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It's a Wash: Laundering Suggestions for Woven Cotton Fabrics Digitally Printed with Reactive Inks

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Background and Problem

Digital textile printing, in the last decade, has made its way into the mass customization market; slowly replacing original screen-printing processes (Li, 2003). Researchers have evaluated the colorfastness of types of dyes (Blackburn, et al., 2002; Haar, et al., 2013; Sarkar, et al., 2003) and studies have been conducted on the chemistry of inks, types of printers, and chemical pre-treatments. However the colorfastness of inks used for digital textile printing have been understudied. The purpose of this study was to evaluate the colorfastness to washing of woven cotton fabrics digitally printed with reactive inks and provide washing suggestions.

Experimental Design

Samples. All the test fabrics were printed in a digital textile printing lab with reactive inks by one of the researchers. Each fabric was pre-treated commercially with a solution called ProCoat, prior to purchase to allow for maximum ink intake. Digitally printed inks have a low viscosity, which allows them to flow through the print heads, but this creates a wicking problem when once the ink is applied to the textile substrate. Therefore, the fabric must be pre-treated with an alkali solution to deplete wicking. Therefore, the pre-treatment solution has a thickener, such as sodium alginate and alkalis to achieve fixation onto the fabric (Tyler, 2005).

Printing and Post-Treatment. The color swatches in this study were digitally printed in L*a*b* color mode with a textile design consisting of red, blue, and green hues on a Mimaki TX2-1600 digital textile printer. These colors were chosen since light reflected from the textile design sends electrical responses from the retina to the brain using the red, green, and blue cone receptors (Ujiie, 2006). After printing, the paper backing on the reactive fabric samples was removed, then all the samples were steamed, at one time, for 60 minutes in an industrial steamer to set the inks.

Laundry Test. Twenty-five, 2"x6," cotton fabrics in canvas (n=5), duck (n=5), percale (n=5), sateen (n=5), twill (n=5) samples, digitally printed with reactive inks, were tested using the AATCC standard Colorfastness to Laundering: Accelerated, test method 61-2013. Each fabric type was tested 5 times, tests A1-A5 (variations of conditions: water, detergent, agitation), in a steel lever lock canister along with a multi-fiber test cloth in an AATCC approved SDl Atlas Launder-Ometer. The machine ran for 45 minutes. After laundering, the samples were removed and rinsed three separate times in distilled water, then laid flat to dry.

Color Measurement. The spectrophotometer, Cary 300 UV-Vis, was used to read the color intensity after each laundry test for CIELab coordinates and the ΔE* color change of the red, green and blue hues. The gray scale for color change was evaluate using the gray scale AATCC evaluation procedure 1-2012 (AATCC, 2015). For color transfer or staining, the multi-fiber test swatches were compared to the 9-step chromatic transference scale, AATCC evaluation procedure 8-2010 (AATCC, 2015).

Summary of Results

The values obtained from the ΔE* color changing test demonstrated significant color loss in the reactive twill samples; however, the reactive cotton sateen did not experience as much color loss. Cotton percale, duck, and canvas all also lost a substantial amount of color during the laundering process. The gray scale ratings, 9-step chromatic transference scale, and the CieLab color readings confirmed the ΔE* results for all samples. As a result of the experiment the following is suggested for washing cotton fabrics printed with reactive inks: (a) wash duck, percale, sateen and twill in a high volume of water with less agitation and more detergent and (b) wash canvas with low agitation, but with moderate amount of water with larger amount of detergent.

Significance

With the rapid growth on the digital textile printing industry it is imperative to continually conduct new research. New ink types, fiber technologies, and printing equipment are constantly developed. Quality assurance research must be conducted on various fibers and fabrication to ensure that compatible inks are used in digital textile printing processes for the specified use of the end products. This research examines the laundering process of digitally printed reactive ink fabrics to determine the proper laundering cycle for the best colorfastness results. Benefiting the industry and academia, this research provides advantages and disadvantages of the laundering process for digitally printed reactive inks.

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