A renewed interest in knitting has ushered in an increase in demand for yarn. Image Source: Shutterstock user Studio ART

Knitting, once imagined to be a pastime solely for older generations, is undergoing something of a renaissance. Driven by YouTube, Etsy, and lifestyle bloggers, young people are increasingly learning how to knit, creating everything from sweaters to activist art projects to wooly simulacra of biological structures. But while online environments may have helped spur the proliferation of knitting, Juliet Bernard, editor of *The Knitter* magazine, believes its popularity is growing in part as a backlash against digital environments. "With so many of us working in the service, management, digital, and creative industries, we don't actually 'make' anything," she says. "The pride in being able to stand back and admire something that we have physically produced is incredibly satisfying."[1] Rosy Greenlees, executive director of Crafts Council, agrees. "People want to connect to the real, physical world, with each other, and with the world around them, and picking up something as simple as a couple of needles and a ball of yarn can help do that."

The renewed appeal of knitting is also driving a growing interest in and demand for yarn itself, as increasingly savvy knitters seek to realize their vision. This creates a challenge for dye houses, as packaged yarn dyeing has a wide margin of error when it comes to color variation, and maintaining a consistent color is often such a trial that yarns must be separated in dye lots to account for inconsistencies in color from one yarn batch to the next. Dye lots present a number of problems for both manufacturers and retailers and many have sought out ways to eliminate the need for them in textile manufacturing. But while certain acrylic yarns have been developed to not require dye lots, the higher cost, natural yarns popular with today's knitters have yet to see an alternative.

Melih Günay, an expert in textile engineering, believes that the resolution to consistency issues is technology. "Quick response, just-in-time, and right-first-time dyeing can only be achieved by a basic in-house dye house laboratory," she explains.[2] Modern color measurement technologies, specifically

spectrophotometers, must be an integral part of this laboratory in order to overcome common barriers to color consistency and create a wider selection of no dye lot yarns in a variety of materials.

The process of dyeing yarn can result in batch-to-batch color variations. Image Source: Shutterstock user YANNA2560

Right-First-Time (RFT) Dyeing Concepts in Yarn Manufacturing

In any manufacturing process, Six Sigma concepts can be applied to make production more effective while minimizing waste. The right-first-time (RFT) philosophy goes hand-in-hand with Six Sigma, as its end goal is to ensure a company only has to dye an item once. In the past, a dye house may have started with a lighter shade and then dyed the item several more times, resulting in heavy variances based on batch. Using an RFT method, in which the correct color is targeted in the first **dyeing process**, reduces expenses and improves consistency in the result.

According to Dr. Anupama Prashar's Six Sigma-based study of the textile manufacturing process, the most significant point of vulnerability lies in the matching of shades.[3] Dr. Prashar also found that errors in color matching have three primary root causes:

- **Yarn dye-ability:** Materials, especially natural ones like cotton, can be distinctly different at a structural level, meaning how well they will absorb and hold dye will vary even for items within the same batch.
- **Water quality:** Water quality can vary for a number of reasons, including climate and age of the pipes. This impacts the pH value of the water, which can have an adverse chemical reaction with the dye.
- **Dye batch inconsistency:** Even when dyeing yarns of a similar structure using similar dyeing conditions, batch-to-batch fluctuations may occur. In the yarn manufacturing industry, this is

not corrected but instead, it marked on the package, so the end user is able to buy products from the same dye lots to ensure color consistency.

When these three areas were targeted, RFT results increased by 4%. While 4% may seem low, when one considers the time and cost of re-dyeing 4% of a batch of 1000 pounds of yarn, that 4% can represent tens of thousands of dollars. As a result, any increase in RFT production represents significant cost and time savings.

However, even with strict quality control, one area that's challenged manufacturers of packaged yarn is the dye lot. Now, some manufacturers have been able to minimize or eliminate the need for dye lots in acrylic yarn using state-of-the-art spectrophotometric technology to improve RFT processes.

With more checks in the production process, inconsistencies from batch to batch can be reduced — or eliminated. Image Source: Shutterstock user bouybin

Creating Consistency in Colored Yarn Lots Using Spectrophotometers

A spectrophotometer can serve as a key part of RFT dyeing, as it allows the manufacturer to establish the target shade formulation and monitor that shade during the dyeing to ensure it doesn't deviate from the standard. By creating a target shade for various stages of production during the initial color creation process and measuring against that target during manufacturing, unwanted color variations can be rapidly detected and corrective action taken. For example, spectrophotometric analysis can be used to test the initial strength of dye from the supplier to allow manufacturers to correct for any strength differentials by batch. It can also be used on the line to monitor yarn as it's being dyed, helping operators to identify and eliminate variations in the process that may cause color changes, such as high pH levels in water or increases and decreases in temperature. Finally, spectrophotometers can be used to test the end color to ensure dye lots can be largely grouped and remain consistent.

Both benchtop and portable spectrophotometer may be used to measure acrylic yarn before it moves into the spinning process. However, this is not something that works as well for other fabrics, such as wool and cotton, which are easier to dye after they've been spun. For monitoring color in these more complex materials, an on-line spectrophotometer may be a better option to consistently measure color through the dyeing process. While variations should still be expected—and the yarn may still require a dye lot—they can be significantly reduced with the constant monitoring afforded by modern spectrophotometric technology.

HunterLab Quality

HunterLab's innovative range of color measurement tools includes portable, benchtop, and on-line spectrophotometers, giving yarn manufacturers the ability to monitor color at all stages of production, reduce errors, and improve RFT results. This allows manufacturers to create more consistent, larger dye lots or potentially eliminate them entirely. Contact us to learn more about how our state-of-the-art technologies can become a major part of your RFT process, helping you optimize quality and efficiency.

1. "Pride in the Wool: The Rise of Knitting", July 6, 2011,

   https://www.theguardian.com/lifeandstyle/2011/jul/06/wool-rise-knitting

2. "The Future of Dye House Quality Control with the Introduction of Right-First Dyeing

   Technologies", https://cdn.intechopen.com/pdfs-wm/25009.pdf

3. "Right-First-Time Dyeing in Textile Using Six Sigma Method",
   https://www.ijser.org/researchpaper/Right-First-Time-dyeing-in-Textile-using-Six-Sigma-

   methods.pdf