Natural Vs. Synthetic Dyes: A Comparative Study of Colorfastness on Cotton Fabrics

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ABSTRACT

Dyeing is one of the most energy and resource intensive processes of textile development. An alternative and more sustainable option could be utilizing natural dyes such as indigo, turmeric, and cochineal and other natural dyestuffs, which results in less toxic effluent than the prevailing traditional dyeing. **Objectives**: 1) How do different dyeing methods affect cotton fabric properties, and 2) Comparing colorfastness properties of cotton fabrics being dyed with natural, direct, and reactive dyes. **Method**: Woven cotton fabrics with same construction and yarn and knit cotton fabrics with same construction and yarn were dyed with natural, direct, and reactive dyes. These dyed fabrics were evaluated for colorfastness to crocking, colorfastness to light, and colorfastness to laundering for staining using AATCC 8, AATCC 16, and AATCC 61 test methods respectively.

FEW FACTS

- Even with an assist from salts and alkali added to the dye solution, cotton takes up only about 75% of the dye (Bombgardner, 2018)
- Direct dyes have limited brightness and poor chlorine fastness, and they require after-treatments to achieve adequate wash fastness (Cotton Inc, n.d.)
- Textile production is estimated to be responsible for about 20% of global clean **water pollution** from dyeing and finishing products (European Parliament, n.d.)

HYPOTHESIS

The conventional methods of laundering will likely cause color transfer of the natural dyestuffs and result in color fading from the cotton fabric.

MATERIALS

- **27 6x6" 100% Cotton Samples**
- **Cochineal**
- **Chlorophyllin**
- **Tumeric**
- **Direct Red 81**
- **Direct Blue 218**
- **Carta Yellow**

MATERIALS

- **Blue HFRL**
- **Yellow CL2RL**
- **Red CL5B**
- **Landrometer**
- **Crockometer**
- **Xenon Fade-Ometer**
- **Detergent**
- **Multifiber Strip**

Colorfastness to Light
Reactive

	20 Hrs	40 Hrs
R	3.5	3
G	4.5	4
Y	4.5	4.5

Direct

	20 Hrs	40 Hrs
R	4.5	4
G	4.5	4.5
Y	5	5

Natural

	20 Hrs	40 Hrs
R	2	1.5
G	3	3
Y	1.5	1

Colorfastness to Laundering
Reactive

	R	G	Y
Acetate	5	5	5
Cotton	5	5	5
Nylon	5	5	4
Polyester	5	5	4.5
Acrylic	5	5	4.5
Wool	5	5	3

Direct

	R	G	Y
Acetate	4.5	5	5
Cotton	2.5	3	4.5
Nylon	3	3.5	3.5
Polyester	5	5	5
Acrylic	5	5	5
Wool	4	3.5	4.5

Natural

	R	G	Y
Acetate	3.5	5	2
Cotton	4	4	3
Nylon	1	3	1
Polyester	5	5	5
Acrylic	5	5	5
Wool	2	3.5	2.5

DRY CROCKING
Reactive

R	5
G	5
Y	4.5

Direct

R	5
G	5
Y	5

Natural

R	4.5
G	4
Y	4

WET CROCKING
Reactive

R	5
G	5
Y	3

Direct

R	5
G	4.5
Y	5

Natural

R	5
G	3.5
Y	5

METHOD

NATURAL DYES:

ADD 25ML mordant to 225 ml water. Add fabric at 200 Degrees Fahrenheit for 20 minutes. Remove swatches and add to 225 ml dye bath with pinch of natural dye and salt. Dye for 20 minutes. Rinse until water runs clear and dry.

Direct Dyes:

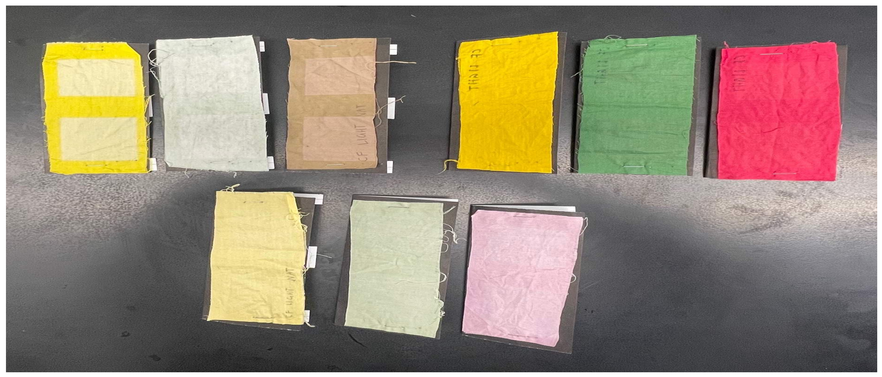
Add 150 ml dye solution and 150 ml water. Dye swatches for 15 minutes. Add 3 g of salt and dye for 10 minutes. Add 2ND installation of salt and dye for 15 minutes. Rinse and dry swatches

150 ml dye solution 150 ml water (300 ml liquid

Reactive dyes:

Add 150 ml dye and 150 ml of water. dye fabric for 10 minutes. Add 2 grams of salt and dye for five minutes. Add 2 grams again and dye for 5 minutes. Add last installment-4g baking soda and dye for 10 min. rinse and dry

USE TESTS: AATCC 8, AATCC 16, and AATCC 61





RESULTS AND CONCLUSION

This study validated the idea that natural dyes are not efficient or applicable for larger consumption because the average consumer will not be able to adhere to the care label to maintain colorfastness of their garments. Also, this study stimulated dyers to explore options or tweaking mordants to improve the color performance of cotton fabrics that are dyed by natural dyes. These results revealed that direct dyes perform better in Colorfastness to light tests while reactive dyes are more colorfast to laundering. All dyes passes the dry crocking tests.