Case Study of Durability, Abrasion Resistance, and Colorfastness to Crocking and Frosting on Faux Leather Fabrics

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Introduction

In the past, many high-end apparel brands did not widely use faux leather, due to the significant differences in quality and durability from genuine leather (Mohamed & Hassan, 2015).

Genuine leather produces a heavily polluting substance, due to the use of harmful chemicals in the tanning and finishing process (Jung et al., 2014; Kim et al., 2016). Therefore, many fashion designers and brands are more apt to use faux leathers because faux leather is a better alternative of genuine leather for environmental concerns and animal rights (Mohamed & Hassan, 2015; Kim et al., 2016).

Although faux leather is non-biodegradable and produces toxic gas when burning, development of eco-friendly faux leather made of bio-based polyurethane and nanocellulose could minimize environmental concerns (Kim et al., 2016).

Faux leather is made by coating a layer of polyurethane (PU) embossed onto the surface of a fabric. Polyurethane has good adhesion to the fabric, durability at low temperature, softness, viscosity, abrasion resistance, resistance to oils, cleaning resistance, and wash proof (Wentao et al., 2010). Faux leather looks and feels like genuine leather, but genuine leather is more durable, water vapor permeable, and hydrophilic.

According to Mohamed and Hassan's study (2015), faux leather is less abrasion resistant and breathable, but more colorfast to light than genuine leather. As faux leather fabrics are increasingly used, more extensive research on faux leathers is needed to better understand durability and abrasion resistance aspects of faux leathers that influence performance and apperance of apparel products.

Thus, the purpose of this study was to examine faux leather's durability, abrasion resistance, and colorfastness related to various abrasions, surface contact, and rubbing. This study focused on testing faux leather fabrics' abrasion resistance-related issues because faux leathers with coatings may have more potential problems, due to surface abrasion.

Methods

Samples
Two different types of faux leather fabrics were used as a sample in this study: 1) faux leather fabric with PU coating (base: 100% polyester, coated: 100% polyurethane), 2) textured faux leather fabric without PU coating (100% polyester).

The care label of the faux leather fabric indicates 'wipe with a damp cloth,' and that of the textured faux leather fabric is 'hand wash separately cold, non-chlorine bleach, line dry, do not iron.' These fabrics were tested by AATCC and ASTM standard test methods for durability, abrasion resistance, and colorfastness pertaining to crocking and frosting.

The faux leather's weight was 4.72 oz/yd^2 and classified as a medium weight fabric; the textured faux leather's weight was 4.2 oz/yd^2 and classified as a lightweight fabric.

Textile Testing Methods Used

- ASTM D 1424 Test Resistance of Woven Fabrics by Falling-Pendulum (Elmendorf) Apparatus
- ASTM D 5034 Breaking Load and Elongation of Textile Fabrics
- ASTM D 3886 Abrasion Resistance of Textile Fabrics (Inflated Diaphragm Method)
- ASTM D 3885 Abrasion Resistance of Textile Fabrics (Flexing and Abrasion Method)
- AATCC 93 Abrasion Resistance of Fabrics: Accelerator Method
- ASTM D3512 Pilling Resistance (Random Tumble Pilling Tester)
- ASTM D 3939 Snagging Resistance of Fabrics (Mace Test Method)
- AATCC 8 Colorfastness to Crocking
- AATCC 1194 Color Change Due to Flat Abrasion (Frosting)

Results

ASTM D 4232 Standard Performance Specification for Men's and Women's Dress and Vocational Career Apparel Fabrics was used to determine the specification requirements for apparel products.

Tearing Strength
Regarding ASTM D 1424, the faux leather fabric's tearing strength was 4.02 lbf (warp) and 7.80 lbf (filling) and met the minimum specifications of 3.5 lbf for medium weight fabric. The textured faux leather fabric's tearing strength was 3.19 lbf (warp) and 3.38 lbf (filling) and met the minimum specification of 2.5 lbf for lightweight fabric.

Breaking Strength
For ASTM D 5034, the faux leather fabric's breaking strength was 66.3 lbf (warp) and 23 lbf (filling), where the minimum specification is 40 lbf for medium weight fabric. The textured faux leather fabric's breaking strength was 14.65 lbf (warp) and 11.35 lbf (filling) and failed to meet the minimum specifications of 35 lbf for lightweight fabric.

Flat Abrasion Resistance
For ASTM D 3886, both fabrics did not have a hole or broken threads even after 3,000 cycles and met the minimum specification of 3,000 cycles, indicating good flat abrasion resistance. But, the surface coatings on both fabrics were significantly changed by peeling indicating severe visual changes, due to repeated flat abrasion.

Flex Abrasion Resistance
For ASTM D 3885, the faux leather fabric did not have a rupture after 1,000 cycles and met the minimum specification showing good flex abrasion resistance. Unfortunately, the textured faux leather fabric ruptured at average 499 (warp) and 479 (filling) cycles, exhibiting poor flex abrasion resistance.

Multi-directional Abrasion Resistance
For AATCC 93, the faux leather fabric received a 4.90% weight loss while the textured faux leather fabric received a 5.78% weight loss. Both fabrics did not meet the minimum specification of 3% weight loss, exhibiting poor resistance against multi-directional abrasion.

Pilling Resistance
For ASTM D3512, both fabrics were Class 5 and met the minimum specification of Class 4, indicating good pilling resistance.

Snagging Resistance
For ASTM D 3939, the faux leather fabric had Class 1.5 for warp and Class 2 for filling; whereas the textured faux leather fabric had Class 3 for warp and Class 3.5 for filling. Both fabrics did not meet the minimum specification of Class 4, exhibiting poor snagging resistance on the surface.

Colorfastness to Crocking
For AATCC 8, the faux leather fabric had Class 5 for dry test and Class 4 for wet test meeting the minimum specification, indicating good colorfastness to crocking. Unfortunately, the textured faux leather fabric had Class 3.25 for dry test and Class 2 for wet test and failed to meet the minimum specification of Class 4 for both dry test and Class 3 for wet test

Colorfastness to Surface Rubbing (Frosting)
For AATCC 119, the faux leather fabric had an average of Class 5, indicating little color change, due to flat abrasion (frosting) and good colorfastness to frosting. However, the textured faux leather fabric showed an average Class 2 and did not meet the minimum specification for Class 4.

Table 1.1 Tearing strength for the faux leather with PU coating (lbf)

Sample #	1	2	3	4	5	Mean
Warp	4.26	4.12	3.92	3.84	3.96	4.02
Filling	7.59	6.99	7.87	7.73	8.83	7.80

Table 1.2 Tearing strength for the textured faux leather (lbf)

Sample #	1	2	3	4	5	Mean
Warp	2.68	3.13	3.19	3.05	3.19	3.05
Filling	3.07	2.99	2.96	3.33	3.38	3.15

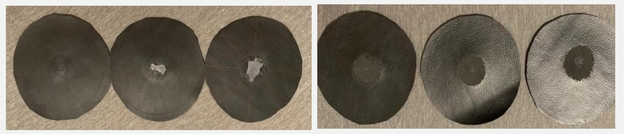

Figure 1 Flat abrasion resistance of the faux leather (Left) and textured faux leather (Right) fabrics: Surface change after 1000, 2000, and 3000 cycles respectively

Table 2 Flex abrasion resistance (Cycles)

	Faux Suede with PU Coating			Textured Faux Suede		
No.	1	2	Average	1	2	Average
Warp	2,991	3,000	2,995.5	495	502	498
Filling	3,000	3,000	3,000	475	484	478.5

Table 3 Colorfastness to crocking (Class)

	Faux Suede with PU Coating			Textured Faux Suede		
	Warp	Filling	Average	Warp	Filling	Average
Dry	5	5	5	3	3.5	3.25
Wet	4	4	4	1.5	2.5	2

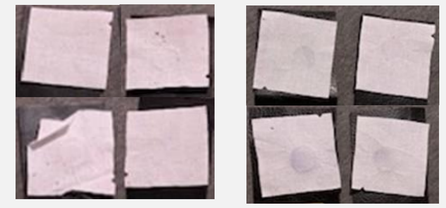

Figure 2 Colorfastness to crocking of the faux leather (Left) and textured faux leather (Right) fabrics; dry test (top) and wet test (bottom)

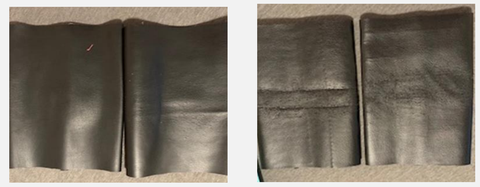

Figure 3 Snagging resistance of the faux leather (Left) and textured faux leather (Right) fabrics

Table 4 Colorfastness to frosting (Class)

	Faux Suede with PU Coating			Textured Faux Suede		
Sample #	1	2	Average	1	2	Average
Frosting	5	5	5	2.5	1.5	2

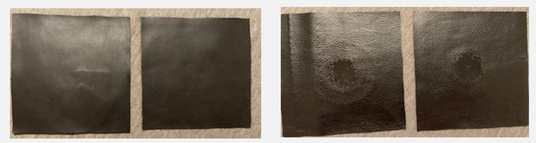

Figure 4 Colorfastness to frosting of the faux leather (Left) and textured faux leather (Right) fabrics

Discussion

The faux leather fabric with PU coating exceeded almost all product specifications except for breaking strength in filling direction, multi-directional abrasion resistance, and snagging resistance. The textured faux leather fabric without PU coating failed to meet almost of all the product specifications except for tearing strength, flat abrasion resistance, and snagging resistance.

Results show the faux leather fabric with PU coating was durable and abrasion resistant against flat and flex abrasions, and pilling; also had good colorfastness to surface contact and rubbing (crocking) and flat abrasion (frosting). The textured faux leather fabric without PU coating was resistant against flex abrasion and pilling only.

However, both fabrics had severe visual changes after flat abrasion because of coated surface peeling, weight loss due to multi-directional abrasion, and severe surface changes due to snagging.

The different results between the two faux leather fabrics need more investigation as to what makes a faux leather superior to another faux leather. Results from this study provided academic researchers and consumers with more detailed information about faux leather fabrics' durability, abrasion resistance, and colorfastness aspects in relation to various abrasions, surface contact, rubbing, pilling, and snagging.