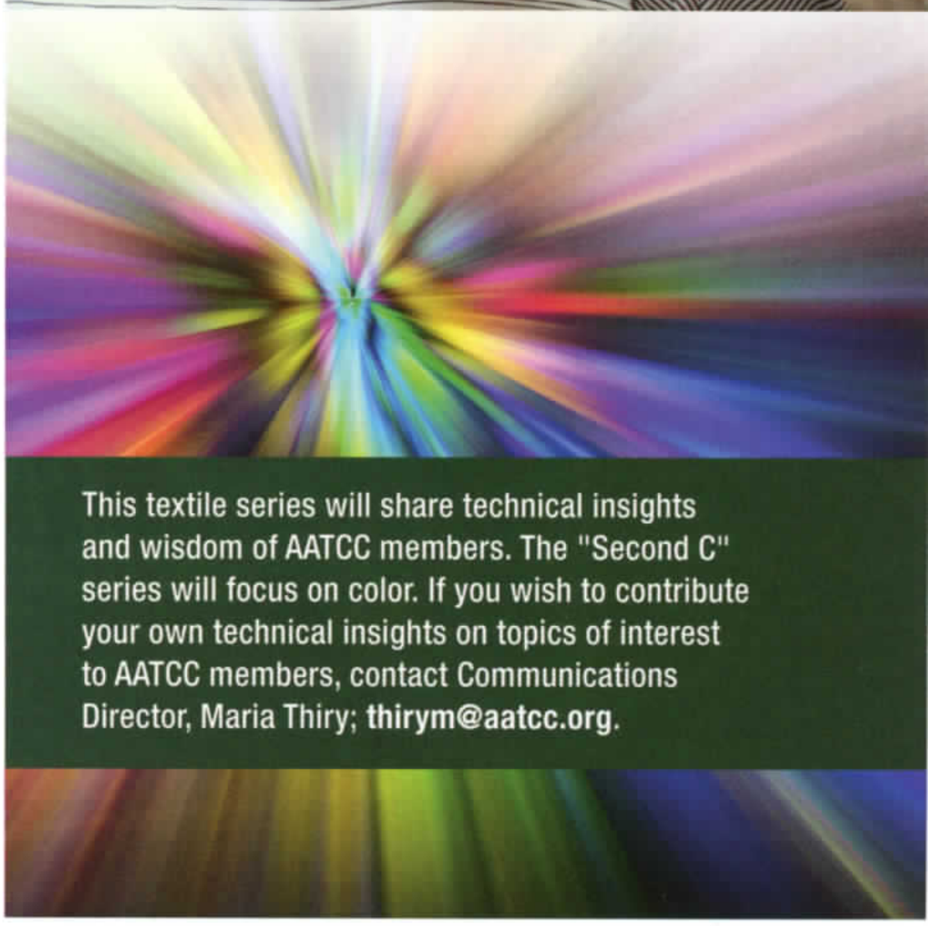
Designers at modern retail brands are also responsible for choosing colors. Information about these colors is communicated to the mills assigned to dye fabrics in these colors. There is little opportunity for direct communication between the designer and the mills. Besides language barriers, some brands have policies expressly forbidding such dialogue. Many large brands have set up color offices to manage color development, so the designers' intent behind each color is lost.

The Nature of The Color Specification

According to the Project Management Institute, quality is defined as "conformance to requirements/ specifications." [1] So, the ultimate quality of the color of the product relies on how designers view that specification—the color standard. In my experience, designers think of color standards in one of three ways: [2]

The Color Standard as a Starting Point—A designer finds colors close to what is desired and asks the mill to send several lab dips for each color, not with the intention of achieving a match, but to see variations of the color. When the designer sees a "nice version," it is approved. At that point, the approved lab dip becomes the real standard.

The Hopeful Color Standard—A designer finds the perfect colors and sends them to the mills with the expectation that each will be matched. However, the designer has no assurance that the colors can be acceptably matched on any given fabric.



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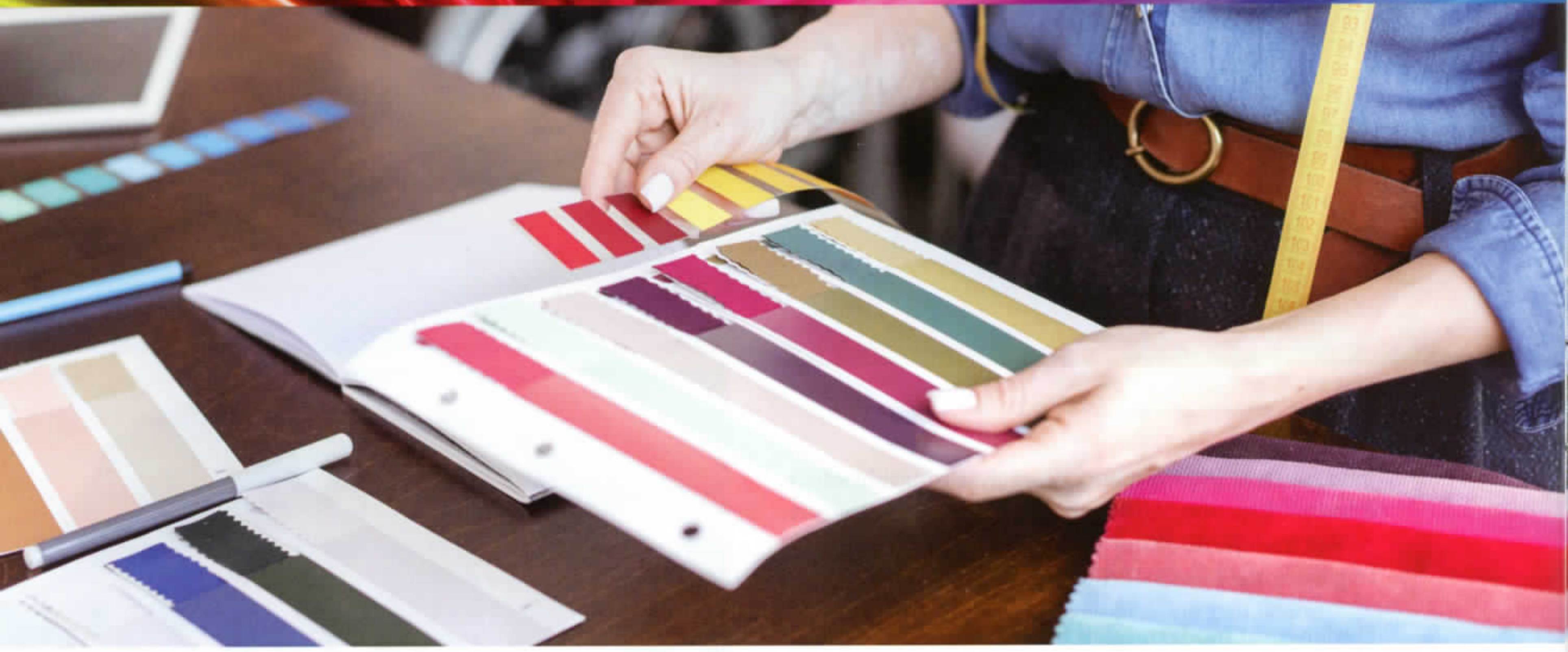

The Feasible Color Standard—A designer finds the perfect colors and has them vetted for color match and fastness feasibility for all fiber types or general fabric categories—before sending anything to the mill. The vetting process identifies any problems (metamerism, gamut, fastness, cost) allowing the designer to choose alternate colors without the technical issues. The resulting feasible colors are set up as master spectral data standards and sent to the mills for color matching.

Lab Dyeing 101

Once a mill receives the brand's information about color and fabrics, the process of color matching begins. A lab dyeing is created to achieve two purposes: 1) translate the designer's color specification onto a specific fabric and 2) define a dye recipe that can be scaled to production. This process involves the use of precisely controlled, small-scale dyeing machines that can mimic the processes and outcome of full-scale production dyeing. The amount of each dye used in a lab dyeing recipe is linked to the weight of the fabric to be dyed (referred to as the "goods") to enable a scale-up process.

For example, consider the following dye recipe:

Yellow CL2R: 0.83% OWG
Red CL3B: 1.64% OWG
Navy CLR: 3.15% OWG

What does the percentage refer to (1.64% of what)? And what's up with "OWG"? In exhaust dyeing, most recipes involve the use of a "trichromy;" a mixture of red, yellow, and blue dyes known to perform well in combination. The amount of each dye in the trichromy is expressed as a percentage of the weight of goods (OWG stands for "on weight of goods," not "off we go!") being dyed.

So, if the weight of the lab fabric swatch is 20g, then the amount of each component used to create the lab dyeing is calculated as follows:

Yellow CL2R: 0.83% X 20 g = 0.166 g of dye
Red CL3B: 1.64% X 20 g = 0.328 g of dye
Navy CLR: 3.15% X 20 g = 0.63 g of dye

The same percentages are used to determine the amount of each dye used in a production lot. Assuming that the weight of the fabric is 400kg, then the amount of each component used to dye the production lot is calculated as follows:

Yellow CL2R: 0.83% X 400 kg = 3.32 kg of dye
Red CL3B: 1.64% X 400 kg = 6.56 kg of dye
Navy CLR: 3.15% X 400 kg = 12.60 kg of dye

From the brand's perspective, lab dips are just little fabric swatches that are reviewed and thrown away. But, from a mill's perspective, a lab dyeing is the outcome of a scientific process allowing them to go into production with a high likelihood of shade accuracy. Color development is done on a small scale (in the lab) and the results translate to the large scale (in the dyehouse). So, it is very important for there to be good "lab-to-bulk correlation," that is, a given dye recipe must produce the same shade on a 20 g swatch as it does on a 400 kg production dyelot.

So, What Could Go Wrong?

Now that we see how the color replication process works at a single mill, it is important to understand that the same process takes place concurrently at every mill producing that color for the brand. Since several fabrics are used in a seasonal product line, multiple mills are involved in matching each color at the same time.

Brands that follow the "starting point" process use lab dipping as an extension of color exploration. When the designer eventually approves a lab dip from one mill (because it is pretty, not because it matches), then the target for the other mills has changed without them knowing it. The approved lab dip cannot be distributed to the other mills (it is too small). So, color matching at the other mills becomes a drawn-out guessing game, likely ending in a Best Can Do (BCD). From a mill's perspective, there is little incentive to match the colors they receive. Without establishing a clear standard to match, the brand has diminished its own product quality and unwittingly disincentivized the mills.

Brands that follow the "hopeful" process are a little better off. Spectral data is often used in this process, so there is a clear understanding of the desired color. Sometimes, mills can match the colors and sometimes they cannot. When a mill fails to match a color, the designer (or brand colorist) assumes the mill is incompetent. In fact, in many cases the color cannot be matched for technical reasons like gamut limitations, unavoidable metamerism, or texture/appearance issues. In other cases, the mill knows that the designer or colorist does not understand technical issues, so a bogus excuse is offered to try and sell a bad match ("There was an issue with fiber disgronification, but I think it looks better than the standard").

Brands that follow the "feasible process" take the happy path. They have sorted through the technical exceptions up front rather than managing BCD's at the end of the process. Spectral data is the optimum format for expressing the color specification. And, since they have solved for feasibility up front (rather than trying to do it concurrently at multiple mills), there is really no need to follow the conventional lab dip process at all. The only thing necessary is to have access to the spectral data of production lots to assure they are within the accepted tolerance. Adopting the "feasible" process is the key to eliminating weeks, if not months, required for lab dips in the development calendar.

Just One Thing, Though...

Mills are successful using spectral data to match colors on flat, texture-free fabrics. However, both color and texture are product attributes. The presence of significant texture (shadows) or a specular component (sheen) interacts with the pure color of the fabric, introducing the concept of Total Appearance. [3, 4] When the Total Appearance of a fabric includes significant texture or sheen, it impacts how one perceives the color.

Most brands that embrace the use of digital color evaluation include process exceptions, stipulating textured fabrics as "out of scope" for digital assessment. These samples must be reviewed visually. Determining how the color of a flat, matte standard should be interpreted on a textured or shiny fabric is subjective. There is emerging technology to objectively assess the impact of Total Appearance, thus allowing the complete automation of color approval. Watch for updates in upcoming installments.

The First Circle of Hell

Dante called it Limbo, I call it lab dip review. In the next installment, we will look at the brands' lab dipping process. Some want to introduce digital technology to make an antiquated process faster. Others have shown that the entire process can be eliminated and replaced with analytics. If you are in limbo, there is a way out.

References

1. **www.pmi.org/learning/library/quality-management-9107**
2. "LEDSimulator: The Colour Box," Ming Ronnier Luo, Keith Hoover, Tinwei Huang, Jianlong Zhang
3. CIE 175:2006 A Framework for the Measurement of Visual Appearance, Vienna.
4. Hunter R. S. and Harold H., The Measurement of Appearance, 2nd edition, John Wiley and Sons, New York (1987).

Keith Hoover, President of Black Swan Textiles (**www.blackswantextiles.com**), implements manufacturing-centric digital processes for color and fabric development. He has implemented digital color management programs for Ralph Lauren, Target, Lands' End, JCPenney, and Under Armour, ultimately leading to a process that eliminated lab dips altogether. At Under Armour, Hoover championed the UA Lighthouse, driving digitalization and advanced manufacturing processes to explore local-for-local sourcing. Black Swan recently developed BlackOPS Fabric Decoder (BFD), technology to digitize fabric, a key component for digitalization in the Fashion and Textile industry.