



The Impact of Commercial Laundering on Brand Color Durability on Printed Textiles

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Introduction

- The multibillion-dollar athletic apparel industry relies on a combination of innovation of materials and meeting brand colors accurately (Pedersen, 2016).
- Color is a cornerstone in brand identity (Conti & Walker, 2019); however, manufacturers struggle to consistently ensure accurate color when printing across a wide range of textiles and materials (Walker & Bridges, 2024).
- Not only does the brand color need to be correct when purchased, uniforms need to maintain color fastness and avoid fade even after washing and treatments for stains.
- This creates a complex balance between textiles that meet performance demands, and the printing processes used to produce accurate and consistent colors.
- As a result, manufacturers and apparel designers must consider the best combination of fabric and printing process to ensure longevity even after dozens of washes in harsh cleaning chemicals.



Introduction

- This study builds on previous work that examined the accuracy and durability of two brand colors when printed and washed using ISO 105 C06, the standard used to replicate the home laundering process for textiles (Walker & Bridges, 2024).
- We will present the analysis of color readings after commercial laundering and compare those with both the pre-wash readings and with the previous home laundering results.



Previous Study

- Examined color accuracy (defined as the recreation of the specified color onto the textile) and durability (defined as color fastness after treatment)
- Two brand-specific colors were analyzed, Clemson Orange and Regalia (purple)



VARIABLES

Processes

Screen Printing

Direct-to-Garment (DTG)

Dye Sublimation

Substrates

Cotton

Polyester

Blend

Previous Study Findings

- Screen printing provided the most accurate color on any of the three textiles when compared to the target brand color.
- The DTG process in combination with polyester or poly-blend material provided the best durability of the color after laundering was completed.
- Dye sublimation on blend or polyester textiles provided the most color stability after the full five treatment cycles.

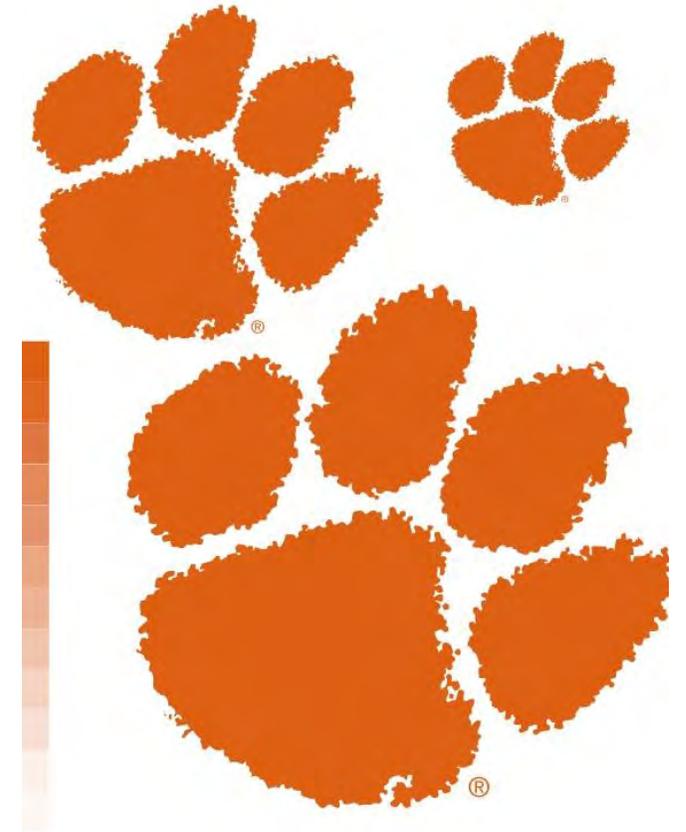


Methods

- Selected textiles for this research were similar to those frequently used in textile printing—100% cotton, 50/50% cotton/polyester blend, and 100% polyester.
- The two brand colors were printed separately on each textile type using three selected print production processes, resulting in a total of eighteen samples.

Methods

- Target patches were created in Adobe Illustrator for both brand colors, orange and purple
- The thirteen patches of a tint scale, which ranged from 100% to 0% opacity, were printed for each target color
- Three sizes of the official brand logo were included in the design
- The logos were not measured for data analysis but rather to visually check ink consistency and the ability for the process to maintain small detail



Methods

- We determined that since this study examined textile production, Pantone color references provided directly from the brand should be used for both colors.
- Pantone values were later converted to LAB values using Pantone's Connect tool to make comparisons with spectrophotometer results (Pantone Corporation, n.d.).



Methods



- Dye Sublimation

- Epson Surecolor F570 roll fed dye sublimation printer
- Epson brand dye sublimation paper and CMYK inks
- Manufacturer recommended settings and profiles were used for printing the artwork
- Spray on polymer coating applied then cured according to manufacturer recommendations for temperature, pressure, and time
- George Knight Swing Away flatbed heat press with a 16 x 20 inch platen was used for printing and curing
- Manufacturer recommended settings
- Settings for cotton and blend textiles were 375 degrees Fahrenheit, medium pressure, for 60 seconds
- Polyester settings were 400 degrees Fahrenheit, medium pressure, for 45 seconds
- To prevent burning or sticking, parchment paper was used between the press and the textile samples

Methods

- DTG
 - Epson Surecolor F2100 printer with a 14 x 16 inch platen
 - Same test target was used and manufacturer color profile
 - George Knight Swing Away flatbed heat press was used for curing
 - Settings used were recommended by the press manufacturer, 335 degrees Fahrenheit
 - The heat press hovered over the garment for 30 seconds, followed by light pressure for one minute



Methods

- Screen
 - SAATI exposure unit to image the screens
 - Brand specific spot colors were premixed by a local, brand-affiliated vendor
 - A manual 4-station screen printing unit was used for production
 - Cured for approximately 30 seconds on a commercial belt dryer



Methods

- Samples were measured before treatment using i1Basic Pro 3 Plus spectrophotometer
- Laundering was done with a Huebsch-brand washer and dryer
- Samples were washed one time in the commercial machines using original Beeks-brand detergent
- Same commercial washing machine and soap utilized for laundering sports uniforms at the collegiate level
- Samples were then dried in a commercial dryer set to “no heat,” as recommended by the assistant director of sports equipment at Clemson



Methods



- After treatment, an i1Basic Pro 3 Plus spectrophotometer was used to measure each color patch on the tint scale ranging from 100% to 0% opacity
- This spectrophotometer has a wider aperture of 8 millimeters, which is more accurate when measuring textiles
- Calibration was done prior to each measurement using the manufacturer provided white patch
- To maintain accuracy with each color reading, a white backing was placed under the textile prior to using the spectrophotometer
- Measurements were taken before and after treatment and the Delta E 2000 (ΔE) formula was used to analyze accuracy and durability for each sample

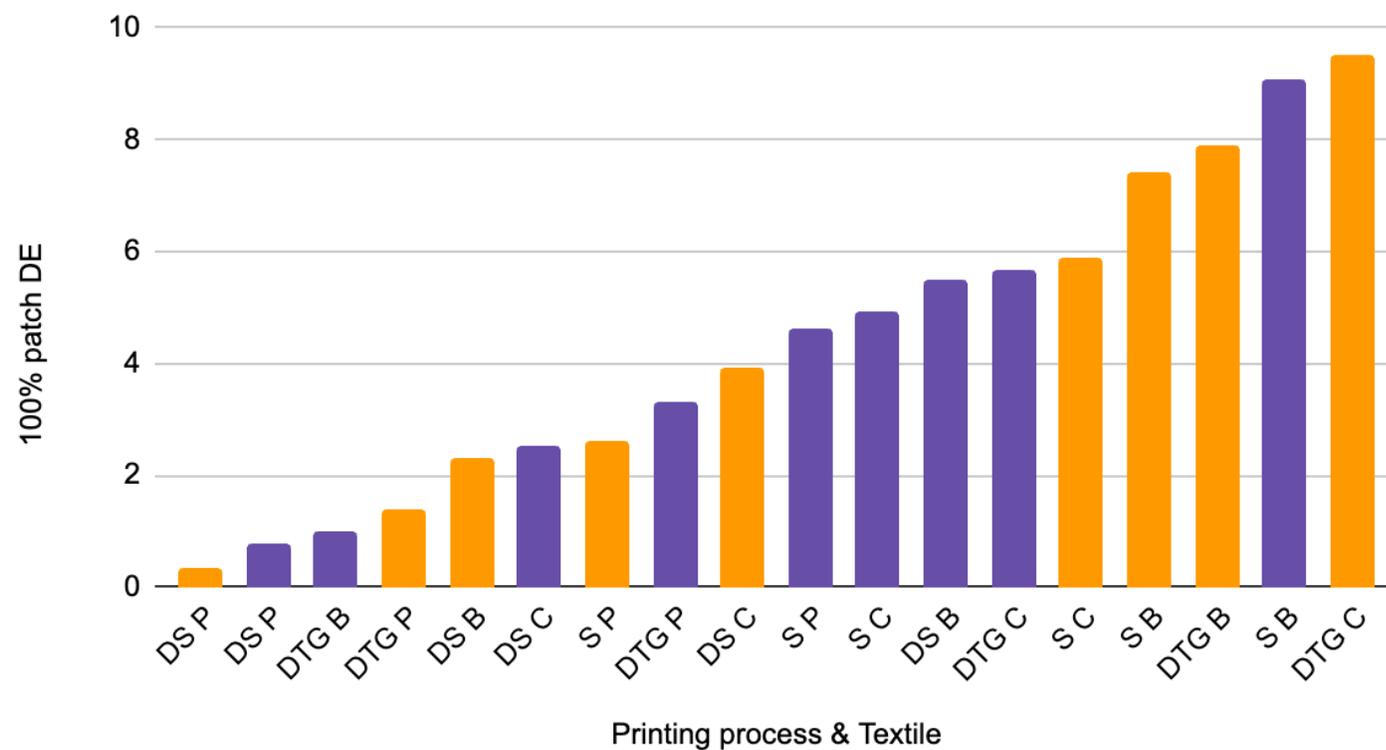
Results Summary

- Analysis of the ΔE revealed that certain combinations of process, textile, and color are more resilient after the commercial wash treatment than other combinations tested in this study
- Only four samples maintained an “imperceptible” change in color with a ΔE below two after treatment

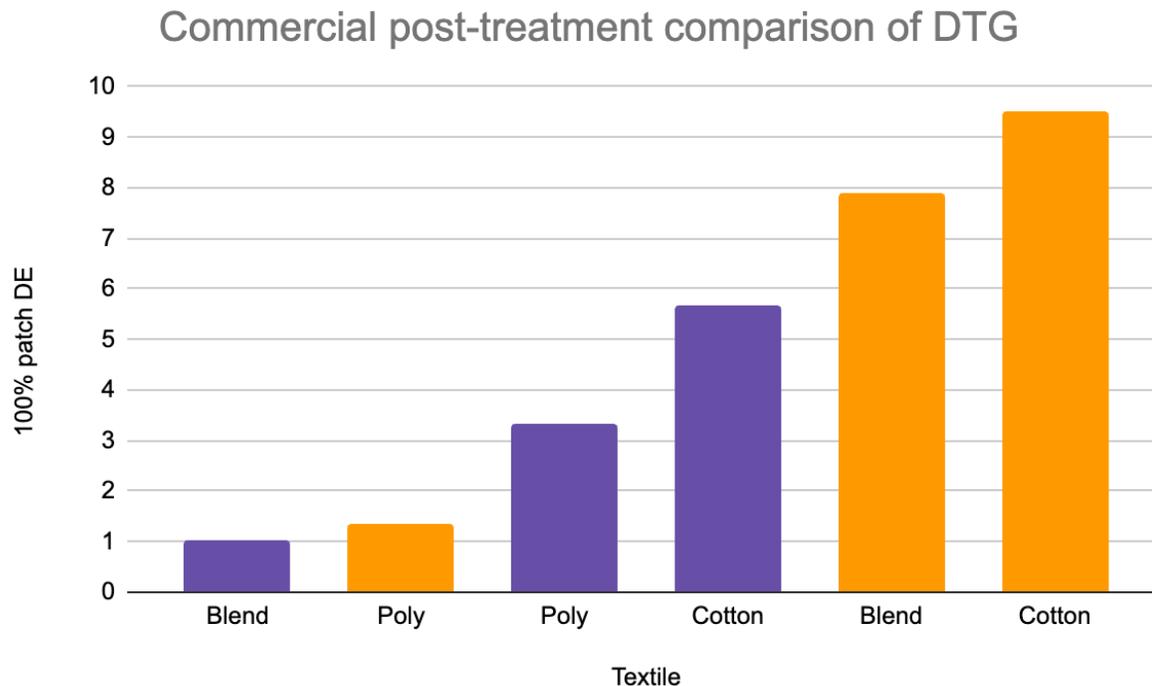


Detailed Results

After commercial treatment comparison of process & textile



Detailed Results



- By process
 - Dye sublimation performs well on 100% polyester textile exhibiting an imperceptible shift in color (0.32 for orange and 0.79 for purple)
 - Orange is less likely to discolor than purple with fabric that contains any polyester when printed with the dye sublimation process
 - With DTG, orange fades more than purple unless it is printed on 100% polyester
 - On average, screen printing experienced the most significant color change after the commercial treatment, when compared to the other processes
 - ΔE values ranged from 2.6-9.08 indicating that screen printed products are significantly degraded by the chemicals present in the commercial laundering process after just one wash cycle

Results Commercial vs. Home Treatment

- Dye sublimation:
 - 100% polyester textile out performs other textiles type regardless of treatment (100% polyester ΔE 0.32-0.79 other textiles ΔE 0.38-21.35)
 - The exception is the blended textile sample printed orange and washed with the home treatment which had a ΔE 0.38
 - All the other textile types exhibited noticeable fade with either treatment with ΔE values greater than 2.31

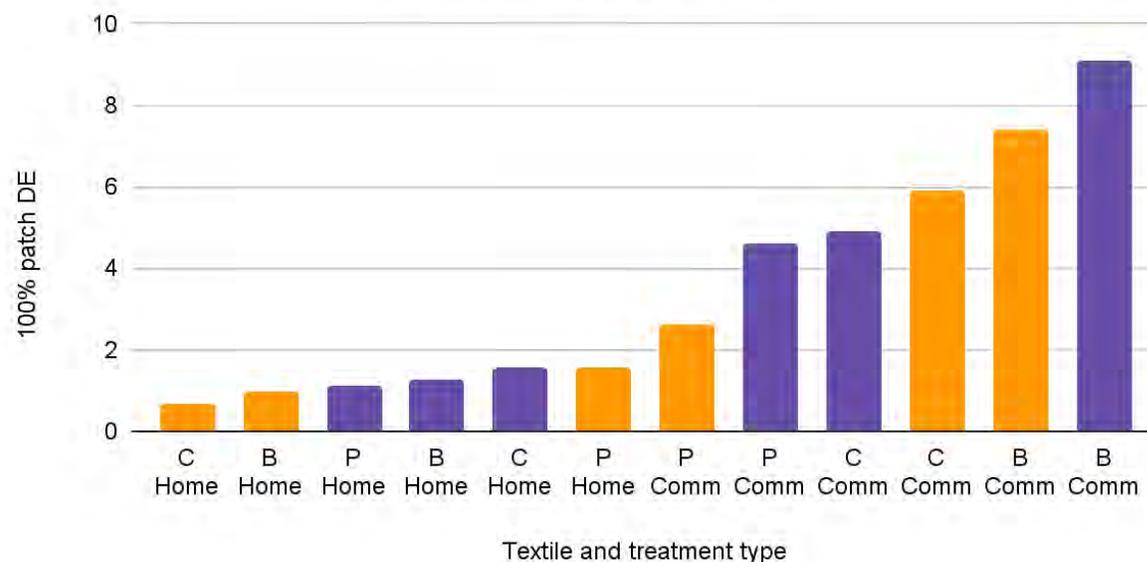
Results Commercial vs. Home Treatment

- DTG
 - When comparing the two treatments, polyester and blended textiles maintained the brand color specifications better than the cotton samples with only two samples both from the commercial treatment, the purple polyester and the orange blend, reading over a ΔE of 2 (ΔE 3.33 and 7.89 respectively)
 - The cotton samples ranged from ΔE 2.98-10.76 with the purple cotton sample treated at home experiencing the most fade

Results Commercial vs. Home Treatment

- Screen
 - For screen printing, the samples that underwent the commercial treatment were impacted more than the home treatment set regardless of color or textile type
 - After home treatment the ΔE ranged from 0.65-1.58 indicating no visually perceptible change in color
 - Commercial readings were all over ΔE 2, a result which indicates that the color change can be detected by most viewers (ΔE 2.6-9.08)

Screen printing comparison of home and commercial treatment by textile type and color



Discussion

- Although there is not one single combination of textile and process that performs objectively better after commercial treatment than all the other combinations in this study, it can be helpful to break down the analysis based on fabric type, process, and color to garner recommendations for situations where one of those variables is predetermined
- For example, if you are printing orange, using a 100% polyester, dye sublimation or DTG would be a good choice of process whether the garment will be commercially or home laundered
- If the design will be printed on cotton and home laundered, screen printing would be a better process to use
- However, if the DTG process was already chosen, then purple might be a better color than orange to print on blended fabrics because orange tends to degrade more noticeably after either type of washing
- Screen printing is a good choice for any fabric, if the apparel is likely to be home laundered but it will fade significantly if washed commercially.



Conclusions

- The results of these two studies combined can provide manufacturers of athletic apparel guidance for the best combinations of textile and process to achieve long-lasting, accurate results for these two brand colors
- Conversely, this study reveals that some combinations of textile and process are more likely to not maintain brand accurate color



Future Research



- Future research might include additional comparison for newer textile printing processes such as direct-to-film (DTF) which is a growing part of this market
- Other comparisons might be made with pre-dyed fabrics and embroidery, both of which are widely used for non-printed elements on uniforms
- Finally, we acknowledge that this is only examining the impact on two brand colors
- Every team has their own brand identity and different colors might exhibit different results than what was seen with orange and purple

Thank you

Questions?

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